Technical Specification for Civil Works

City of Melbourne

April 2023

Contents

1. Execution of the works

1.1 General

This section of the Specification describes the Works to be undertaken as part of the civil works package.

1.2 Extent of Work

The civil works to be carried out as part of the project include, but are not limited to, the following:

- Crushed rock pavement layers;
- Concrete Base Pavements;
- Asphalt Pavement layers;
- Stormwater drainage and subsurface drainage;
- Bluestone Kerb and Channel;
- Line marking, traffic and parking signs;
- Street Furniture.

1.3 Schedule of Drawings

The drawings to be read in conjunction with this Specification are listed in Section 7 of this document or can also be found on Council's web site:

Engineering Standard Drawings - City of Melbourne

2. Quality assurance

2.1 General

2.1.1 Scope

This section of the specification covers the Quality Assurance requirements for the civil works component of the project.

The purpose of Quality Assurance in the context of this project is:

(a) to provide the Principal with assurance that the quality of the product or service will be in accordance with the Contractual requirements; and

(b) to place on the Contractor the responsibility for achieving the required quality and then demonstrating that it has been provided.

2.1.2 Referenced Documents

The following documents which are referenced in this Section, form part of this Specification only to the extent that they are referred to herein:

- Australian Standard / New Zealand Standard ISO 9001:2016 Quality Management Systems – Requirements

- Australian Standard / New Zealand Standard ISO9002:1994 Quality Systems - Model for Quality Assurance in production, installation and servicing.
- Australian Standard / New Zealand Standard ISO8402:1994 Quality Management and quality assurance - vocabulary.
- Australian Standard / New Zealand Standard ISO9000:2000 Quality Management Systems – Fundamentals and vocabulary

2.1.3 Definitions

The definitions contained in Australian Standard / New Zealand Standard ISO 9002 and ISO 8402 shall generally apply, however, the following definitions shall be used for this project.

Lot

For the purpose of this Contract, a lot is an essentially homogeneous section of the Works, the limits of which will be chosen by the Contractor, but subject to the approval of the Superintendent (see also Clause 2.3.7).

Hold Point

Australian Standard / New Zealand Standard ISO 8402 defines a hold point as a point, defined in an appropriate document, beyond which an activity shall not proceed without the approval of a designated organisation or authority. The approval to proceed beyond a hold point is given usually in written form, but it may be given by any other agreed system of authorisation.

For the purposes of this Contract, hold points will apply at the points defined in the approved Project Quality Plan, and also at any point at which a non-conformance is detected.

Witness Point

A witness point is a point at which the Superintendent may review, inspect or test the works.

2.2 Quality System

2.2.1 General

The Contractor shall plan, establish, implement and maintain a Quality System for the works to meet the requirements of Australian Standard / New Zealand Standard ISO 9002, and in accordance with the requirements of this Section of the Specification.

The Contractor shall undertake and bear all costs of all independent and internal inspections and testing, surveillance of all manufacturing, construction and commissioning processes, and quality system audits.

The Principal may, at his discretion, carry out audits and surveillance as deemed necessary.

2.2.2 Project Quality Plan

The Contractor shall prepare a Project Quality Plan for the Works and submit it to the Superintendent for approval within seven calendar days from the date of award of the Contract. The Project Quality Plan shall cover all of the works under the Contract (both on-site and off-site) and shall include:

- a statement of the Contractor's Quality Policy;
- system application;
- management responsibilities;
- organisation requirements;
- quality system element procedures;

- project procedures;
- technical procedures;
- Inspection and Test Plans;
- Hold Points and Witness Points;
- planned audits; and
- a schedule and program of all quality documentation to be prepared during the progress of the Works.

Parts of the Project Quality Plan (notably items (f), (g), (h) and (i) above) may be submitted progressively for each different phase of the works, subject to the agreement of the Superintendent. However, all relevant parts of the overall Plan shall have been submitted and approved before the particular phase of the works (to which that part of the Project Quality Plan applies) is commenced.

Within 3 days of approval of any part of the Project Quality Plan by the Superintendent, the Contractor shall submit 3 controlled copies to the Superintendent for his retention.

(a) Changes to the Project Quality Plan

Changes to the Project Quality Plan for the Work may be made by the Contractor at any time. However, where the change affects the Work either directly or indirectly, the proposed change shall be subject to the prior written approval of the Superintendent.

The Contractor shall immediately implement changes to the Quality System upon receipt or issue of a non-conformance Report or Corrective Action Request against any aspect of the Work, or if the Contractor determines that the existing Project Quality Plan:

- is causing non-conformance;
- has to be changed as a result of an audit;
- no longer represents the Contractor's current or appropriate practice; or
- does not address the needs of the Contract.

Any change to the Project Quality Plan shall be subject to the change complying with the following requirements:

- the change does not cause the Works to be constructed to a lower standard than specified in the Contract;
- the change does not include any increase in payment by the Principal to the Contractor or others;
- approval of the change does not incur any liability for the Superintendent or the Principal for any consequences of the change; and
- the change can be implemented without any disruption to the Work under the Contract.

The Contractor shall remove all superseded documents and modify all relevant procedures and the ITP's and shall replace them with the new documents and procedures.

(b) Sub-Contractors' Quality Plans

The Contractor shall specify on all purchasing documents, subcontracts or Contract-related documents the relevant Quality System standard and audit provisions for all subcontract works (which for the purposes of this clause is deemed to include the supply of materials, material testing and all other services).

Subcontractors undertaking construction works or material fabrication shall prepare Inspection and Test Plans for the work concerned. Should the Subcontractors not be able to provide satisfactory Inspection and Test Plans and the appropriate procedures, the Contractor shall ensure that the Contractor's Inspection and Test Plans incorporate the necessary Hold Points to ensure that the specified requirements are met.

2.2.3 Quality Records

a) General

Quality records shall include the results of any system and product audits, tests, observations or measurements, including any relevant calculations or analyses.

b) Forms

All compliance tests, measurements and observations, test results, calculations and analyses shall be reported on forms prepared by the Contractor as part of his Project Quality Plan to include at least the following:

- the date (including the date of sampling);
- the lot number;
- lot description;
- type of test;
- the three dimensional location of the test;
- a clear and logical tabulation of results, calculations and analyses;
- a comparison of actual test results with the specified values;
- an indication of compliance or non-compliance; and
- the signature of an authorised representative of the Contractor.

c) Retention of Records

The Contractor shall retain all primary records in accordance with the Contractor's Project Quality Plan, statutory requirements, and the Contract. These documents shall be handed over the Superintendent in an agreed format at the completion of the Works. The records shall be retained and made available to the Contractor for updating as necessary as a result of any work performed by the Contractor during the Defects Liability Period.

The handing over of these documents shall be a condition precedent to the issue of a Certificate of Practical Completion. For the purpose of the Contract, primary records shall include at least:

- all conformance and non-conformance reports;
- all monitoring and testing results, analyses, reports, measurements and observations; and
- the original Project Quality Plan and any changes made to it.

d) Progress and Summary Charts

The Contractor shall maintain progress and summary charts of tests, measurements and observations during the Project. Copies of all charts shall be progressively supplied to the Superintendent during the course of the Contract.

e) National Association of Testing Authorities, Australia Tests

Conformance tests undertaken by the Contractor shall be performed by laboratories registered with National Association of Testing Authorities, wherever applicable.

All such tests shall be covered by the terms of registration of National Association of Testing Authorities and all test reports shall be issued on a National Association of Testing Authorities report signed by a National Association of Testing Authorities authorised signatory for the test concerned.

f) Conformance Reports

Conformance data shall be entered in the record system daily as soon as possible after compliance testing has been completed.

Conformance reports shall be prepared and recorded prior to any Progress Claim. Each conformance report shall be signed by the Contractor's Quality Representative and shall include a statement in the following form:

"On behalf of (Contractor), we certify that the Works represented by the items of work listed have been tested in accordance with the Project Quality Plan and conform in all respects with the requirements of the Contract."

Where work is to be covered up after conformance has been actioned, preparation of the conformance report prior to covering up shall constitute a Hold Point.

g) Non-Conformance Reports

All non-conformance reports and records shall be submitted to the Superintendent as soon as practicable and within one (1) working day of the nonconformity being recognised.

2.2.4 Quality Audits

a) Contractors Quality Audits

The Contractor (and Sub-Contractors and Suppliers) shall undertake quality audits in accordance with the approved Project Quality Plan.

b) Principal's Quality Audits

In addition to the Contractor's Quality System audits, the Superintendent and/or any other authorised representative of the Principal shall at any time and from time to time be entitled to conduct such audits of the Contractor's Works and Quality System including the works and quality systems of Subcontractors as are considered necessary. The Contractor shall provide every assistance to the Principal's Representative in the conduct of such audits. The cost of additional testing associated with audits conducted by the Principal's Representative shall be borne by the Principal.

Where appropriate National Association of Testing Authorities tests exist, comparative testing by the Principal's Representative shall be conducted by a laboratory with National Association of Testing Authorities accreditation for the test methods specified, with nominated proficient testing operators and shall be reported on National Association of Testing Authorities endorsed test reports.

Both scheduled and unscheduled audits may be conducted as follows:

(i) Scheduled Audits

Audits may be conducted on a scheduled basis on all aspects of the Works and the Quality System and shall be performed in accordance with recognised quality audit procedures.

The Principal's Representative shall give the Contractor at least five (5) days' notice that a scheduled audit is to be conducted.

(ii) Unscheduled Audits

Audits additional to scheduled audits may be conducted at any time on products, service, processes and technical procedures.

If an unscheduled audit indicates a significant non-conformance of a product or service, the Principal's Representative shall be entitled to conduct a Quality System element audit with twenty-four (24) hours' notice to the Contractor.

During any audit, the Contractor shall provide the Principal's Representative with all documentation, access and assistance necessary for its completion.

Auditing may take one or a combination of the following forms:

- a check on whether the Contractor is complying with the requirements of the Quality System;
- a check on the Contractor's individual procedures, records and/or calculations;
- a continuous check on the Contractor's processes; or
- a program of independent compliance inspections of any number of lots in accordance with the procedures in the Specification.

The Principal's Representative shall immediately advise the Contractor, in writing, of any deficiency or deviation in the Contractor's Quality System.

If any deficiency or deviation in the Contractor's Quality System is detected, the Contractor shall immediately rectify the Quality System in compliance with the requirements of Clause 2.2.2.

If the deficiency or deviation has caused a non-conformance, the Contractor shall immediately submit a non-conformance report and comply with the requirements of Clause 2.3.9.

Where an audit detects any errors, deficiencies or deviations in any procedure, record, test, calculation, analysis or report, the procedure, record, test calculation, analysis or report shall be immediately corrected. If the correction of an error, deficiency or deviation generates a non-conformance, the Contractor shall immediately submit a non-conformance report and comply with the requirements of Clause 2.3.9.

If, in the opinion of the Superintendent, any process, procedure, test method, calculation, analysis or report has resulted or will result in a serious non-conformance, then the Superintendent may direct the Contractor, in writing, to stop the work or operation concerned and the Contractor shall immediately carry out any corrective or remedial action.

2.2.5 Conforming and Non-conforming Materials and Work

a) Progress Payment for Conforming Work

Progress payments under the provision of the General Conditions of Contract will only be made for those lots of the Works for which a Conformance Report has been prepared and recorded under the provisions of Clause 2.2.3.

Each lot subject to payment shall include a Conformance Report that verifies that all survey checks have been completed and as built records documented in accordance with the Contractor's Quality Plan.

b) Nonconforming Materials and Work

Unless express approval has been otherwise granted by the Superintendent, nonconforming materials or work shall be repaired, or shall be removed and replaced with conforming materials or work.

2.3 Quality System Elements

2.3.1 General

In considering the requirements of the Quality System, the Contractor shall, among other matters, take into account the requirements of Section 4 of Australian Standard / New Zealand Standard ISO 9002:1994.

Quality Plans, Procedures and Work Instructions shall be prepared by the Contractor to meet the objectives of Clause 4.2 of Australian Standard / New Zealand Standard ISO 9002:1994.

Quality Plans and Procedures shall be prepared to be preventive of defective materials being incorporated into the works and preventive of performance of defective contract works.

Procedures shall be prepared for all on-site works and off-site works carried out at sites or new factories prepared for this contract or off-site works involving unique manufacture/ construction.

Procedures shall also be prepared for off-site material production or manufacture/ construction involving output from established factories.

2.3.2 Contract Reviews

The Contractor shall carry out the reviews required under Clause 4.3 of Australian Standard / New Zealand Standard ISO 9002:1994, and any exceptions or non-conformances shall be reported to the Superintendent.

2.3.3 Design

The Contractor shall provide Design Assurance and Design Verification to comply with Clause 4.4 of Australian Standard / New Zealand Standard ISO 9001:2016 only, for the following:

- temporary works for construction purposes; and
- any alternative designs proposed by the Contractor and accepted by the Superintendent for the permanent works.

2.3.4 Documentation

In addition to the requirements of Clause 4.5 of Australian Standard / New Zealand Standard ISO 9002:1994, the Contractor shall keep on site copies or originals of all project documentation. Such documentation shall include all relevant codes of Practice and Standards referred to in the Specification or required to carry out and test any part of the Works.

2.3.5 Purchasing

The Contractor's Quality Plan shall provide for the requirements of Clause 4.6 of Australian Standard / New Zealand Standard ISO 9002:1994 in respect of Subcontractors and Suppliers.

The selection of the appropriate quality system standard, if any, shall be subject to the approval of the Superintendent.

If work under the Contract to be undertaken by a Subcontractor is to be further subcontracted, the Contractor shall ensure that the Subcontractor complies with Clause 4.6 of Australian Standard / New Zealand Standard ISO 9002:1994 in relation to that Subcontractor's subcontractor(s).

The Contractor shall establish and maintain a register of subcontracts and all significant material suppliers describing details of the subcontract including the scope of works of each subcontract or supply agreement, the quality system specified and the Subcontractor's Quality Representative.

A copy of the register is to be submitted to the Superintendent as updates occur.

The Contractor shall establish and maintain a procurement program for subcontractors and significant material suppliers to include at least dates for award, commencement, submission quality system documents, shop drawings, samples, prototypes and delivery.

2.3.6 Product Supplied by the Principal

All design, drawings and documentation supplied by the Principal are supplied to the Contractor under the provisions of the General Conditions of Contract. The requirements of Clause 4.7 of Australian Standard / New Zealand Standard ISO9002:1994 shall apply.

2.3.7 Identification and Traceability

a) Identification by Lot

Earthworks and pavement works shall be identified by lots. All other items of work shall be identified by the most appropriate method. Unless specified otherwise, a "Lot" also includes any "item of work" not divided into lots.

The Contractor shall identify all samples and test results with accurate field locations and lots to which they relate.

If, prior to commencement or during construction of a lot, discrete portions of the lot are identified which are visually non-homogeneous and/or non-representative of the lot, the portions concerned shall be excluded by the Contractor from the lot and each excluded portion treated as a separate lot.

The Superintendent shall have the right at any time to determine if any lot is essentially homogeneous, non-homogeneous or non-representative and/or direct that discrete portions of a lot be treated as a separate lot, without additional cost to the Principal.

For the purposes of this Contract, essentially homogeneous shall be taken to mean a lot or a section of the work where there is no variation due to assignable causes.

Where the term "homogeneous lot" or "homogeneous section of the work" appears elsewhere in the Contract it shall be taken to mean "essentially homogeneous lot" or "an essentially homogeneous section of work".

Lot numbers shall be used as identifiers on all Quality System data.

The Contractor shall determine the proposed bounds of each lot before construction commences and shall include the proposals in the Contractor's Inspection and Test Plan(s).

Unless otherwise approved by the Superintendent, the depth of lots for earthworks and pavements shall be limited to the depth of a single layer placed for compaction purposes.

Sample identification shall uniquely define the lot which is represented by the sample.

b) Lot Numbering

Each lot shall be given a lot number. The allocation of lot numbers shall be carried out by the Contractor to suit the circumstances of construction provided the lot numbering system complies with the following requirements:

- the Contractor shall establish a system which immediately relates the schedule item number and program activity number for the work to the lot number; and
- the lot number shall be entered into a register which provides at least the following information:
    - three dimensional surveyed location of the lot (chainage of the start and finish points, lateral location and layer location) and/or the particular structure (e.g. pier or abutment number, pour number);
    - indication of conformance or non-conformance;
    - the replacement lot numbers for non-conforming lot;
    - summary of test results (e.g. characteristic value);
    - location of detailed test results (form number, file number); and
    - relevant schedule item number and program activity number.

A non-conforming lot which is reworked and resubmitted for compliance testing or which has been subject to a fresh compliance testing program or which has been subdivided into smaller lots for rework and/or a fresh compliance testing program shall retain its original lot identification number. A new number, or numbers, shall be allocated to the reworked/resubmitted/subdivided lot(s).

Details of the lot numbering system shall be included in the Contractor's Inspection and Test Plan(s).

Similar records shall be maintained for all items of work not divided into lots.

c) Field Identification

To ensure all site personnel can readily identify where the particular lots are in the field, the Contractor shall implement a field identification system which shall clearly identify the bounds of each lot and the lot number.

This identification system is to be detailed in the Project Quality Plan and shall be maintained during all phases of construction of the lot and until the Contractor has ensured that the lot has achieved specified quality.

Work on a lot shall not commence until the field identification has been established.

The boundaries of a lot may be changed if subsequent events cause the original lot to be no longer essentially homogeneous. Where the Contractor initiates such a change, the prior approval of the Superintendent shall be obtained.

d) Daily Lot Number Notification

As part of the Quality System, the Contractor shall arrange to supply the Superintendent by 9.30am each day on which work is being performed, a list of all lots on which work commenced and was completed on the preceding working day, with the lot numbers and general descriptions.

2.3.8 Process Control

The sequence of operations required as part of each process procedure shall be in the form of a flowchart or checklist and shall reflect the requirements of the Specification. They shall include relevant inspection and test points, survey control points, Hold Points and Witness Points and indicate where these points occur in the sequence.

2.3.9 Inspection and Testing

a) Inspection and Test Plans

The Contractor shall set up an appropriate regime of inspection and testing of the Works as well as the works of Subcontractors.

The Contractor shall develop Inspection and Test Plans to cover all activities and components that are necessary to complete the Works. Inspection and Test Plans shall include for the documentation and recording of sufficient test and inspections to ensure that the Works comply with the Contract.

- Inspection and Test Plans shall include the following information:
- Who carries out the inspection or test;
- The method of inspection or test;
- The specified acceptance criteria;
- The form of record of results;
- The frequency and timing of the tests;
- Details of what is to be inspected;
- Details of Witness Points;
- Details of Hold Points; and
- Details of audits to be carried out by the Contractor's quality assurance team.

b) Testing

All conformance testing shall be based on lots.

The frequency of testing for conformance shall be approved by the Superintendent.

(i) Control Testing

Control testing shall be carried out by the Contractor to verify that the process is proceeding as planned. The frequency and extent of control testing shall be at the discretion of the Contractor which shall take into account previous performance and the impact of non-conformance on progress of the works.

The results of control tests shall be documented and reported to the Superintendent.

(ii) Conformance Testing

Conformance testing shall be performed on a lot at the time when the Contractor considers that the lot has been processed sufficiently to comply with the requirements of the Contract.

Prior to commencement of conformance testing, the limits of the lot shall have been clearly identified and an identification number shall have been allocated to the lot.

Once conformance testing of the lot has commenced, the conformance testing procedures shall be completed and a result reported.

(iii) Reinstatement

The Contractor shall reinstate all core holes, test holes, excavations and any other disturbance resulting from control and/or conformance testing.

The reinstatement shall be to a standard which is at least equal to the specified requirements for the particular work.

c) Sampling

Inspection and Test Procedures shall detail sampling methods and plans.

Unless specified otherwise random sampling procedures shall be used.

The term "sampling" shall be taken to also include testing, inspection and any other term used for the checking of sections of the work for conformance.

d) Inspections

The Contractor's Project Quality Plan shall set out procedures for incoming inspections, in-process inspections, final inspections and inspection status in accordance with Clauses 4.10, 4.11 and 4.12 of Australian Standard / New Zealand Standard ISO 9002:1994.

In addition, the Contractor shall conduct Procedural and Compliance inspections as set out in the following:

(i) Procedural Inspection

Procedural Inspections shall be completed by the nominated person for each section of the work and this person shall signify that correct construction procedures have been followed.

Inspection records shall be held by the nominated person in charge of the Works during all phases of the Works covered by the appropriate inspections and made available to the Superintendent upon request.

(ii) Conformance Inspections

Conformance Inspections shall be completed and certified by the Contractor's Quality Representative or his nominee.

Conformance inspection records of completed lots shall be compiled daily into a register or computer database. The data shall be kept up to date with records compiled within 24 hours of execution or completion of work.

The Contractor shall prepare Conformance Reports setting out completed lots in accordance with the provisions of Clause 2.2.3 of this Section.

e) Witness Points

The Contractor's Project Quality Plan shall nominate Witness Points. The Contractor shall establish notification procedures acceptable to the Superintendent to allow inspection of the work at each Witness Point.

The Contractor shall not proceed beyond a Witness Point without the written concurrence of the Superintendent.

The Contractor shall have available at each Witness Point evidence of compliance of work completed. Concurrence of the Superintendent shall generally be in the format of signature on a suitable form provided by the Contractor.

Signature of the Superintendent shall not constitute verification, acceptance or approval of the works completed at the Witness Point. The quality of the Works shall remain the responsibility of the Contractor as provided elsewhere in the Contract.

The nomination of Witness Points shall be subject to approval by the Superintendent.

Witness Points shall include, but not be limited to, those detailed in other Sections of the Specification.

f) Hold Points

The Contractor's Project Quality Plan shall nominate Hold Points. The Contractor shall establish notification procedures acceptable to the Superintendent to allow inspection of the work at each Hold Point.

The Contractor shall not proceed beyond a Hold Point unless compliance with the following conditions is certified by the Contractor or his Quality Representative.

- all underlying lot(s) and any adjacent lot(s) affected by the lot in question are conforming;
- all conformance reports for any underlying lot(s) or any adjacent lot(s) affected by the lot is question have been submitted; and
- the proposed dispositions and corrective actions related to all non-conformances for any underlying lot(s) or any adjacent lot(s) affected by the lot in question have been approved by the Superintendent.

Additionally, the Contractor shall not proceed beyond a Hold Point without the written concurrence of the Superintendent in the format of signature on a suitable form provided by the Contractor.

Signature of the Superintendent shall not constitute verification, acceptance or approval of the works completed at the Hold Point. The quality of the Works shall remain the responsibility of the Contractor as provided elsewhere in the Contract.

The nomination of Hold Points shall be subject to approval by the Superintendent.

Hold Points shall include, but not be limited to, those detailed in other Sections of the Specification.

g) Control of Nonconforming Product and Corrective Action

The Contractor's Project Quality Plan shall provide for two levels of non-conformance reporting:

(a) Internal Quality System Monitoring

This level shall provide for the reporting of actual and potential Quality System non-conformances of all the Contractor's processes of management, administration and construction. Such non-conformances shall be

subject to reporting through Non-conformance Reports by all of the Contractor's personnel and Subcontractors with the view to improving productivity.

The Contractor's Project Quality Plan shall identify the commitment, objectives, quality assurance procedures, organisation and structure and induction/training to ensure this level of Project monitoring.

(b) Works Monitoring

In respect of any lot or item of work, the treatment of all non-conformances shall comply with Australian Standard / New Zealand Standard ISO 9002:1994 Clauses 4.13 and 4.14.

The Contractor shall obtain acceptance by the Superintendent of all dispositions affecting the Works proposing repair or use-as-is.

The Contractor shall maintain two registers of non-conformances, one for active non-conformances and one for resolved conformances. The register of active non-conformances shall show the following status of each non-conformance:

- Initial report raised and copied to the Superintendent;
- With Contractor for dispositioning;
- Subsequent Corrective Action Requests raised;
- Corrective action proposal with Superintendent or Contractor's Quality Representative (CQR) for acceptance;
- Corrective action proposal accepted but not implemented;
- Contractor doing corrective action;
- With CQR for verification of corrective action, copy to Superintendent; and
- Non-conformance released, no further action.

The Contractor shall each week review the non-conformance register and submit an updated copy to the Superintendent.

Any nonconforming Works detected by personnel of either the Contractor or the Superintendent shall be reported to the Contractors Quality Representative, through a Non-conformance Report or a Corrective Action Request.

All nonconforming Works detected by the Contractor's Quality System shall be reported to the Superintendent as soon as practicable and within one (1) working day of the non-conformance being recognised using a Non-conformance Report. Non-conformance Reports and Corrective Action Requests shall be submitted with all records which indicate a departure from the requirements of the Contract.

The Contractor shall also immediately submit a Non-conformance Report if the Superintendent advises the Contractor, in writing, of non-conformance with a process or a specification requirement.

The submission of a non-conformance report shall constitute a Hold Point.

A Witness Point shall apply prior to covering up rectification work.

The Contractor shall advise the Superintendent in each Non-conformance Report the proposed disposition of the non-conformity and the corrective action to prevent the recurrence of the non-conformance. The proposed disposition shall include one of the following:

- Proposed additional works to bring the lot up to the specified standard; or
- Replacement of all and/or part of the lot to bring it up to the specified standard; or

- Request for the utilisation of the non-conforming work when it is demonstrated to the satisfaction of the Superintendent that the work is satisfactory for its intended use.

All of the above options shall be subject to approval by the Superintendent. In options (i) and (ii) after approval by the Superintendent of the proposed disposition, the reworked/replaced lot shall be subject to verification in the Project Quality Plan.

2.3.10 Preventive Action

The Contractor shall advise the Superintendent of any potential courses of non-conformity through a Corrective Action Request. Preventive actions are to be monitored as per disposition and corrective actions as specified in Clause 2.3.9.

The procedures for preventive action shall comply with the requirements of Clause 4.14.3 of Australian Standard / New Zealand Standard ISO9002:1994.

2.3.11 Records of Contractor's Quality System

a) General

All records shall be stored and maintained such that they are retrievable in facilities that provide a suitable environment to prevent deterioration or damage, and to prevent loss.

The Contractor's records procedures shall ensure that all contract records are duplicated and second copies are stored separately from the first copy for fire protection and loss prevention purposes. One set of records may be held by the Superintendent or Subcontractors provided such records are notified and recorded as such.

All records shall be properly and clearly indexed and filed. Updated copies of the Contractor's file index shall be copied to the Superintendent.

- The record system shall contain at least the following:
- Records of Inspection and Test Plans;
- Records of non-conformances;
- Records of corrective and preventive actions;
- Records of audits;
- Original records of certification and approvals by statutory authorities;
- Certificates and warranties of manufacturers and suppliers;
- Material quality records and analyses; and
- Records of surveys.

The Contractor shall make all records available to the Superintendent at all reasonable times. Where requested by the Superintendent, the Contractor shall permit the Superintendent to copy all records.

b) As-Built Records

The Contractor shall establish procedures to progressively record and document the as-built construction details of the Works. These works shall be in accordance with the City of Melbourne As-Built Spatial Standards, July 2015.

Details below:

https://www.melbourne.vic.gov.au/SiteCollectionDocuments/as-built-spatial-standards.pdf

Such procedures shall include identification and traceability of all drawing amendments during the source of the Works including changes to shop drawings and all drawings issued for construction, cross referenced to relevant survey and records.

Each lot or groups of lots of the Works shall be subject to assessment for compilation onto as-built records.

2.3.12 Contractor's Quality Audits

The Contractor's Project Quality Plan shall include an internal audit plan in accordance with the requirements of Clause 4.17 of Australian Standard / New Zealand Standard ISO9002:1994.

3. Site preparation and earthworks

3.1 General

3.1.1 Scope

This Section specifies requirements for excavation, filling and the preparation of the sub grade on which pavements or buildings are to be constructed.

3.1.2 Referenced Documents

The following document, which is referenced in this Section, forms part of this Specification only to the extent that it is referred to herein.

Standards Association of Australia

Australian Standard 1289 Methods of Testing Soils for Engineering Purposes.

Australian Standard 1289.5.1.1 Method 5.1.1 Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort

Australian Standard 1289.5.2.1 Method 5.2.1 Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using modified compactive effort

Australian Standard 1289.5.3.1 Method 5.3.1 Soil compaction and density tests - Determination of the field density of a soil - Sand replacement method using a sand-cone pouring apparatus

Australian Standard 1289.5.8.1 Method 5.8.1 Soil compaction and density tests - Determination of field density and field moisture content of a soil using a nuclear surface moisture–Density gauge - Direct transmission mode

3.1.3 Definitions

Spoil comprises any surplus materials or any materials, which cannot be used in the works for any reason.

Sub grade Level is the prepared surface of the in-situ material after the completion of all stripping and excavation and prior to any filling.

Formation Level is the level of completed earthworks including excavation, filling, compaction, trimming and a like, to the finished earthworks design levels and profiles as shown on the drawings.

Engineering Services includes drains, power cables, control cables, sewers, water pipes, gas pipes, ducts or any other pipe, cable, associated structure or similar objects.

Batter is the uniform side slope of a cut or fill.

Optimum Moisture Content is the moisture content of a soil at which a specified amount and type of compactive effort will produce the maximum dry density.

Dry Density Ratio based on Modified Compactive Effort is defined as the ratio expressed in a percentage, of the material in its in-situ condition to the dry density of the same material when compacted at optimum moisture content as determined by the laboratory compaction test described and defined by Australian Standard 1289.5.2.1. The field density and field moisture content of the soil shall be as determined by either Australian Standard 1289.5.3.1 or Australian Standard 1289.5.8.1.

Dry Density Ratio based on Standard Compactive Effort is defined as the ratio expressed in a percentage, of the material in its in-situ condition to the dry density of the same material when compacted at optimum moisture content as determined by the laboratory compaction test described and defined by Australian Standard 1289.5.1.1. The field density and field moisture content of the soil shall be as determined by either Australian Standard 1289.5.3.1 or Australian Standard 1289.5.8.1.

3.1.4 Working near public Trees

When working in the vicinity of public trees, an arborist from the Urban Forest and Ecology Team must be notified if:

- Roots are exposed during works
- Damage could occur, has occurred, to tree roots
- Tree plot sizes require alteration
- Soil levels require alteration

3.1.5 Plant and Equipment

The plant and equipment used in the Works shall be appropriate for the execution of the tasks and shall be maintained in satisfactory working condition at all times while operating.

3.1.6 Geotechnical Information

If a geotechnical report is provided for the Works by the Principal, the Contractor shall be responsible for interpretation of the information given in the geotechnical report, and if the Contractor considers the information is lacking or inadequate, shall be deemed to have carried out further investigations as considered necessary to adequately assess subsurface conditions.

3.2 Materials

3.2.1 Non-Descript Crushed Rock

Non-Descript Crushed Rock shall be 20mm or 40mm nominal maximum size crushed rock complying with the following requirements:

Permissible Range for % Passing Sieve Size

Sieve Size (mm)	**40mm Non-Descript Crushed Rock**	**20mm Non-Descript Crushed Rock**
53.0	100	-
37.5	85 – 100	-
19.0	75 – 90	95 – 100
9.5	50 – 80	60 – 90
2.36	20 – 45	30 – 55
0.425	10 – 25	12 – 28

Sieve Size (mm)	40mm Non-Descript Crushed Rock	20mm Non-Descript Crushed Rock
0.075	7 - 15	7 – 15

The Non-Descript Crushed Rock material shall have a maximum plasticity index of 20.

Where the Superintendent considers that the Non-Descript Crushed Rock material differs from that of the approved sample, further compliance testing may be ordered at the Contractor's expense.

3.2.2 Select Fill

Select Fill shall be imported from an approved source. The material shall be stable and well graded, free from organic or deleterious matter and shall meet the following requirements:

- Particle Size after compaction — maximum 100mm
- Percentage passing 19m Australian Standard Sieve — maximum 80
- Percentage passing 0.075mm Australian Standard Sieve — maximum 50

Material retained on a 2.36mm Australian Standard Sieve shall consist of hard durable particles of rock and/or gravel.

Material passing a 0.425mm Australian Standard Sieve shall have the following physical properties:

- Liquid Limit (LL) — maximum 50
- Plasticity Index — 6 to 30
- Product of LL and percent passing 0.425 Sieve — maximum 1600

Where the Superintendent considers that any Select Fill material delivered for use in the works differs from that of the approved sample, further compliance testing may be ordered at the Contractor's expense.

Fill material supplied which is not approved as Select Fill shall be immediately removed from the Site to a place of legal disposal or used as a General Fill or Landscape Fill.

3.2.3 General Fill

Material for general fill shall be approved stable, well graded earth fill material excavated from the site, free from organic matter, clay lumps or stones greater than 100mm in size or other material deleterious to compactive effort.

3.2.4 Contaminated Soil Management

For contaminated soil management procedures refer to council document "Roadworks – Contaminated Soil Management Procedure 2015"

Link below:

https://www.melbourne.vic.gov.au/SiteCollectionDocuments/contaminated-soil.pdf

3.2.5 Subsoil (Landscape) Fill

Imported subsoil (landscape) fill shall contain organic matter, be able to support plant life, be free from unwanted matter such as rocks, asphalt, bricks, concrete, clay lumps, tree roots, sticks, rubbish, material toxic to plant growth and any other material deemed unsatisfactory by the Superintendent. Subsoil shall comprise of approximately 60% short, friable clay, free of large clay lumps, with the remaining 40% of a heavy loam, free of foreign matter and a pH range of 5.5 to 7.0.

3.2.6 Topsoil

Imported topsoil shall be sieved, sandy loam to Australian Standard 2223. It shall be free from unwanted matter such as weeds, rubbish, petrol, oil, lime, rocks, asphalt, bricks, concrete, clay lumps, tree roots, sticks or other deleterious matter and shall have a pH range of 6.0 – 7.0. Electrical conductivity shall be less than 1200 micro Siemens per cm.

3.3 Construction

3.3.1 Site Preparation

The Contractor shall remove all obstructions including abandoned engineering services, divert all drainage, relocate existing engineering services which are to be retained and, where appropriate, install new engineering services and drainage prior to the commencement of excavation or filling in any area.

When works will occur within the vicinity of public trees, contact Urban Forest and Ecology for an arborist to determine whether tree protection measures are required.

3.3.2 Setting Out

The Contractor shall be responsible for the setting out of the Works in accordance with the survey details and dimensions shown on the Drawings. Where the Contractor believes that necessary dimensions are not shown on the Drawings, he shall request the Superintendent to provide these dimensions. He shall make adequate provision, in time, for the Superintendent to determine such dimensions without causing delay to the Works.

The Contractor shall be responsible for the protection of all survey marks on the site.

Prior to commencing earthworks over any section of the Site, the Contractor shall place marks as may be required for setting out and provide the Superintendent with a schedule and plan of such marks, showing their location and level.

The Contractor shall be responsible for the maintenance of all survey marks and recovery pegs throughout the duration of the Contract.

3.3.3 Access Roads

The Contractor shall provide and maintain all necessary temporary access roads. The proposed alignments and levels of temporary access roads shall be submitted to the Superintendent for approval prior to their construction.

3.3.4 Protection of Services, Structures and Other Property including Public Tree Assets

A Dial Before You Dig is required before any work on site is to be done and the contractor is to have those records onsite at all time. If any special requests are required by service authorities such as CitiPower, there shall be no go/dig without prior approvals.

The Contractor shall make all reasonable enquiries to identify and confirm the location, depth and size of existing services, structures or tree roots that may be encountered in the performance of the works, and shall take all reasonable and necessary precautions to protect these services and structures from damage. It is rarely possible to repair stressed or damaged trees. Care must be taken to ensure that no damage is caused to public tree trunks, roots, canopy or branches during works.

In the event of any damage to any such structure, service, property or tree asset, the owner and the Superintendent must be immediately informed. If the Superintendent determines that repairs shall be made by the Contractor, such repairs will be ordered or arranged as provided for under the General Conditions of Contract.

3.3.5 Drainage

During earthworks, the Contractor shall provide drainage such that all excavation and filling will be free draining to low points clear of the Works at all times. Water shall be drained or pumped from low points to prevent damage to the Works due to inundation, flooding, ponding or other causes. The Contractor shall do all things necessary to divert any water, which interferes with progress of the Works, and to keep areas free from water during excavation and filling. The Contractor shall provide sufficient pumps, well-points or other equipment for keeping trenches and excavations dewatered during the Works at no additional cost to the Principal.

Existing drainage lines and structures may be utilised by the Contractor in draining the site. Before breaking into any lines or structures, the Contractor shall obtain prior approval from the Superintendent in writing. Should such approval be given, restitution of the structure to a condition at least equivalent to that before the breaking occurred shall be undertaken by the Contractor at his expense.

3.3.6 Batter Slope and Shape

Unless otherwise specified, temporary batter slopes shall be not steeper than 1 vertical to 2 horizontal. The batter face shall be finished by trimming to produce a uniform shape. Permanent batter slopes shall be as shown on the drawings.

3.3.7 Demolition and Grubbing

Unrequired or obsolete materials or structures shall be demolished and cleared from the site to a depth of 150mm below either the existing ground surface, or earthworks subgrade level, whichever is the lower.

Holes remaining after the demolition and clearing shall be backfilled to the level of the existing ground surface or the subgrade level whichever is the lower with Select Fill compacted in layers not greater than 150mm loose thickness to a dry density ratio of 95% using Standard Compactive Effort.

3.3.8 Stripping of Ground Surface

All areas within the limit of the works shall be stripped to a depth of at least 100mm and any greater depth required such that all vegetation, grass roots, organic soil and humus is removed.

Such stripping shall extend for a distance of 1m beyond the limits of the earthworks as shown on the drawings and, in each area, shall be completed prior to commencing earthworks.

3.3.9 Excavation

The Contractor shall excavate every type of material encountered within the limit of earthworks to the lines and levels shown or indicated on the Drawings.

Existing road and footpath hard pavements shall be saw-cut to produce a neat, straight delineation between new and existing pavements.

Excavation shall not proceed closer than 100mm to the proposed earthworks subgrade level if it is raining or if rain is imminent.

The final excavation and trimming of areas on which it is proposed to construct the pavements shall be undertaken as specified in Clause 3.3.12, 'Finishing Subgrade Surfaces'.

Areas of over-excavation shall be restored to the required levels in accordance with Clause 3.3.14, “Subgrade Replacement', at the Contractor's expense.

Bluestone kerbstone, gutterstone and pitchers shall be excavated in a careful manner, cleaned of all adhering material and either stockpiled on site for later use or delivered to the Councils nominated Depot. Should the Superintendent consider that the Contractor has not exercised the required degree of care and has been

negligent in his attempts to extract or handle bluestone materials then the Contractor shall be required to replace the damaged bluestone material at its own cost.

Pavement light shall not be disturbed. Construction of bluestone pavements to have a 100mm wide full depth charcoal coloured concrete surround around all sides of pavement lights including the installation of full depth expansion material and suitable silicon sealant at surface.

The Contractor shall leave a minimum clear distance of 0.5m or as directed otherwise by the Superintendent between the edge of any excavation and the inner toe of an adjacent spoil bank.

3.3.10 Excavation in the Vicinity of Trees and Tree protection zones

Refer to City of Melbourne Urban Forest Tree Protection fact sheets for tree protection requirements. https://www.melbourne.vic.gov.au/sitecollectiondocuments/tree-protection-fact-sheet-service-contractors.pdf

The Contractor acknowledges that the following requirements and excavation restrictions apply in landscaped areas and in the vicinity of public trees:

- In accordance with Australian Standard 4970 Protection of trees on development sites, Tree protection zones shall be established prior to the commencement of work and remain in place until the works are complete
- Any work within the Tree protection zone must be under the supervision of an Australian Qualifications Framework Level 5 arborist and work methods must be approved by the arborist, in compliance with Australian Standard 4970.
- All other construction activities, including storage of equipment and materials, shall be excluded from Tree protection zones at all times, as detailed in factsheet information for services providers and contractors undertaking works near council trees.
- All tree roots must remain undamaged with bark in-tact in accordance with Australian Standard 4970 Protection of Trees on Development Sites. The contractor shall contact Council's Urban Forest and Ecology Team for arborist supervision where root trimming that is required. All root pruning must comply with Australian Standard 4373
- Lifting and relaying of pitchers must be undertaken in a root-sensitive manner that does not damage roots.
- Any excavation within the Tree protection zone must be undertaken using root-sensitive, non-destructive excavation techniques, such as manual excavation using non-mechanical handheld tools or low-pressure hydro-excavation.
- Where possible and practical, modify work methods to accommodate for tree roots. For instance, shaving or cutting pitchers when re-instating over tree roots; or, using less crushed rock when re-instating asphalt is preferred over pruning tree roots.
- Examples of Tree protection zone radius based on trunk diameter:

Trunk Diameter at Breast Height	Tree protection zone radius from centre of trunk:
<16cm	2m
20cm	2.4m
40cm	4.8m
75cm	9m
100cm	12m
125cm	15m (except where crown protection is required)

Note: Palms at least 1m outside crown projection

- In accordance with Australian Standard 4790, stockpiling, loading of building materials, disposal of waste and vehicular traffic should not occur within a Tree protection zone; and

- Prior to excavation, the Contractor shall contact Council's Parks and Greening or the Superintendent to ascertain the location of any existing irrigation service. Any damage to the water service shall be repaired and the cost to be borne by the Contractor.

3.3.11 Utilisation of Stripped and Excavated Material

All materials recovered from stripping or excavations shall be assessed by the Contractor for re-use in the Works as topsoil, general fill, or as spoil. The Contractor shall advise the Superintendent of this assessment prior to re-using any stripped or excavated materials in the Works. The Superintendent may order the Contractor to re-assess the materials until an acceptable classification is obtained for all materials, which are to be re-used in the Works.

Stripped or excavated materials in excess of that required in the Works, or which due to unsuitability for any other reason cannot be used in the Works shall be classified as spoil and shall be disposed of in accordance with the requirements of the Clause 3.3.11, 'Spoil'.

If the stripped or excavated materials which have been approved for re-use in the Works cannot be incorporated into the Works at the time of stripping or excavation, respectively, then the materials shall be stockpiled at locations outside the limits of the earthworks area as approved by the Superintendent. Stockpiled materials which have been approved for re-use in the Works shall be moved to their final position in the Works by the Contractor as and when appropriate for the correct and expeditious completion of the Works. All work associated with moving materials to and from stockpiles shall be at the Contractor's expense.

Excavated materials approved for re-use as topsoil shall be used to resurface areas which are disturbed in the course of the Works.

3.3.12 Spoil

Spoil, including material defined as topsoil, general fill, landscape fill or material excavated for subgrade replacement, which is in excess of that required in the Works shall be disposed off-site at a legal point of disposal by the Contractor at no additional cost to the Principal.

3.3.13 Finishing Subgrade Surfaces

Finishing of subgrade surfaces shall include final excavation to earthworks subgrade level and proof rolling of the subgrade surface.

Final excavation shall comprise the removal of material, which is within a depth of 100mm of the earthworks subgrade level and shall be undertaken so as to minimise disturbance of the subgrade surface.

Within 24 hours of completion of the final excavation of the subgrade, the first layer of fill shall be placed and compacted.

The Contractor shall trim the subgrade to provide a reasonably smooth surface, free from all loose excavated material that shall conform to the shape required at that section. The degree of finish shall be that ordinarily obtainable with a grader blade. Cobbles and boulders, which protrude above the surface, shall be removed and the surface in such areas shall be restored to the required levels with Select Fill in accordance with Clause 3.3.14, 'Subgrade Replacement'.

The surface of the subgrade in areas of cut shall not be above the Earthworks Formation Level at any point.

3.3.14 Subgrade Preparation

Proof rolling of the subgrade shall be undertaken as directed by the Superintendent using a pneumatic tyred roller loaded to 2 tonnes per wheel, with a tyre pressure of 750kPa. The roller shall be operated for a maximum of two coverages where one coverage is defined as one application of the roller to each point on the subgrade surface.

The subgrade shall be assessed visually by observing the deflection and recovery of the surface of the subgrade behind the roller tyres.

The assessment shall be carried out by walking behind and to the side of the roller outer wheels and continuously observing the response of the subgrade surface to the rolling wheel.

Subgrade that is unstable or of inferior materials shall be defined as the condition when:

- The roller becomes bogged under normal rolling conditions;
- The surface of the subgrade ruts excessively, yields or shows signs of distress; and
- The surface of the subgrade exhibits excessive elastic deflection, which is clearly visible from a standing position.

Proof rolling of the subgrade shall be a designated Witness Point.

3.3.15 Subgrade Replacement

Unstable areas of subgrade shall be excavated to the full extent and depth of the instability and replaced with Select Fill, which shall be placed and compacted in accordance with the requirements of Clause 3.3.15.

Where a provisional quantity has been provided in the Schedule of Prices for subgrade replacement, the Contract Price shall be varied according to the actual amount of replacement material ordered by the Superintendent in writing, excluding that to be replaced at the Contractor's expense, at the appropriate rate shown in the Schedule of Prices. The unit rate for replacement material given in the Schedule of Prices shall include costs for excavation, cartage and disposal of excavated material, supply, delivery, placing and compaction of replacement material, construction of any temporary haul roads over other parts of the subgrade, dewatering, over-excavation, ramps, shoring, delays, overheads and profits, and any other associated costs.

Measurement for payment of replacement material shall be the solid volume of replacement material directed or approved by the Superintendent. Measurement shall be made up to the level of the surrounding in-situ material where the work is being executed. At the completion of each day's work, the Contractor shall agree with the Superintendent the quantity of replacement material, other than that to be replaced at the Contractor's expense, executed during that day, and shall issue a docket, countersigned by the Superintendent, stating that quantity. One copy of the signed docket shall be retained by the Superintendent.

3.3.16 Fill

Fill shall be constructed within the limits of earthworks at the locations and to the lines and levels shown on the Drawings.

Fill shall be placed in layers essentially parallel to the finished surface with each layer not less than 75mm or greater than 150mm in thickness and compacted to a dry density ratio of not less than the following:

Table 3.1 – Compaction Requirements

Fill Material	Specified Minimum Dry Density Ratio	Compactive Effort
Non-Descript Crushed Rock	98%	Modified
Select Fill (greater than 300mm above Earthworks Subgrade Level)	98%	Modified
Select Fill (within 300mm of Earthworks Subgrade Level)	95%	Standard
General Fill	95%	Standard

The fill material shall be placed in the Works in layers of uniform thickness such that:

The moisture content of the materials throughout the full depth of the layer is maintained during placing, compaction and finishing within 1% of the moisture content at which maximum field compaction is attainable for the material and the equipment being used;

Where a compacted course 200mm or less in nominal thickness is required, the material shall be placed and compacted in a single layer; when a nominal compacted course thickness in excess of 200mm is required, the material shall be placed and compacted in layers of approximately equal thickness, but no layer shall be in excess of 150mm nominal thickness;

The underlying layers are not disturbed during placing, compacting and trimming;

The least possible surface disturbance is necessary to obtain the design shape, grade and levels within the tolerances specified;

Segregation and contamination of the materials does not occur;

The layer is at the finished level or it can be trimmed to level, shaped and smoothed by cutting off excessive material and;

The completed layer meets the specified density, thickness, surface level and surface shape requirements for that layer.

Mixing and placing procedures or associated equipment used shall be adjusted, as necessary, to obtain the finished surface levels within the allowable tolerances, to prevent segregation and degradation, and to reduce or accelerate loss or gain of water.

Before each section is placed, any material at the end of the preceding section or at the edge of an abutting area which, is segregated or contaminated shall be rejected and removed and disposed of in accordance with the requirements of the Specification.

The edges of previously placed materials shall be watered to maintain the moisture content specified herein for compaction prior to placement of adjoining material. The surface of the fill shall be watered as necessary to maintain the required moisture content until completion of the compaction. Such watering shall not result in the removal of the fines from the surface of the layer.

Fill layers shall not be constructed when the weather conditions are such that the moisture content cannot be maintained within the specified limits during spreading and compaction. Any areas that are damaged by rainfall or other weather conditions shall be reinstated to conform to the requirements of the Specification.

Where fill is to be placed against an existing slope steeper than one vertical to six horizontal, whether natural or man-made, the existing slope shall be first stripped of topsoil to the minimum depth shown on the Drawings or directed by the Superintendent and then benched out as the fill proceeds at vertical intervals of not less than 200mm nor more than 500mm.

Filling in areas on which pavements or buildings or structures are to be constructed shall not commence until the completion of proof rolling of the subgrade surface in accordance with Clause 3.3.13, ‘Subgrade Preparation’.

Compaction of fill within one metre of footings, walls, slabs or other structures shall be by hand held motorised compaction equipment. Where fill is to be placed against both sides of footings, walls or other structures the Contractor shall raise the fill on opposite sides of the structures equally and compact the fill simultaneously with similar equipment. Where fill is to be placed against one side only of footings, walls or other structures the Contractor shall support such structures to prevent overloading.

3.3.17 Surface Finishing

Upon the completion of all compaction, the surface of the fill shall be finished by lightly watering, and where the surface is excessively high, by cutting down to the required level, and rolling with a pneumatic tyred roller

ballasted such that the load is equally distributed to all wheels to achieve a wheel load of not less than two (2) tonnes with the same tyre pressure in each tyre of not less than 750kPa.

Material cut from the surface of the fill shall be removed and stockpiled in a surplus stockpile.

The surface shall not be raised to the required level by the addition of thin layers of material. Areas below the specified level shall be corrected prior to the subsequent layer being placed by removing material from the surface where necessary and placing new material in layers having a compacted thickness of at least 100 mm. When additional material is added it shall be placed, spread, compacted and finished in accordance with the requirements of the Specification.

3.3.18 Protection of Fill Surface

The surface of the fill and any underlying layers shall only be trafficked by vehicles and equipment essential for the construction, repair and maintenance of the fill, and shall be kept to the minimum necessary. Any area of fill that is damaged in any way by traffic shall be reinstated to conform to the requirements of the Specification.

3.3.19 Finished Surface Level Tolerances

The completed earthwork formation shall be excavated or filled within the following tolerances above (plus) or below (minus) the theoretical dimensions and or levels shown on the Drawings:

- Horizontal Dimensions:
    - Plus 150mm, minus 0mm (lengths, breadths, etc.)

Levels:

- Fills – plus 0mm, minus 30mm
- Excavation – plus 0mm, minus 50mm

Slopes and batters shall be neatly cut and trimmed to the respective slopes indicated and shall be carried around curves in a uniform manner.

3.3.20 Cultivation of Existing Topsoil for Landscaping

Where specified on the Drawings the Contractor shall, no less than seven days before cultivation, apply a non-residual, selective herbicide to designated areas as per manufacture's recommendations. When all existing grasses and weeds are dead, the existing topsoil shall be cultivated by 'Reciprocating Harrow' (or other approved method) to a maximum depth of 150mm. Cultivation shall be undertaken by hand within the Tree protection zone of an existing public tree.

3.3.21 Subsoil and Topsoil placement

Imported subsoil shall be placed in layers no more than 150mm deep, compacted to the satisfaction of the Superintendent, and levelled to 100mm below the finished level.

Imported topsoil shall be spread and compacted with a light roller or other approved method to the finished levels shown on the Drawing. The roller's weight shall not exceed 100kg per metre width and topsoil shall be rolled in two directions.

Within the Tree protection zone of a public tree, the soil must remain penetrable with a metal spike or similar.

3.4 Quality Assurance

3.4.1 Requirements

The Contractor shall implement a Quality Assurance program in accordance with Section 2 of this Specification.

The program shall comprise Pre-Commencement, Production and Process Control and Post-Construction phases as defined in the following clauses.

3.4.2 Pre-Commencement Phase

a) Supply of Information on Materials Sources

The following information shall be supplied for the Non-Descript Crushed Rock and Select Fill materials:

- location of source from which the material will be obtained;
- source rock type and petrographic description; and
- a summary of the results of recent tests on samples of the material from the designated source indicating that the material complies with all the requirements specified herein and endorsed by a laboratory registered by National Association of Testing Authorities for the performance of such tests.

b) Reference Samples

Reference Samples shall be taken from the sources from whence the Non-Descript Crushed Rock and Select Fill course materials are to be obtained.

Such Reference Samples shall be truly representative of the materials and shall comply in all respect with all requirements of the Specification.

The Reference Samples shall be divided into two representative portions, with one being held by the Contractor and the second portion by the Principal until completion of the Defects Liability Period.

3.4.3 Production and Process Control Phase

a) Program

The Contractor's production and process control program shall consist of sampling and testing the materials and product, and a continuous assessment of the adequacy of the production control. All such testing of fill shall be done in a laboratory which is adequately equipped and staffed for carrying out the tests required to be undertaken in the Contract. The Contractor is responsible for designing and implementing a control program which provides adequate and effective control over the works, however the minimum amount of control testing that shall be undertaken is set out in this section of the Specification.

If at any time during the production of materials the control program being undertaken by the Contractor is inadequate, the Superintendent may order the Contractor to cease production and/or the delivery of materials to the works.

The Contractor shall keep a record upon a plan of the works, of where each work shift's production has been incorporated in the works.

If the control results indicate that the materials being produced are not in accordance with the requirements of the Contract then the Contractor shall record a non-conformance and shall not incorporate the materials represented by those test results into the works. The Contractor shall modify the manufacturing process so that conforming materials are produced.

b) Compaction

At the completion of compaction of each Lot of fill, the Contractor shall determine the in-situ moisture content and the dry density ratio at random locations throughout the Lot.

A Lot of Fill is defined as a section in which all of the material has been obtained from the same source with uniform properties, using the same production techniques and which has all been subjected to the same handling, placing and compaction processes.

The Scale A rate of in-situ moisture content and field dry density testing shall be not less than one for each 500m² of surface area of each layer. Scale A testing shall be undertaken until the results of all the tests undertaken in 5 consecutive lots conform. When this is achieved the frequency of the testing can be reduced to Scale B. The Scale B rate of in-situ moisture content and field dry density testing shall be not less than one for each 1000m² of surface area of each layer. Scale B rate of testing can be maintained on the basis that all test results conform. If a non-conformance is found then the Scale A level of testing shall be recommenced.

Each Lot to be tested shall be divided into subsections of approximately equal area. The number of subsections shall be the same as the number of dry density determinations it is proposed to undertake. The location for each dry density determination shall be determined randomly within each subsection.

The in-situ dry density shall be determined in accordance with the requirements of Australian Standard 1289.5.3.1 or some other method accepted in writing by the Superintendent.

Modified maximum dry density or Standard Maximum Dry Density determinations shall be made at a rate of not less than one for each sixteen (16) field density determinations, in accordance with the requirements of Australian Standard 1289.5.2.1 and Australian Standard 1289.5.1.1, respectively.

Conformance of the Lot with the specified compaction requirements shall be assessed as follows:

If the average of the dry density ratio determinations for any Lot:

- Equals or exceeds the specified minimum dry density ratio and no individual density result is less than specified minimum dry density ratio - 1%, then the Lot shall be considered as complying with the dry density requirements;
- Equals or exceeds the specified minimum dry density ratio less 1% (i.e. specified minimum dry density ratio - 1%) and any individual density result is less than specified minimum dry density ratio - 4%, then the Lot shall be further tested and the results interpreted as in (d) below;
- Equals or is less than the specified minimum dry density ratio less 3% (i.e. specified minimum dry density ratio - 3%) then the Lot shall be considered as not complying with the dry density requirements and shall be rejected; and
- Is between the limits given in the preceding paragraphs (i.e. between 1 and 3% below the specified minimum dry density ratio), then an additional four randomly located dry density determinations shall be made in the lot in accordance with the requirements of the Specification. If the average of all the dry density ratio determinations for that Lot:
    - equals or exceeds the limit given in the preceding paragraph (a), then the Lot shall be considered as complying with the dry density requirements;
    - is less than the limit given in the preceding paragraph (a), then the Lot shall be considered as not complying with the dry density requirements and shall be rejected.

c) Witness Point

The following Witness Point shall be incorporated into the Contractors Construction Program:

- Proof rolling of the prepared subgrade.

3.4.4 Post-Construction Phase

a) Finished Surface

The finished surface of the Fill shall conform to the grades and levels shown on the drawings within the tolerances specified above.

b) As-Constructed Details

An as-constructed survey by a licensed or competent surveyor of the finished formation level shall be submitted to the Superintendent. The survey shall detail the following:

- Levels on a nominal 10m by 10m grid over the entire site.
- Levels at location of spot levels and cross section as shown on the drawings.

The as-constructed information shall be submitted on A1 sized plans and in electronic file form in a format that meets the requirements set out in City of Melbourne's As-Built Spatial Standards reference to be made to (https://www.melbourne.vic.gov.au/SiteCollectionDocuments/as-built-spatial-standards.pdf).

c) Quality Assurance Records

Within 3 weeks of completion of the Works, the Contractor shall supply two copies of a report detailing the results of all quality control and testing undertaken.

d) Non-Conforming Materials and Work

All non-conforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Specification.

4. Cold planing

4.1 General

4.1.1 Scope

This section covers the requirements for removal of pavement by cold planing (profiling) including the cleaning up, removal and disposal of the excavated materials.

4.1.2 Standards, Codes and Referenced Specifications

The following documents, which are referenced in this Section, form part of this Specification only to the extent that they are referenced herein:

VicRoads: Section 402 – Removal of Pavement by Cold Planing

4.1.3 Plant and Equipment

The plant and equipment used in the Work under the contract must be appropriate for the execution of the tasks and must be maintained in satisfactory working condition at all times while operating.

Specific items of equipment to be used in the Work under the contract must comply with the following requirements:

a) Profiling Machines

Profiling machines shall have the ability to remove materials to depths in the range 12mm to 100mm in a single isolated pass and at a rate of 800 sq.m per hour.

Profiling machines must be self-propelled, pneumatic tyred equipment that must not apply heat to the pavement to facilitate its removal. Tracked equipment may be permitted provided that tracks are fitted with pads in good condition and it can be demonstrated that it causes no damage when travelling over new or existing concrete or asphalt surfaces.

The profiling machines must incorporate a rotating milling drum having accurate control of the cutting depth on each side of the drum, and must have a cutting width of at least 1.8m. An additional machine of reduced cutting width may be used for limited special purposes.

Depth control equipment must be capable of automatic adjustment to a pre-set value and must be accurate to within ± 5mm of that setting.

b) Sweepers and Brooms

Sweepers and brooms must be power operated and must be suitable for rapidly cleaning the profiled surface. Vacuum sweepers and Bob Cats capable of being fitted with both a bucket and a broom/bucket combination must be provided by the Contractor and must be available throughout all work periods in which the profiling machine is operated.

Brooms must have non-metallic bristles. Where metallic bristles are required to enable satisfactory cleaning to be achieved, they may be permitted provided that the Contractor establishes and maintains a suitable cleaning system to ensure that no dislodged bristles remain on the finished surface of the pavement.

4.1.4 Working near Public Trees

When working in the vicinity of public trees, an arborist from the Urban Forest and Ecology team must be notified, if:

- Roots are exposed during works
- Damage could occur, or has occurred, to tree roots
- Tree plot sizes require alteration
- Soil levels require alteration

4.2 Materials

4.2.1 Materials

Not applicable

4.3 Construction

4.3.1 Existing Site Conditions

Prior to commencement of works, the Contractor shall inspect the site of the work to satisfy himself that no visible obstructions are present which would seriously delay or prevent completion of the profiling operation in the area specified on the Drawings.

4.3.2 Cutting Depths, Widths, Lengths, Surface Profile

The nominal depth, width and length of pavement to be removed by cold planing shall be as shown on the Drawings.

The profiling must remove the entire existing surface and must be uniform and continuous over the area providing a free draining surface with no steps or abrupt changes in grade.

Unless otherwise specified or directed by the Superintendent, the profile of the planed surface shall follow the general longitudinal and transverse grades of the existing pavement surface and shall be guided by the existing edge of channel, crown line and median kerb invert levels. The depth of profiling must be at least to, and not more than 10mm greater than, the nominated cutting depth. After planing, no point on the planed surface shall lie more than 10mm below a 3m straight edge placed on the planed surface in any direction.

4.3.3 Surface Texture

The existing asphalt surfaced pavement must be profiled in the areas shown on the Drawings to provide a surface texture which is sufficiently coarse to promote bonding of the new asphalt surfacing, but not coarse enough to be safety hazard for vehicular traffic while exposed.

4.3.4 Cleaning and Removal of Profiled Material

Following profiling of the existing surface, the entire area must be cleaned using Bobcats fitted with a bucket/broom combination and swept using a vacuum sweeper to remove all dust, loose gravel, rubbish and debris of any kind, whether or not resulting from the profiling operation, to the satisfaction of the Superintendent. Such sweeping must be completed prior to any subsequent work and the Contractor must allow in his construction program for this operation.

Use of water by the profiling machine must be kept to an absolute minimum, particularly in areas which are to be tack coated immediately following clean-up. Where excessive water has been used, the profiled surface must be cleaned of slurry prior to application of tack coat.

Unless otherwise specified or directed by the Superintendent, the profiled material shall be disposed off-site at a legal point of disposal by the Contractor.

4.3.5 Temporary Ramping

The following minimum safety measures must be completed and fully checked by the Contractor's representative prior to releasing the area to unsupervised traffic flow:

a) Longitudinal Edges

Any exposed longitudinal edges within the trafficked area shall be ramped down at a slope no steeper than 5 horizontals to 1 vertical by constructing a temporary wedge of hot mixed or cold mixed asphalt.

b) Transverse Edges

Any exposed transverse edges within the trafficked area shall be ramped down by constructing a temporary wedge of hot mixed or cold mixed asphalt. Temporary ramping shall not be steeper than:

- 20 horizontals to 1 vertical for traffic speeds greater than 75km/hr or
- 10 horizontals to 1 vertical for traffic speeds less than 75km/hr

c) Manholes and Service Covers

Where manholes, surface covers and similar have not been adjusted prior to the profiling operation, the depth of cut adjacent to and around such fittings shall not under any circumstances, be greater than 40mm unless specifically authorised in by the Superintendent. Temporary ramps shall be constructed along the longitudinal and transverse edges of manholes and service covers as specified above.

The Contractor shall ensure that the perimeters of the profiled area and all service covers or other obstruction which may have been circumvented during the profiling operation and as defined on the "Signs and Edge Ramping Arrangement" Drawing No. 8D 11956 are to be edge ramped with a 5mm minus full graded cold mixed asphalt binder material compacted with a mechanical rammer. In the event of work being stopped due to unforeseen causes, the area shall be rendered drivable by alternate means (by traffic controllers), ramped and effectively barricaded until recommencement of the normal operation is possible.

d) Removal of Temporary Ramps

Before asphalt placement, temporary ramping shall be removed by cutting back along a straight line to expose a vertical face of fully compacted asphalt of the specified layer depth.

e) Exposed Unbound Granular Materials

Any areas of unbound granular base materials exposed by the cold planing process shall be reinstated with 10mm size hot mix asphalt or temporarily patched with cold mix asphalt flush with the surrounding surface. Extensive areas of exposed granular base materials may be barricaded off by arrangement with the Superintendent or immediate asphalting by Council arranged or at least one traffic lane shall be patched by the Contractor, as required.

4.3.6 Supervision and Control

The Contractor shall provide a duly authorised and competent supervisor and qualified traffic controllers to be present for the full duration of the work. The Contractor must ensure that the operation is executed in a safe manner in accordance with the approved Safety Plan and methodically and expeditiously in accordance with the approved Traffic Management Plan. In particular, the Contractor must ensure that the required signs, barricades, lane markers and traffic controllers are located in accordance with the Traffic Management Plan and Safety Plan. The Contractor shall assume total responsibility for the site until Practical Completion is granted by the Superintendent.

4.4 Quality Assurance

4.4.1 Requirements

The Contractor shall implement a Quality Assurance program as defined in the Section 2 of the Specification.

The program shall comprise Production and Process Control and Post-Construction phases as defined in the following clauses.

4.4.2 Production and Process Control Phase

a) Program

The Contractor is responsible for designing and implementing a control program that provides adequate and effective control over the work covered by this section of the Specification.

Upon commencement of profiling in each shift, the Contractor shall check that the profiling machine cutters and forward speed/method of operation are achieving the required surface texture.

Upon commencement and completion of profiling in each shift, the Contractor shall check that safety, traffic management and environmental protection measures included in the respective project Safety Plan, Traffic Management Plan and Environmental Management Plan are in place.

4.4.3 Post-Construction Phase

a) Finished Profiled Surface

The finished profiled surface shall be such that the depth of profiling is at least to, and not more than 10mm greater than, the nominated cutting depth. After planning, no point on the planed surface shall lie more than 10mm below a 3m straight edge placed on the planed surface in any direction.

b) Non-Conforming Materials and Work

All non-conforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Specification.

5. Crushed rock pavement courses

5.1 General

5.1.1 Scope

This Section specifies requirements for the supply of materials, spreading, compaction, trimming and finishing of crushed rock pavement courses.

5.1.2 Standards, Codes and Referenced Specifications

The following documents, which are referenced in this Section, form part of this Specification only to the extent that they are referenced herein:

Australian Standards*:*

Australian Standard 1289 Methods of Testing Soils for Engineering Purposes

Australian Standard 1289.5.2.1 Method 5.2.1 Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using modified compactive effort

Australian Standard 1289.5.3.1 Method 5.3.1 Soil compaction and density tests - Determination of the field density of a soil - Sand replacement method using a sand-cone pouring apparatus

Australian Standard 1289.5.4.1 Method 5.4.1 Soil compaction and density tests - Compaction control test - Dry density ratio, moisture variation and moisture ratio

Australian Standard 1289.3.6.1 Method 3.6.1 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving

Australian Standard 1289.6.4.1 Method 6.4.1 Soil strength and consolidation tests - Determination of compressive strength of a soil - Compressive strength of a specimen tested in undrained triaxial compression without measurement of pore water pressure

VicRoads:

Section 172 Examination and Testing of Materials and Work (Road works)

Section 304 Flexible Pavement Construction

Section 812 Crushed Rock and Plant Mixed Wet-Mix Crushed Rock for Base and Sub-base Pavement.

5.1.3 Working near Public Trees

When working in the vicinity of public trees, an arborist from the Urban Forest and Ecology team must be notified, if:

- Roots are exposed during works
- Damage could occur, or has occurred, to tree roots
- Tree plot sizes require alteration
- Soil levels require alteration

5.2 Materials

5.2.1 Sub-base Course Crushed Rock

Sub-base course crushed rock shall be 20mm or 40mm nominal size Class 3 Plant Mixed Wet-Mix Crushed Rock complying with the requirements of VicRoads Standard Specification Section 812 and with a moisture content within plus 0.5% and minus 1.0% of optimum.

5.2.2 Base Course Crushed Rock Material

Base course crushed rock shall be 20mm nominal size Class 2 Plant Mixed Wet-Mix Crushed Rock complying with the requirements of VicRoads Standard Specification Section 812 and with a moisture content within plus 0.5% and minus 1.0% of optimum.

5.2.3 Granitic Gravel

The granitic gravel shall be Tooborac fine grained, brown, granitic gravel of low plasticity, Rocla Quarry Products or approved equivalent with a pH range between 4-7 and a maximum silt content of 6% (by volume) as specified by the Australian Standard 1141-33.

5.3 Construction

5.3.1 Spreading

The first layer of pavement material shall be spread and compacted within 24 hours of final trimming and compaction of the Formation.

The pavement material shall be spread in even and equal layers not more than 150mm in compacted thickness. Each layer shall be spread and compacted before the next layer is spread.

Pavement material shall be spread by means which minimise segregation into fine and coarse components. Where segregation does occur, the material shall be remixed and respread.

5.3.2 Compaction

Compaction shall commence immediately after the material is spread. Where necessary the Contractor shall lightly water the material to maintain the moisture content within plus 0.5% and minus 1.0% of the optimum moisture content. Material shall be compacted sufficiently to provide a dense surface by the time work ceases at the end of each day. Material from unstable areas shall be removed, remixed and reconstituted to comply with the material specification and then be replaced and recompacted before further layers are added.

During compaction the Contractor shall keep the surface shaped to the required profile free from ruts, depressions, waves and isolated hard spots by use of power graders.

Each layer of sub-base and base course shall be compacted to a dry density ratio of not less than 98% using Modified Compactive Effort.

5.3.3 Finishing

Crushed rock pavement courses consisting of one or more layers of the same material shall be finished to a reasonably smooth and uniform surface and shall conform to the lines, grades, thicknesses and cross sections shown.

The finished surface of granitic gravel shall be free draining, not liable to ponding and flush with all adjoining edges.

5.4 Quality Assurance

5.4.1 Requirements

The Contractor shall implement a Quality Assurance program as defined in the Section 2 of the Specification.

The program shall comprise Pre-Commencement Phase, Production and Process Control and Post-Construction phases as defined in the following clauses.

5.4.2 Pre-Commencement Phase

a) Supply of Information on Materials Sources

The following information shall be supplied for the base and sub-base materials:

- supplier and source of crushed rock;
- source rock type and petrographic description;
- proposed method of processing and transportation; and
- a summary of the results of recent tests on samples of the material from the designated source indicating that the material complies with all the requirements specified herein and endorsed by a laboratory registered by National Association of Testing Authorities for the performance of such tests.

b) Reference Samples

Reference Samples shall be taken from the sources from whence the base and sub-base course materials are to be obtained.

Such Reference Samples shall be truly representative of the materials and shall comply in all respect with all requirements of the Specification.

The Reference Samples shall be divided into two representative portions, with one being held by the Contractor and the second portion by the Principal until completion of the Defects Liability Period.

5.4.3 Production and Process Control Phase

a) Program

The Contractor's production and process control program shall consist of sampling and testing the materials and product, and a continuous assessment of the adequacy of the production control. All such testing of base and sub-base course materials shall be done in a laboratory which is adequately equipped and staffed for carrying out the tests required to be undertaken in the Contract. The Contractor is responsible for designing and implementing a control program which provides adequate and effective control over the works, however the minimum amount of control testing that shall be undertaken is set out in this section of the Specification.

If at any time during the production of materials the control program being undertaken by the Contractor is inadequate, the Superintendent may order the Contractor to cease production and/or the delivery of materials to the works.

The Contractor shall keep a record upon a plan of the works, of where each work shift's production has been incorporated in the works.

If the control results indicate that the materials being produced are not in accordance with the requirements of the Contract then the Contractor shall record a non-conformance and shall not incorporate the materials represented by those test results into the works. The Contractor shall modify the manufacturing process so that conforming materials are produced.

b) Layer Thickness

The Contractor shall measure the thickness of the compacted base and sub-base courses upon completion of compaction and surface finishing by direct measurement or some other method acceptable to the Superintendent. The frequency of thickness measurements shall be as for the dry density ratio determinations.

Field dry density and thickness determinations may be performed at the same locations.

These measurements shall be recorded and included in the Quality Assurance records.

No part of the base or sub-base courses at any location shall have a thickness of less than 90% of the specified thickness.

c) Compaction

At the completion of compaction of each Lot of the base and sub-base courses, the Contractor shall determine the in-situ moisture content and the dry density ratio at random locations throughout the Lot.

A Lot of base and sub-base courses is defined as a section in which all of the material has been obtained from the same source with uniform properties, using the same production techniques and which has all been subjected to the same handling, placing and compaction processes.

The Scale A rate of in-situ moisture content and field dry density testing shall be not less than one for each 500m² of surface area of each layer. Scale A testing shall be undertaken until the results of all the tests undertaken in 5 consecutive lots conform. When this is achieved the frequency of the testing can be reduced to Scale B. The Scale B rate of in-situ moisture content and field dry density testing shall be not less than one for each 1000m² of surface area of each layer. Scale B rate of testing can be maintained on the basis that all test results conform. If a non-conformance is found then the Scale A level of testing shall be recommenced.

Each Lot to be tested shall be divided into subsections of approximately equal area. The number of subsections shall be the same as the number of dry density determinations it is proposed to undertake. The location for each dry density determination shall be determined randomly within each subsection.

The in-situ dry density shall be determined in accordance with the requirements of Australian Standard 1289.5.3.1 or some other method accepted in writing by the Superintendent.

Modified maximum dry density determinations shall be made at a rate of not less than one for each sixteen (16) field density determinations, in accordance with the requirements of Australian Standard 1289.5.2.1.

The dry density ratio shall be determined in accordance with the requirements of Australian Standard 1289.5.4.1 using the appropriate field dry density and modified maximum dry density determinations.

The Contractor shall determine the particle size distribution and Plasticity Index of a sample of the material made by combining an equal representative portion of the material obtained from each Lot of each layer of base and sub-base courses for the purpose of determining the field dry density in accordance with the requirements of Australian Standard 1289.3.6.1. and Australian Standard 1289.3.4.1 using the wet preparation method.

Conformance of the Lot with the specified compaction requirements shall be assessed as follows:

If the average of the dry density ratio determinations for any Lot:

- Equals or exceeds the specified minimum dry density ratio and no individual density result is less than specified minimum dry density ratio - 1%, then the Lot shall be considered as complying with the dry density requirements;
- Equals or exceeds the specified minimum dry density ratio less 1% (i.e. specified minimum dry density ratio - 1%) and any individual density result is less than specified minimum dry density ratio - 4%, then the Lot shall be further tested and the results interpreted as in (d) below;

- Equals or is less than the specified minimum dry density ratio less 3% (i.e. specified minimum dry density ratio - 3%) then the Lot shall be considered as not complying with the dry density requirements and shall be rejected;
- Is between the limits given in the preceding paragraphs (i.e. between 1 and 3% below the specified minimum dry density ratio), then an additional four randomly located dry density determinations shall be made in the lot in accordance with the requirements of the Specification. If the average of all the dry density ratio determinations for that Lot:
    - equals or exceeds the limit given in the preceding paragraph (a), then the Lot shall be considered as complying with the dry density requirements;
    - is less than the limit given in the preceding paragraph (a), then the Lot shall be considered as not complying with the dry density requirements and shall be rejected.

5.4.4 Post-Construction Phase

a) Surface Smoothness Testing

The surface smoothness of the completed base course shall be checked using a 3m long straight edge.

Surface irregularities that depart from the straight edge by more than 10mm shall constitute a non-conformance and shall be clearly marked.

b) Finished Surface Levels

The finished surface of the base and sub-base courses shall conform to the grades and levels specified and shall not deviate at any point by more than:

- 0mm above or 10mm below for base course; and
- 10mm above for sub-base course

from the design surface level shown on the Drawings.

The finished surface level of granitic gravel pavements shall be to a similar standard found generally on the Tan Track, Melbourne and on pathways in Shiel Street, North Melbourne.

c) Quality Assurance Records

Within 3 weeks of completion of the Works, the Contractor shall supply two copies of a report detailing the results of all quality control and testing undertaken.

d) Non-Conforming Materials and Work

All non-conforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Specification.

6. Lime stabilised clay

6.1 General

6.1.1 Scope

This Section specifies requirements for materials and construction of in-situ lime stabilised clay layers.

6.1.2 Standards, Codes and Referenced Specifications

The following documents, which are referenced in this Section, form part of the Specification only to the extent that they are referenced herein:

Standards Association of Australia:

Australian Standard 1289 Methods of testing soils for engineering purposes

Australian Standard 1289.5.1.1 Method 5.1.1 Soil compaction and density tests - Determination of the dry density/ moisture content relation of a soil using standard compactive effort

Australian Standard 1289.5.3.1 Method 5.3.1 Soil compaction and density tests - Determination of the field density of a soil - Sand replacement method using a sand-cone pouring apparatus

VicRoads:

Section 290 - Materials and Construction for Lime Stabilized Sub-Base Pavement Layers

6.2 Materials

6.2.1 General

The materials and definitions set out under Section 3 of the Specification shall apply to the work under this Specification section.

6.2.2 Quicklime

Quicklime shall comply with the requirements of VicRoads Standard Specification Section 290, shall have an equivalent calcium hydroxide content of not less than 60 percent, and shall be from an approved supplier.

6.2.3 Hydrated Lime

Hydrated lime shall comply with the requirements of VicRoads Standard Specification Section 290, shall have a calcium hydroxide content of not less than 60 percent, and shall be from an approved supplier.

6.2.4 Water

Water shall be clear and free from detrimental impurities such as oils, salts, acids, alkalis and vegetable substances.

6.3 Construction

6.3.1 General

Construction shall be carried out as described in VicRoads Standard Specification, Section 290 and in conformance with the following requirements:

a) Preparation

The material to be stabilised shall be scarified to a depth at least equal to the thickness of the stabilised layers and the surface re-compacted to provide a reasonably even surface.

b) Weather Limitations

Stabilisation (including spreading, compacting and finishing) shall not proceed:

- during wet weather, or
- if rain is imminent and likely to occur during any stage of the stabilisation process, or
- during periods when the wind is sufficiently strong to cause particles of stabilising agent to become airborne.

c) Protection

Traffic or equipment not involved in spreading or mixing of the stabilising agent shall not pass over the spread material prior to the completion of mixing.

d) Mixing

Mixing shall be undertaken using equipment purpose built for the process of in-situ mixing of pavement materials. The equipment shall be capable of:

- mixing to the depth specified for the layer to be stabilised
- distributing the stabilising agent uniformly throughout the full depth and over the whole area of the layer to be stabilised.

As mixing blades or tynes wear they shall be replaced so as to maintain effective and uniform mixing.

Mixing shall be uniform over the full depth of the layer, with no lenses, pockets, lumps or granules of either incompletely mixed pavement material or incompletely mixed stabilising agent present.

Section spacing shall be arranged to ensure that unstabilised material is not left between lanes.

Where indicated by visual inspection or the results from testing, the Contractor shall carry out additional passes or the mixing equipment to improve the uniformity of:

- the materials being stabilised;
- the distribution of the stabilising agent; and
- the distribution of the added moisture.

6.3.2 Lime Stabilisation

a) Spread Rate

Lime shall be uniformly spread over the prepared surface using appropriate equipment and at a nominal distribution rate of 12kg/m2 for 150mm thick layers (based on an Equivalent calcium oxide content of 100%).

The field spread rate shall be determined using the following formula:

$$\text{Field Spread Rate} = \frac{\text{Nominal distribution rate} \times 100}{\text{Equivalent calcium oxide content}}$$

The Contractor shall check and record the uniformity of spreading of lime by placing mats with a plan area not less than 1m2 in the path of the spreading vehicle and dividing the mass of lime deposited on each mat by the plan area of the mat, or by other approved method.

Immediately following completion of spreading of lime, the Contractor shall check and record the average spread rate of lime by dividing the mass of lime spread by the area over which lime has been spread.

b) Slaking of Quicklime

Quicklime shall be slaked with sufficient water to allow complete hydration such that the material remains friable after slaking.

c) Mixing

Where quicklime is used, mixing shall not commence until slaking is complete. The lime shall be mixed to the depth shown within six hours of spreading. Mixing shall proceed until all material other than stones can pass through a 37.5mm Australian Standard sieve and at least 60 percent of such material can pass a 9.5mm Australian Standard sieve and the lime is mixed uniformly throughout the soil mass.

The moisture content of the mixture shall be increased as required by spraying uniformly to maintain the moisture content of the mixture within the range 85 percent to 105 percent of optimum moisture content.

d) Compaction

The stabilised pavement shall be compacted in a single layer which, after trimming, will provide the specified compacted layer thickness.

The process of spreading, shaping, and compaction through to final finishing shall commence as soon as mixing is completed and shall proceed continuously until completed.

Water shall be added to the stabilised material during the mixing process so that, at the time of completion of mixing, the stabilised material has uniformly distributed moisture content, which is not less than 85% of the optimum moisture content.

The stabilised layer shall be compacted to a dry density ratio of 98% using standard compactive effort.

The Contractor shall ensure that full compaction of the stabilised material is achieved in all areas including the interfaces between successively placed lanes and sections of stabilised material.

f) Trimming

Immediately following compaction, the stabilised layer shall be trimmed and compacted to produce a level, free draining surface.

Subsequent secondary trimming may be undertaken on one or more occasions with the objective of meeting level and shape requirements. Secondary trimming shall involve cutting to waste.

g) Curing

The surface of the compacted layer shall be kept moist until the succeeding layer is placed. Construction or other traffic shall not use a compacted layer where damage to the surface may occur. Placing and compacting of subsequent layers shall be carried out within 48 hours of completion of compaction and trimming.

6.3.3 Finished Surface Level Tolerances

The completed lime stabilisation layer shall be finished to the following tolerances above (plus) or below (minus) the theoretical dimensions and or levels shown on the Drawings.

Horizontal Dimensions - plus 150mm, minus 0mm
(lengths, breadths, etc.)

Levels: - plus 0mm, minus 30mm

6.4 Quality Assurance

6.4.1 Requirements

The Contractor shall implement a Quality Assurance program in accordance with Section 2 of this Specification.

The program shall comprise Pre-Commencement Phase, Production and Process Control and Post Construction phases as defined in the following clauses.

6.4.2 Pre-Commencement Phase

a) Supply of Information on Materials Sources

The following information shall be supplied for the Lime to be used:

- Source and Supplier of lime;
- Equivalent calcium oxide Content;
- Particle Size Distribution; and
- Slaked residue of quicklime.

6.4.3 Production and Process Control Phase

a) Program

The Contractor's production and process control program shall consist of sampling and testing the materials and product, and a continuous assessment of the adequacy of the production control. The Contractor is responsible for designing and implementing a control program which provides adequate and effective control over the works, however the minimum amount of control testing that shall be undertaken is set out in this section of the Specification.

If at any time during the production of materials the control program being undertaken by the Contractor is inadequate, the Superintendent may order the Contractor to cease production.

The Contractor shall keep a record upon a plan of the works, of where each work shift's production has been incorporated in the works.

If the control results indicate that the materials being produced are not in accordance with the requirements of the Contract then the Contractor shall record a non-conformance and shall not incorporate the materials represented by those test results into the works. The Contractor shall modify the manufacturing process so that conforming materials are produced.

b) Compaction

At the completion of compaction of each Lot of lime stabilisation, the Contractor shall determine the in-situ moisture content and the dry density ratio at random locations throughout the Lot.

The level A rate of in-situ moisture content and field dry density testing shall be not less than one for each 500m² of surface area of each layer. Level A testing shall be undertaken until the results of all the tests undertaken in 5 consecutive lots conform. When this is achieved the frequency of the testing can be reduced to level B. The level B rate of in-situ moisture content and field dry density testing shall be not less than one for each 1000m² of surface area of each layer. Level B rate of testing can be maintained on the basis that all test results conform. If a non-conformance is found then the Scale A level of testing shall be recommenced.

Each Lot to be tested shall be divided into subsections of approximately equal area. The number of subsections shall be the same as the number of dry density determinations it is proposed to undertake. The location for each dry density determination shall be determined randomly within each subsection.

The in-situ dry density shall be determined in accordance with the requirements of Australian Standard 1289.5.3.1 or some other method accepted in writing by the Superintendent.

Standard dry density determinations shall be made at a rate of not less than one for each sixteen (16) field density determinations, in accordance with the requirements of Australian Standard 1289.5.1.1.

Conformance of the Lot with the specified compaction requirements shall be assessed as follows:

If the average of the dry density ratio determinations for any Lot:

- Equals or exceeds the specified minimum dry density ratio (specified minimum dry density ratio) less 1% (i.e. specified minimum dry density ratio - 1%) and no individual density result is less than specified minimum dry density ratio - 4%, then the Lot shall be considered as complying with the dry density requirements;

- Equals or exceeds the specified minimum dry density ratio less 1% (i.e. specified minimum dry density ratio - 1%) and any individual density result is less than specified minimum dry density ratio - 4%, then the Lot shall be further tested and the results interpreted as in (d) below;
- Equals or is less than the specified minimum dry density ratio less 3% (i.e. specified minimum dry density ratio - 3%) then the Lot shall be considered as not complying with the dry density requirements and shall be rejected;
- Is between the limits given in the preceding paragraphs (i.e. between 1 and 3% below the specified minimum dry density ratio), then an additional four randomly located dry density determinations shall be made in the lot in accordance with the requirements of the Specification. If the average of all the dry density ratio determinations for that Lot:
    - equals or exceeds the limit given in the preceding paragraph (a), then the Lot shall be considered as complying with the dry density requirements;
    - is less than the limit given in the preceding paragraph (a), then the Lot shall be considered as not complying with the dry density requirements and shall be rejected.

c) Conformances for Rate of Spread of Lime

The uniformity of spreading and average spread rate shall be determined for each Lot. An average spread rate less than the specified spread rate shall constitute a non-conformance.

d) Conformances for Depth Stabilisation

The thickness of the stabilised layer shall be determined at every location at which density is determined. An average thickness less than that specified or any thickness less than 80% of that specified shall constitute a non-conformance for the lot.

6.4.4 Post-Construction Phase

a) Finished Surface Levels

The finished surface of the lime stabilised layer shall conform to the grades and levels specified within the tolerances specified in Clause 4.3.3.

b) Quality Assurance Records

Within 3 weeks of completion of the Works, the Contractor shall supply two copies of a report detailing the results of all quality control and testing undertaken.

c) Non-Conforming Materials and Work

All non-conforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Specification.

7. Priming

7.1 General

7.1.1 Scope

This Section specifies requirements for supply and placement of the prime coat on the completed crushed rock base course in areas intended for vehicular traffic where the specified asphalt pavement thickness is less than 100mm. The superintendent may waive this requirement if traffic conditions or working restrictions make it impracticable to prime coat.

7.1.2 Standards, Codes and Referenced Specifications

The following documents, which are referenced in this Section, form part of this Specification only to the extent that they are referenced herein:

Australian Standards*:*

Australian Standard 1160 Bituminous Emulsions for the Construction and Maintenance of Pavements

Australian Standard 2008 Bitumen for Pavements

Australian Standard 2157 Cutback bitumen

Australian Standard 2341.13 Methods of testing bitumen and related roadmaking products Determination of durability of bitumen

VicRoads:

Section 408 Priming, Primer Sealing and Sealing.

7.2 Materials

7.2.1 Primer

The primer shall consist of approved cutback bitumen grade AMC0 complying with Australian Standard 2157.

7.3 Construction

7.3.1 General

The methods and equipment for priming shall comply with the requirements of VicRoads Standard Specification Section 408.

7.3.2 Surface Preparation

Crushed rock pavement surfaces shall present a tight stone mosaic which shall be slightly moist and shall be thoroughly cleaned of all foreign and loose matter by brooming or other suitable means immediately prior to priming.

Adjacent concrete work and other surfaces shall be effectively covered before spraying.

Preparation of the crushed rock pavement surfaces shall be a designated Witness Point.

7.3.3 Priming

Cutback bitumen primer of grade AMC shall be applied at a spraying temperature between 35□C and 55□C. Other prime coats shall be applied at a spraying temperature recommended by the manufacturer.

Spraying shall be carried out using an approved mechanical sprayer at a rate of application within the range 0.8 and 1.1l/m2.

The rate of application of prime coat shall be selected by the Contractor so that the prime coat will penetrate the surface of the base course and be free from any pools of bituminous material in not less than 6 hours and not more than 48 hours after the time of application, and so that the depth of penetration is not less than 6mm and not more than 10mm.

Table 1: Volume Correction Table

(Multipliers for reducing the volume of hot bituminous material to the equivalent volume at 15oC)

Observed Temp.(°C)	Multiplier
33	0.989
36	0.987
39	0.985
42	0.983
45	0.981
48	0.979
51	0.978
54	0.976
57	0.974

NOTE: Dividing the volume of bitumen at 15□C by these multipliers will give the equivalent volume of hot bituminous material at the temperature shown.

Priming shall not be carried out when the shade temperature is less than 10□C or when rain is imminent.

The Contractor shall allow sufficient time to elapse (at least 48 hours) following completion of priming before subsequent work is carried out to ensure that the primer is thoroughly dry and cured. Any pockets of surplus primer shall be broomed to distribute the surplus.

7.4 Quality Assurance

7.4.1 Requirements

The Contractor shall implement a Quality Assurance program as defined in Section 2 of this Specification.

The program shall comprise Pre-Commencement Phase, Production and Process Control and Post-Construction phases as defined below.

7.4.2 Pre-Commencement Phase

a) Supply of Information on Materials Sources

The following information shall be supplied for the cutback bitumen:

- Supplier and source of prime coat; and
- Certificate of Compliance.

7.4.3 Production and Process Control Phase

a) Program

The Contractor's process control program shall consist of a continuous assessment of the adequateness of the process control. The Contractor is responsible for designing and implementing a control program which provides adequate and effective control over the Works, however, the minimum amount of control testing that shall be undertaken is set out in this Section of the Specification.

The Contractor shall keep a record, upon a plan of the Works, of where each work shift's production has been incorporated in the Works.

b) Application Rate

The average rate of application of cutback bitumen for each lot, shall not deviate from the rate selected for the lot by more than plus or minus 10%. The rate shall be determined from the measured area sprayed, and the

quantity of cutback bitumen sprayed as determined by dipping the bituminous sprayer before and after spraying.

c) Witness Point

The following Witness Point shall be incorporated into the Contractor Construction Program:

- Completion of surface preparation and prior to the application of the primer.

7.4.4 Post-Construction Phase

a) Quality Assurance Records

Within 3 weeks of completion of the Works, the Contractor shall supply two copies of a report detailing the results of all quality control and testing undertaken.

b) Non-Conforming Materials and Work

All non-conforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Specification.

8. Asphalt

8.1 General

8.1.1 Scope

This Section specifies requirements for the supply, placing and compacting of asphalt.

8.1.2 Standards, Codes and Referenced Specifications

The following documents, which are referenced in this Section, form part of this Specification only to the extent that they are referenced herein:

Australian Standards*:*

Australian Standard 1160 Bituminous Emulsions for the Construction and Maintenance of Pavements

Australian Standard / New Zealand Standard 1580.601.1 Paints and related materials - Methods of test Colour - Visual comparison

Australian Standard 2008 Bitumen for Pavements

Australian Standard 2150 Hot Mix Asphalt – A Guide to Good Practice

Australian Standard 2157 Cutback bitumen

Australian Standard 2891.14.1.1 Methods of Sampling and Testing Asphalt

Australian Standard 4049.1 Paints and related materials - Pavement marking materials Solvent borne paint - For use with surface applied glass beads

Australian Standard 4049.2 Paints and related materials - Pavement marking materials Thermoplastic pavement marking materials - For use with surface applied glass beads

Australian Standard 4049.3 Paints and related materials - Pavement marking materials Waterborne paint - For use with surface applied glass beads

VicRoads:

Section 407 – Asphalt

Code of Practice RC 500.22 – Selection and Design of Pavements and Surfacings

8.1.3 Working near Public Trees

When working in the vicinity of public trees, an arborist from the Urban Forest and Ecology team must be notified, if:

- Roots are exposed during works
- Damage could occur, or has occurred, to tree roots
- Tree plot sizes require alteration
- Soil levels require alteration

8.2 Materials

8.2.1 Tack Coat

Tack coat shall be a Grade CRS 170/60 rapid breaking cationic bitumen emulsion complying with Australian Standard 1160.

8.2.2 Hot Mix Asphalt

Unless otherwise specified in the Drawings, hot mix asphalt shall be complying with the requirements of VicRoads Standard Specification Section 407.

8.2.3 Cold Mix Asphalt (for temporary reinstatement)

The cold mix shall consist of 94% grit (not greater than 3 mm size), 5% bitumen Class 170 and 1% fuel oil complying with the requirements of VicRoads Standard Specification Section 407.

8.3 Selection of Dense Graded Asphalt Types

The selection of dense graded asphalt types shall be in accordance with VicRoads Code of Practice RC500.22 – Appendix D and to the satisfaction of Council.

8.4 Construction

8.4.1 Tack Coat

The tack coat shall be applied uniformly over all base course materials immediately prior to asphalting. Where asphalt is to be spread over clean, freshly laid asphalt the Superintendent may, upon the request of the contractor, consider the omission of the tack coat from the works. Freshly laid asphalt shall be considered to be asphalt laid on the same working day.

It shall be applied only to a cleaned, near dry surface at a rate as of 0.15 to 0.3litre/m2 or 0.3 to 0.6 litres/m2except for joints and chases where rates shall be doubled.

When spraying the tack coat, a shield shall be used and all necessary precautions taken to protect adjoining surfaces, structures, parked vehicles and traffic. Any tack coat not covered by asphalt shall be covered with clean grit or sand before the road is opened to traffic.

Asphalt shall not be placed on the tack coated surface until the emulsion has broken and the water has substantially evaporated.

8.4.2 Supply of Asphalt

Unless otherwise specified in the Schedule of Prices (Section 3), the contractor shall supply and deliver all hot mix asphalt (HMA) and cold mix asphalt required for the Works. Supply and transport costs shall be borne by the Contractor.

8.4.3 Manufacture, Delivery and Spreading of Asphalt

The manufacture, delivery and spreading of hot mix asphalt shall comply with the requirements of VicRoads Specification Section 407.

The manufacture, delivery and spreading of cold mix asphalt shall comply with the requirements of VicRoads Specification Section 407.

8.4.4 Compaction of Hot Mix Asphalt

The compaction of the hot mix asphalt shall be effected by breakdown rolling, self-propelled vibrating steel wheel rolling and pneumatic tyred rolling while the mix is at a temperature above 80□C. Further self-propelled pneumatic tyred rolling shall be used to tighten the surface of the asphalt and produce a satisfactory surface macro texture, following compaction rolling.

Rolling of the mix shall begin as soon after spreading as the mix will bear the rolling without undue displacement. Delays will only be permitted when the asphalt is at too high a temperature or is too tender to be rolled, in which case the vibrating roller shall be held back a minimum distance behind the paver.

8.4.5 Application of Cold Mix Asphalt

Cold mix asphalt shall be used in areas requiring temporary reinstatement for public safety (e.g. temporary ramping of sharp edges and sudden drops in level). Cold mix asphalt shall be placed and compacted with a mechanical rammer (or other suitable method), to achieve the required thickness, density and shape profile for its intended purpose. The surface shall be even and tidy with all surplus material broomed and removed from the street. A coating of sand shall be broomed over the cold mix asphalt surface to reduce stickiness.

8.4.6 Tolerances

Each layer shall, after final compaction, conform within the following limits to the lines, levels, grades, thicknesses and cross-sections specified or shown on the Drawings.

Level: The top of each layer shall not vary from the specified level by more than 10mm, except that where asphalt is placed against kerb and channel the surface at the edge of the wearing course shall be flush with or not more than 5mm above the lip of the channel.

Thickness: The thickness of each layer of asphalt shall not be less than shown on the Drawings.

Shape: No point on the finished surface shall lie more than 4mm below a 3m straight edge laid either parallel to the centreline of the pavement or, except on crowned sections, at right angles to the centreline.

8.5 Quality assurance

8.5.1 General

a) Requirements

The Contractor shall implement a Quality Assurance program in accordance with Section 2 of this Specification.

This program shall comprise Pre-Commencement Phase, Production and Process Control and Post-Construction phases as defined below:

8.5.2 Pre-Commencement Phase

a) Supply of Information on Materials Sources

The following information shall be supplied for the Asphalt:

- Supplier of Asphalt;
- Plant location; and
- A statement confirming compliance with VicRoads Specification Section 407 requirements for each specified mix.

8.5.3 Production and Process Control Phase

a) Program

The Contractor's production and process control program shall consist of sampling and testing the materials and product, and a continuous assessment of the adequacy of the production control. The Contractor is responsible for designing and implementing a control program which provides adequate and effective control over the works, however the minimum amount of control testing that shall be undertaken is set out in this section of the Specification.

If at any time during the production of materials the control program being undertaken by the Contractor is inadequate, the Superintendent may order the Contractor to cease production and/or delivery of materials to the works.

The Contractor shall keep a record upon a plan of the works, of where each work shift's production has been incorporated in the works.

If the control results indicate that the materials being produced are not in accordance with the requirements of the Contract then the Contractor shall record a non-conformance and shall not incorporate the materials represented by those test results into the works. The Contractor shall modify the manufacturing process so that conforming materials are produced.

b) Compaction

At the completion of compaction of each lot of asphalt, the density of the layer shall be determined using nuclear gauge tests in accordance with the requirements of Australian Standard / New Zealand Standard 2891.14.1.1.

Density testing shall be taken at a frequency of one per 500m2 with a minimum of 6 density tests in any lot.

Compliance of compaction testing shall be in accordance with the requirements of VicRoads Specification Section 407 – Clause 407.22(b).

8.5.4 Post-Construction Phase

a) Finished Surface Levels

The finished surface of the asphalt shall conform to the grades and levels specified within the tolerances specified in the above sub clause.

b) Thickness

The average thickness for each lot of asphalt shall be determined from the average spread rate (tonnage) and area.

The average thickness determined by the above method shall not be below the nominal thickness shown on the drawing, and no single point shall be less than 90% of the specified thickness.

c) Shape

The finished surface shape of the asphalt shall conform to the specified tolerances in the above sub clause.

d) Quality Assurance Records

Within 3 weeks of completion of the Works, the Contractor shall supply two copies of a report detailing the results of all quality control and testing undertaken.

e) Non-Conforming Materials and Work

All non-conforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Specification.

8.6 Open Graded Asphalt

8.6.1 General

This section shall be read in conjunction with Section 407 - Asphalt, and covers special requirements for Size 10 open graded asphalt surfacing that are in addition to, or override, the requirements for Section 407. For details refer to City of Melbourne Standard Drawing 1P 50414.

8.6.2 Description of Material

Open Graded Asphalt is an asphalt manufactured essentially from a Size 10 one sized aggregate to produce a mix with high air voids.

8.6.3 Aggregates

Unless otherwise specified, properties of the aggregates used in Open Graded Asphalt shall comply with the requirements for asphalt Type H as specified in Clause 407.03. Further to Clauses 407.03 and 407.09, no Reclaimed Asphalt Pavement shall be added to Open Graded Asphalt.

8.6.4 Binder

Binder used in Open Graded Asphalt shall be a Polymer Modified Binder (PMB), complying with the requirements of the AP T41 06 Austroads Specification Framework for Polymer Modified Binders and Multigrade Bitumen.

Unless otherwise specified in Clause 407.24(a), the PMB to be used in Open Graded Asphalt shall be one of the following grades:

- A15E, A20E, A25E, A30P or A35P.

8.6.5 Mix Design

The asphalt mix proposed for use shall be registered in accordance with Clause 407.06.

The Contractor shall also provide the following information:

- the class and test properties of the PMB proposed; and

- the results of the Binder Paste Drain Off tests meeting the requirements of Clause 417.06(d) and the selected maximum mixing temperature to avoid excess binder drain off.

The Indirect Tensile Modulus of the mix is not required to be submitted.

8.7 Coloured Surface Treatments

These clauses cover the requirements for supply and placement of coloured surface treatments, including site preparation and clean-up.

The Tenderer shall, prior to submitting the Tender:

- Examine the Tender documents;
- Consider the Tender information;
- Become acquainted with the nature and extent of the work to be executed under this contract;
- Assess the risk and cost of carrying out the works; and
- Make investigations, inspections and deductions to ensure the Tenderer's product is compatible with the site of works.

The Tenderer shall make allowance for the deterioration of the site from the time of Tender to the time of award of the Contract.

8.7.1 Sample Required

A sample of the proposed coloured surface treatment (i.e. binder and aggregate and additional binder if proposed) shall be provided to the Superintendent. The sample shall be a minimum of 300mm x 300mm on a rigid surface.

The Contractor shall supply and place a sample of min size 5m2 of coloured surface treatment at a location nominated by the Superintendent. The sample shall be used to monitor colour retention of the treatment.

8.7.2 Documented Evidence of Performance

Documented evidence of satisfactory performance over at least 5 years for the coloured surface treatment in a heavy urban traffic environment shall be provided with the Tender to the Superintendent.

The documentation may include; references from clients, details of sites with the coloured surface treatment, evidence of texture with time, evidence of skid resistance with time, evidence of colour retention with time, evidence of durability with time.

The Superintendent may request additional information regarding performance of the proposed coloured surface treatment at no additional cost. The Superintendent shall determine if the documented evidence is satisfactory. Only products with satisfactory documented evidence will be considered for award of the works.

Acceptance of the documented evidence and acceptance of the proposed coloured surface treatment does not guarantee the performance of the coloured surface treatment, nor relieve the Contractor from any of the requirements of this document.

8.7.3 Contractor Excluded Areas

The contractor shall nominate any areas of the site which will not allow the coloured surface treatments to perform as required. The written notification shall include the approximate size and detailed location of any such areas, and shall be provided to the Superintendent with the Tender. The contractor excluded areas will be considered with other information of the Tender.

8.7.4 Definitions

The following definitions apply to the coloured surface treatments clauses.

Accelerators

Accelerators refer to any material used to reduce the curing time of the binder.

Aggregate

Aggregate refers to any natural or synthetic particles used as a cover material applied to the binder, to provide texture and skid resistance to the surface of the coloured surface treatment.

Aggregate Coating

Aggregate coating includes all materials used to cover and/or colour aggregate.

Aggregate Retention

Aggregate retention refers to the ability of the binder to adhere and retain to the aggregate under traffic conditions.

Binder

Binder refers to any resin used to bond the aggregate to the existing road surface.

Coloured Surface Treatment

Coloured surface treatments consist of a (coloured) binder applied to the existing road surface, and (coloured) aggregate spread over the binder surface. Coloured surface treatments may include an additional layer of (coloured) binder over the aggregate layer.

Cleaning Agents

Cleaning Agents includes all materials used to remove dirt, grime, fuel, oil and other materials from the existing surface.

Delamination

Delamination includes failure of the binder to adhere to the existing surface. Delamination also includes a shear failure in the top layer of the existing asphalt caused by the coloured surface treatment applied to the surface.

Paint

Paint refers to materials in accordance with Australian Standard 4049.1 and 4049.3

Priming Material

Priming material refers to any substance used to clean and prepare the existing road for the application of binder. Priming materials may be used to improve the adhesion of the binder to the existing roadway.

Protective Sealer

Protective sealer refers to any substance used to protect and seal the coloured surface treatment from fuel and oils spills from traffic.

Sideways Force Coefficient

Sideways Force Coefficient, also called sideways-friction coefficient, is a general term for the sideways-force to the vertical reaction on the SCRIM test wheel.

Skid Resistance

Skid resistance is the friction between the vehicle tyre and the pavement surface. Skid resistance shall be measured using a Sideways-force Coefficient Routine Investigation Machine (SCRIM), and in accordance with VicRoads RC421.02.

Surface Texture

Surface texture refers to the mean height of aggregate particles above the level of the binder. Surface texture shall be measured in accordance with the VicRoads Surface Texture by Sand Patch RC317.01.

Test Lots

Acceptance of work and materials shall be based on testing of the work or material in lots. A lot will consist of a single batch or area of like work which has been constructed under essentially uniform conditions and is essentially homogeneous with respect to material and appearance. A lot shall be the smaller of either each day's production, or each 500m2 placed each day.

Discrete portions of a lot which are non- homogeneous with respect to material and appearance shall be excluded from the lot and either treated as separate lots, or replaced. Where the areas excluded from a lot as non- homogeneous exceed 20% of the total lot area, the whole of the lot shall be rejected.

Thermoplastic

Thermoplastic refers to materials in accordance with Australian Standard 4049.2

8.7.5 Material Details

a) Binder

The binder shall be;

- Resistant to fuel and oils spills from traffic;
- Non-flammable after placement and curing on road surface;
- Shall be able to be broomed and high-pressure water cleaned without damage;
- Free from lead;
- Stable in ultraviolet light; and
- Provide adhesion between the existing surface and the aggregate.

The binder shall provide effective adhesion to the existing surface and to the aggregate, to provide a uniform surface. The binder may be pigmented to provide a colour match of final product.

Thermoplastic binders are not permitted. Paint is not permitted.

The following binder details shall be provided to the Superintendent at least 14 days prior to the start of works:

- Priming materials type and source;
- Manufacturer's recommendations/instructions for priming material supply and placement;
- Binder type and source;
- Manufacturer's recommendations/instructions for binder mix quantities and tolerances on mixing components;
- Manufacturer's recommendations/instructions for mixing of binder (and components);
- Manufacturer's recommendations/instructions for pot life of binder–time of mixing to time of spreading;

- Manufacturer's recommendations/instructions for placement of binder including placement quantities and tolerances and placement temperatures;
- Manufacturer's recommendations/instructions for curing;
- Manufacturer's recommendations/instructions for accelerators (if applicable);
- Manufacturer's recommendations/instructions for supply and placement of protective sealers; and
- Type of coloured pigment.

b) Aggregate

The aggregate shall be clean, of uniform shape and quality, free from dirt, free from clay and organic matter, and resistant to fuel and oils spills from traffic, able to withstand traffic stresses without damage, able to be broomed and high-pressure water cleaned without damage. The aggregate may be pigmented to provide a colour match of final product.

The following aggregate details shall be provided to the Superintendent at least 14 days prior to the start of works:

- Aggregate type and source and gradation
- Manufacturer's or contractor’s recommendations/instructions for placement of aggregate including placement quantities

8.7.6 Environmental Protection

The coloured surface treatment shall not emit offensive odours after placement and curing and opening to traffic, such that complaints are received by City of Melbourne. The Superintendent shall determine if the coloured surface treatment is producing offensive odours. The Superintendent’s decisions will be final.

Material Safety Data Sheets (MSDS) for priming materials, binders, aggregate, aggregate coatings, protective sealers and all work materials shall be provided to the Superintendent prior to the start of works. Any requirements for environmental protection measure as recommended by the material manufacturer shall be undertaken and completed.

All materials shall be used and stored in accordance with manufacturer’s instructions, legislation and MSDS.

Any spilled coloured surface treatment material shall be prevented from leaving site and entering waterways. All spills of material shall be reported in writing to the Superintendent. The report shall be provided within two days of the time of the spill.

8.7.7 Site Preparation

The existing pavement markings and line marking at the site may be removed by the contractor as part of the site preparation works, or may be masked to ensure the coloured surface treatments is not applied to the markings. All Raised Reflective Pavement Markers (RRPMs) may be either be removed from the area of works prior to any coloured surface treatments being placed, or masked to ensure the coloured surface treatments is not applied to the RRPMs. All masking shall be removed prior to opening the site to traffic.

Any damage caused to the surface by the removal of pavement markings and RRPMS shall be repaired prior to placement of coloured surface treatments.

The proposed methods of removal and repair shall be submitted to the Superintendent for approval.

The Superintendent shall agree to the method of removal and repairs for pavement markings and RRPMs prior to these works.

All loose material, grit, stones, vegetative matter, and rubbish shall be removed from the area of works prior to placement of coloured surface treatment.

The site may be further cleaned and prepared as required by the contractor. Cleaning and preparation shall not cause structural damage to the roadway. All cleaning agents and removed material shall be removed from site in accordance with Environmental Protection legislation, and with the agreement of the Superintendent.

Cracks in the existing surface shall be masked with a maximum of 50mm total width of tape. The masking tape shall ensure coloured surface treatments is not placed immediately adjacent to existing cracks, and shall be removed after the coloured surface treatments is placed.

Coloured surface treatment shall not be placed until the Superintendent and Contractor agree the road surface is ready for surfacing.

8.7.8 Placement

Coloured surface treatments shall be applied to produce a visually uniform surface. The edges of the work shall provide a neat and clean line onto the adjacent roadway.

a) Priming Materials

Priming Materials may be used to provide a uniform thickness over the site. The spread rate for each lot of material shall be determined by mass or volume divided by the area, and the result recorded. All spread rates for the work shall be provided to the Superintendent.

b) Binder

Binder shall be spread to provide a uniform thickness over the site. The spread rate for each lot of material shall be determined by mass or volume divided by the area, and the result recorded. All spread rates for the work shall be provided to the Superintendent.

c) Aggregate

Aggregate shall be spread to provide a uniform thickness over the site. The spread rate for each lot of material shall be determined by mass or volume divided by the area, and the result recorded. All spread rates for the work shall be provided to the Superintendent.

d) Temperature

The pavement temperature of the site shall be measured and recorded at least every 2 hours during the works. The temperature shall be measured using an infrared temperature gauge accurate to +/- 2oC.

e) Accelerators

Accelerators may be used to reduce the time of curing for the coloured surface treatment. The spread rate for each lot of material shall be determined by mass or volume divided by the area, and the result recorded. All spread rates for the work shall be provided to the Superintendent.

8.7.9 Clean-up

All excess material shall be removed from the site.

Excess aggregate shall be removed from the finished surface prior to opening the site to traffic. Excess aggregate shall be removed from the roadway, kerb and channel, driveways and any trafficked and untrafficked areas prior to opening to traffic.

The contractor and Superintendent shall agree the site is neat and tidy, prior to opening to traffic.

Material which becomes loose after the initial clean-up shall be removed at 3 and 14 days after placement.

8.7.10 Acceptance of Work

Coloured surface treatments shall provide a visually uniform coloured surface with uniform aggregate retention, and free from delamination and areas of wear/scuffing.

a) Surface Texture

The surface texture of coloured surface treatments shall be a minimum of 0.6mm. Each lot of material shall be tested within 2 weeks of initial placement, and within 8 weeks prior to the end of the defects period.

b) Skid resistance

The skid resistance of the coloured surface treatments shall be a minimum of 0.55 sideways force coefficient. The length of entire site shall be tested in the left and right wheel paths. The site shall be tested within 4 weeks of initial placement, and within 8 weeks prior to the end of the defects period. The Superintendent may undertake additional skid resistance testing of the site at any time during the defects period.

The Contractor shall arrange and undertake the skid resistance testing using the VicRoads Sideways-force Coefficient Routine Investigation Machine. The cost of the testing shall be borne by the Contractor. A copy of the results shall be submitted to the Superintendent.

c) Colour

The colour of the finished surface shall be a Rating 3 Approximate Match (or better) with one of the following Australian Standard 2700S – 2011 colours;

R14 Waratah

R15 Crimson

R54 Raspberry (preferred colour)

The initial colour shall be measured in accordance with Australian Standard 1580.601.1:1995. Each lot of material shall be tested within 2 days of placement and shall be tested onsite and under daylight only. Each lot of coloured surface treatment shall provide a Rating 3 Approximate Match (or better) with adjacent lots. The colour test shall be jointly undertaken with the Superintendent and the contractor.

The colour of each lot during the defect's liability period shall be recognisably red as determined by the Superintendent.

In the event of a dispute regarding the colour, the Superintendent may:

Test the colour of the sample at .... The sample shall be recognisably red as determined by the Superintendent, or achieve at least a Rating 3 Approximate Match in accordance with Australian Standard 1580.601.1:1995 in natural daylight only, or

Allow the contractor to clean the coloured surface treatments, and test the surface to achieve at least a Rating 3 Approximate Match in accordance with Australian Standard 1580.601.1:1995 in natural daylight only.

Red Asphalt

The use of red asphalt is usually associated with the delineation of bus lanes within the City of Melbourne. Such delineation shall be with the application of a minimum thickness 35mm wearing course layer of 'Gravelmix' (red asphalt) with minimum 2% red oxide mix with polymer modified binder (PMB) by Asphaltech P/L or approved equivalent. For the application of red asphalt, a minimum of 3 tonnes is required, therefore for areas which are less than 25 m2 a council approved coating shall be applied.

8.7.11 Maintenance and Repairs

The contractor shall be responsible for monitoring and maintenance of the coloured surface treatments from the time of placement, until the end of the defects period.

The contractor shall carry out any works necessary to protect and maintain the surface or to effect repairs to all surface failures. Such failures include but are not limited to lose of aggregate, bleeding, loss of colour, fatty

areas, flushing, loss of skid resistance, and delamination from the existing surface, delamination of the coloured surface treatments including a small depth of the existing asphalt wearing course.

The contractor is not responsible for defects caused by either settlement or failure of the existing pavement, or for damage and repairs to the surface caused by traffic incidents, gouging from vehicle incident and vehicle fire.

Areas of defect repairs shall be agreed with the Superintendent. Areas shall be squared-up and extend the width of the traffic lane. Defective coloured surface treatment shall be removed and replaced.

Repairs shall be undertaken within 4 weeks of notification by the Superintendent. Urgent repairs shall be started onsite within 3 hours of notice by the Superintendent.

HP The contractor shall advise the Superintendent in writing of the proposed treatment for any repairs before undertaking the work.

8.7.12 Excluded Areas

The following areas are excluded from the limits of work:

- All service pits and valve covers;
    - Traffic detector loops; and
    - Pedestrian crossings – the white pavement markings and designated travel path of pedestrians.

8.7.13 Mix Design Requirements

a) Grading Limits and Production Tolerances for Aggregates

Unless otherwise specified or directed, the grading of mineral matter, and the production tolerances from the grading aim shall lie within the limits specified in Table 417.061.

Sieve Size AS (mm)	Grading Aim % Passing (by mass)	Production Tolerance from Grading Aim % Passing (by mass)
13.2	100	Nil
9.5	95	±6
6.7	61	±6
4.75	30	±5
2.36	12	±5
1.18	10	±5
0.600	8	±5
0.300	6	±3
0.150	4	±3
0.075	4	±1.0

(b) Added Filler

The mix shall contain a minimum of 1% by mass of hydrated lime added filler.

(c) Binder Content

Unless otherwise specified or directed, the binder content of the mix shall be 6.5% with a production tolerance of ±0.3%.

(d) Binder Drain Off Test

A series of Asphalt Binder Drain Off tests over the range of likely mix temperatures shall be performed at the specified binder content to determine the maximum allowable mixing temperature to avoid excessive binder drainage. The mass of binder paste drain off shall not exceed 0.3% of the total mass of the sample of mix tested at the maximum allowable mixing temperature.

8.7.14 Temperatures of Binder, Aggregate and Asphalt

Unless otherwise specified or directed, temperatures of binder, aggregate and asphalt shall comply with the requirements of Table 417.071.

Table 417.071

Material	Polymer Modified Binder Temperature °C – Min	Polymer Modified Binder Temperature °C – Max
Binder delivered into plant storage	180	190
Asphalt at discharge from mixing plant	155	180
Asphalt at spreading plant	150	175

8.7.15 Ambient Conditions for Placing

Open Graded Asphalt shall not be placed when the majority of the area to be paved has a surface temperature of less than 15°C.

8.7.16 Water Resistant Bituminous Bond Coat

A water-resistant bond coat shall be applied to the existing surface consisting of cationic rapid setting bitumen emulsion (60% bitumen content) applied at a rate of application of not less than 0.5 litres per square metre using a calibrated sprayer to uniformly spray the emulsion. Hand spraying shall only be permitted on small irregularly shaped areas clear of the traffic path. A cationic rapid setting PMB emulsion with 60% to 70% binder content may be used to reduce the possibility of run off and excessive tackiness.

8.7.17 Spreading

Heating of the paver screed shall cease while the paver is stationary and the screed is in contact with the asphalt mat.

The thickness at any point in the Open Graded Asphalt layer shall not be less than 20 mm and the mean thickness of a test lot of Open Graded Asphalt shall not be less than the specified thickness. For the purposes of this clause a test lot shall be defined as an area of up to a maximum of 4,000 m2.

Unless otherwise specified, all areas of the existing pavement surface that are not free draining shall be filled or regulated with dense graded asphalt as specified prior to placing Open Graded Asphalt.

8.7.18 Joints and Junctions

At junctions where the new asphalt mat is required to match the level of the existing pavement, and where the depth of the Open Graded Asphalt cannot be used to match into the existing pavement, junctions shall be constructed with Size 10 Type H dense graded asphalt over the full width of carriageway as follows:

- Side streets and median openings - 600 mm
    - Through carriageways with a speed limit of 75 km/h or less - 3 metres
    - Through carriageways with a speed limit of more than 75 km/h - 6 metres

At any location where the layer is to be "feathered" to a depth of less than 20 mm, such "feathering" shall be carried out with Type N or H, size 7 or size 10 dense graded asphalt as specified. “Feathering” constructed in the direction of paving shall be placed by the paving machine.

8.7.19 Compaction Requirements

Acceptance of compaction shall be based on the adoption of approved placing procedures.

Such procedures shall include not less than 5 passes with a static steel wheeled roller with a minimum overall mass of 6 tonnes. The Contractor shall provide a self-propelled multi wheel roller for secondary rolling of asphalt but the Superintendent may direct that its use be restricted or omitted altogether if it results in damage to the fresh Open Graded Asphalt.

8.8 Asphalt Recycled from Reclaimed Asphalt Pavement

8.8.1 General Requirements

Unless otherwise specified, Reclaimed Asphalt Pavement may be re cycled by adding it to new asphalt during the mixing process subject to the following requirements:

- All mixes containing Reclaimed Asphalt Pavement shall be registered mixes;
    - Reclaimed Asphalt Pavement shall consist of milled or excavated asphalt pavement free of foreign material such as unbound granular base, broken concrete or other contaminants and shall be crushed and screened to a maximum size not exceeding the size of asphalt produced;
    - The manufacturing process shall provide for addition of Reclaimed Asphalt Pavement to a batch plant pug mill or drum mixer separately from other mix components by a method that avoids damage to the mix by overheating; and
    - No Reclaimed Asphalt Pavement shall be added to Asphalt Types V, HP, HG, SS or SP and Open Graded mixes.

8.8.2 Unconditional use of Reclaimed Asphalt Pavement

The following mix types may contain the following maximum quantities of Reclaimed Asphalt Pavement provided that all relevant specification requirements are met for each mix type:

- Type L - Up to 20% by mass;
- Type N - Up to 15% by mass;
- Types H - Up to 10% by mass;
- Type SI and SG - Up to 20% by mass; and
- Type SF – Up to 30% by mass.

8.8.3 Higher Percentages of Reclaimed Asphalt Pavement with Additional Performance Testing

The Superintendent may approve the use of a registered mix containing percentages of Reclaimed Asphalt Pavement up to 10% above the limits specified in Clauses 407.09(a) (iv) and (b).

Representative samples of production asphalt shall be taken and tested at a frequency not less than that specified in Table 407.091, unless otherwise varied by the Superintendent.

The test results will be assessed on the basis of a "rolling average" where the mean of the last 3 test results for the mix shall be within the specified range or in the case of asphalt particle loss, the value determined for the same mix without Reclaimed Asphalt Pavement inclusion. Test specimens for each test type shall be

compacted to an air voids content as specified in VicRoads Code of Practice RC500.01 for that test type. Test specimens for Asphalt Particle Loss shall be prepared at the air voids content specified for the Moisture Sensitivity test.

The results shall be presented in such a way that trends can be readily ascertained for each asphalt type so corrective action can be taken when required.

Table 407.091 – Frequency of Testing for Mixes with High Percentages of Reclaimed Asphalt Pavement

Check Required	Minimum Frequency
Indirect Tensile Modulus	In each production month - One per 2000 tonnes or part thereof.
Moisture Sensitivity (Min. Wet Strength and Tensile Strength Ratio)	In each production quarter - One per 10,000 tonnes or part thereof.
Mix Cohesion (Asphalt Particle Loss Test on moisture conditioned and unconditioned specimens)	In each production quarter - One per 10,000 tonnes or part thereof.

8.9 Café Mix

When constructing or reconstructing footpaths adjacent to cafes a “café mix” layer shall to be added as following:

- 25mm of size 7mm “Café Mix’ (7.3% Bitumen)
    - 35mm of size 14mm HMA, Type N
    - 50mm of class 2 compacted FCR

9. Concrete pavement

9.1 General

9.1.1 Scope

This Section specifies requirements for the supply of materials and construction of Portland cement concrete pavements.

9.1.2 Referenced Documents

The following documents which are referenced in this section form part of this Specification only to the extent that they are referred to herein:

Standards Association of Australia:

Australian Standard 1012.1 Methods of Testing Concrete

Australian Standard 1141.1 Methods for sampling and testing aggregates

Australian Standard 1152 Specification for test sieves

Australian Standard 1302 Steel Reinforcing Bars for Concrete

Australian Standard 1303 Steel Reinforcing wire for Concrete

Australian Standard 1304 Hard-drawn Steel Wire Reinforcing Fabric for Concrete

Australian Standard 1379 Specification and supply of concrete

Australian Standard 1478.1 Chemical Admixtures for Concrete, Mortar and Grout

Australian Standard 2758.1 Aggregates and rock for engineering purposes – Concrete aggregates

Australian Standard 3972 General Purpose and Blended Cements

Australian Standard 3799 Liquid membrane – forming curing compounds for concrete

VicRoads:

Section 501 - Materials and construction plant for concrete base and sub-base pavement courses.

Section 503 - Construction of concrete base pavement courses.

9.1.3 Working near Public Trees

When working in the vicinity of public trees, an arborist from the Urban Forest and Ecology team must be notified, if:

- Roots are exposed during works
- Damage could occur, or has occurred, to tree roots
- Tree plot sizes require alteration
- Soil levels require alteration

9.2 Materials

9.2.1 Composition

Concrete shall consist of fine and coarse aggregates, uniformly mixed with Portland cement and water.

9.2.2 Aggregate

Concrete aggregates shall consist of freshly crushed rock fragments and naturally occurring sand particles meeting all the requirements of this Specification and each aggregate must:

- Have been produced by crushing approved rock or processing approved sand;
    - If a crushed aggregate, have been produced by crushing rock which is free from particles whose minimum dimensions in any direction is less than 100mm, sand, disintegrated material, friable material, weathered material, lumps or balls or clays, organic matter or other deleterious materials or coatings;
    - Contain no more than a total of 1.0% by mass or weathered, discoloured, soft, fractured, friable or poorly indurated particles; and
    - Comply with the test limits and assessment procedures contained in this Specification, and with other requirements in Australian Standard 2758.1.

If during the progress of the work, materials from other sources are proposed for use a written request shall be submitted sufficiently in advance of the time when the other source is proposed to be used to permit evaluation of the request.

9.2.3 Coarse Aggregate

Coarse aggregate shall consist of unweathered, dense, sound, clean, hard, strong, durable pieces of crushed rock free from deleterious coatings and dust and shall comply with all the requirements of Australian Standard 2758.1.

9.2.4 Fine Aggregate

Fine aggregate shall consist of clean, hard, strong, durable uncoated particles of natural sand or a combination of natural and crushed sand free from weathered particles.

Crushed sand shall be produced by crushing rock that meets the requirements of Clause 8.2.2.

The proportion of natural sand combined with crushed sand shall be sufficient to ensure that concrete of acceptable quality, workability and finish can be produced from the combined fine aggregate.

Particles of the fine aggregate shall be generally spherical or cubical in shape.

The fine aggregate and separate sizes of fine aggregate shall comply with all the requirements of Australian Standard 2758.1.

9.2.5 Cement

Cement shall be Portland Cement Type GA (or Type B for high early strength) complying with Australian Standard 3972.

Cement that has been in storage over 4 months shall not be used until roved satisfactory by retest.

9.2.6 Water

Water for mixing and curing concrete shall be clean, fresh and free from injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances. Water approved by Public Health Authorities for domestic consumption will be accepted for use without being tested. Water of questionable quality shall be tested prior to use in the work.

9.2.7 Admixtures and Colourings

Where specified in the Drawings, ‘charcoal’ or grey coloured concrete shall be achieved by adding 15 kg/cu.m black oxide Bayer 318 or approved equivalent. Coloured rendering of the surface (only) will not be accepted.

The use of any other admixtures to the concrete shall be subject to the approval of the Superintendent.

9.2.8 Curing Materials

a) Membrane Curing Compounds

Membrane curing compounds shall be a white pigmented type conforming to Australian Standard 3799, Type 2. Wax based compounds shall not be used.

b) Impermeable Blankets

Impermeable blankets shall be:

- cotton or hessian backed white opaque polyethylene sheet, or
- white opaque polyethylene sheeting, or
- other approved waterproof sheeting which shall be stitched or cemented together to make blankets at least one metre wider than the section being placed and not less than 9m long.

The blankets shall be uniform in appearance, and free from all visible defects, tears, holes and shall comply with the requirements of Australian Standard TM C.171.

The blankets shall have sufficient strength and weight to meet the required conditions of service.

c) Hessian Blankets

Hessian (or Burlap) mats shall consist of two or more layers of hessian having a combined weight of 0.5kg or more per square metre in a dry condition and shall have a width after shrinkage at least 300mm greater than necessary to cover the entire width and vertical faces of the pavement lane. They shall be new or have only been used for curing concrete and shall be free from tears.

9.2.9 Reinforcement

Reinforcing fabric shall comply with Australian Standard 1304.

9.2.10 Dowels

Unless otherwise specified on the drawings, dowels shall be plain steel and shall be one-piece, straight, bars conforming to Australian Standard 1302 and of the sizes shown on the drawings. The dowels shall be cut to length at the shop or mill prior to delivery to the site. The deformation from true shape of dowels shall not exceed 1mm on the diameter of the dowel, and shall not extend more than 1mm from the end of the dowel. Dowel bars which have been cropped or sheared to length shall not be incorporated in the Works.

Ends of dowels shall be square and free from burrs. Dowels shall be clean and free from mill scale, loose rust or soil.

9.2.11 Concrete

The concrete used in the work shall be ready-mixed concrete manufactured, supplied and delivered in accordance with Australian Standard 1379. Ready-mixed concrete shall be delivered to the site in trucks of the revolving drum type.

The concrete shall comply with the following requirements:

Concrete shall be N20 standard strength grade complying with the requirements of Australian Standard 1379.

- Grade N32 for Footpaths and N50 for Roadways (unless otherwise specified in Drawings);
    - Slump 70mm;
    - Nominal maximum aggregate size 20mm;
    - Suitable for placement by manual methods, between forms and using a combination of internal mechanical vibration (poker vibrators) and vibrating screeds; and
    - Subject to project assessment of strength.

Notwithstanding the provisions of Australian Standard 1379, all concrete shall be completely discharged within 60 minutes of the introduction the cement to either the aggregate or the mixer. There shall be no addition of water or any other material to the concrete on the site.

9.3 Construction

9.3.1 Plant and Equipment

The plant and equipment items used in the Works shall be appropriate for the intended purpose and shall be maintained in good and serviceable condition at all times during which they are operating.

9.3.2 Forms

a) General

Forms shall be designed and set to withstand handling and construction loads without warping, sagging or damage, so that when they are stripped, the formed edge of the concrete is truly vertical (i.e. plumb).

b) Form Removal

Forms shall remain in place for at least 12 hours after the concrete has been placed. When conditions on the site are such that the early strength gain of the concrete is delayed, the forms shall remain in place for such longer period as may be required. Forms shall be removed without injuring the concrete, dowel bars or tie bars. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete damaged in form removal shall be repaired promptly using a suitable method.

All arises shall be removed from the top corner of the concrete immediately after form removal.

9.3.3 Reinforcement Fixing

Reinforcement shall be provided in the locations shown, and shall be placed and securely held in its correct position by the use of approved supports during the placing operation and until the concrete has hardened.

Reinforcing fabric sheets shall be handled so that they remain free from distortion. They shall be lapped so that the two outermost wires of one sheet of fabric overlap the two outermost wires of the sheet being lapped.

Lapped portions shall be tied with wire at a maximum spacing of 500mm.

Reinforcement shall be terminated 75 to 80mm from dowelled contraction joints. Reinforcement shall terminate at least 40mm and not more than 80mm from longitudinal construction joints, or pavement edges.

9.3.4 Placing and Spreading

a) General

The area in which concrete is proposed to be placed shall be inspected and checked immediately prior to commencement of placing. Placement at each placing location shall be at a rate of not less than 20 cubic metres per hour and shall be sustainable. Concrete shall be placed within 60 minutes from the time of batching and before the concrete has obtained its initial set. The temperature of the concrete as deposited in the forms shall be not less than 10□C, nor more than 30□C.

Concrete shall be placed in such manner as to require a minimum of rehandling and shall be so distributed that when compacted and finished, the slab thickness, surface shape and levels required by the Drawings will be obtained. The placing of concrete shall be rapid and continuous between transverse construction joints. Workmen with soil or foreign material on their footwear shall not be permitted to walk in the concrete during placing and finishing operations.

During placing, the concrete shall not be allowed to drop freely by more than one metre onto the base of the paving lane.

Placing and spreading shall not commence until all equipment for placing, spreading, compaction, finishing and curing are at the paving site.

The concrete shall be placed in a manner so that the face of the placed concrete is generally vertical and normal to the direction of the placing. Concrete shall be placed uniformly over the width of the slab or sectioned in such manner as to minimise segregation. Concrete shall be spread to levels slightly above the

required finished surface so that when properly compacted and finished the surface of the concrete will be at the design levels. All hand spreading of concrete shall be done with shovels, not rakes.

Placing of concrete against the face of an existing pavement shall not commence until all organic matter, soil or other deleterious material which is adhering to the face has been removed.

b) Limitations on Placing Concrete

Placing of concrete shall not be permitted when heat, cold, wind, rain, low humidity, plant and equipment defects, inadequate labour or any other reason prevent satisfactory placement and finishing of concrete.

9.3.5 Compaction

Compaction of concrete shall commence immediately after placing and shall be followed immediately by the finishing operations.

All concrete including that adjacent to forms or existing concrete shall be compacted by internal mechanical vibration.

The vibrators shall be capable of transmitting at least 3,500 cycles per minute when under load, and the vibration shall be of sufficient amplitude to produce noticeable vibrations at 300mm radius from the vibrator. The number of vibrators on site in full working order shall be not less than 1 per 7 cubic metres of concrete placed per hour.

The vibrators shall be inserted into the concrete to such depth as will provide the best compaction, but not deeper than 50mm above the surface of the base course. The vibrators shall be operated by slowly inserting and withdrawing them vertically in a non-uniform pattern at a spacing of about 400mm or as directed. The duration of vibration shall be sufficient to produce satisfactory compaction, but not longer than 30 seconds in any one location. Vibrators shall not be used for pushing and spreading concrete.

Particular attention shall be paid to the vibration of concrete adjacent to forms and joints. Any honey combing in excess of 5% of a slab edge will be grounds for rejection of the placed concrete in that entire slab, and removal and replacement of the slab.

The effective operation of the vibrators shall be checked frequently.

9.3.6 Finishing

a) General

Finishing operations shall comprise scraping straight edge finishing, transverse floating and broom finishing, in that order, and shall be started immediately after compaction of the concrete and completed as soon as possible but not later than 60 minutes from the time of batching and prior to the concrete attaining its initial set.

The finishing equipment and tools shall be maintained in a clean condition.

b) Transverse Finishing

Transverse finishing shall be with an approved mechanical vibrating screed. Vibrating screeds shall be at least 300 mm longer than the width of section being finished, equipped with handles and the screed edge shall be at least 100 mm wide. Alternatively, a counter rotating tube screed of approved design may be used.

The concrete shall be accurately struck off and screeded to design levels as soon as possible after vibration. At least two passes and not more than four passes shall be made with the screed over each section of pavement to compact the surface of the concrete and produce a surface of uniform texture and true to level and shape. Manipulation of the concrete which results in an excess of mortar and water being bought to the surface shall be avoided.

The top of the forms or pavement edges upon which the screed travels shall be kept clean of all foreign matter which would affect the precision of the finish.

c) Scraping Straight Edge Finishing

While the concrete is still plastic, minor irregularities and score marks in the pavement surface shall be eliminated by means of hand operated long handled scraping straight edges used in conjunction with long bladed, long handled, hand operated floats. The blades of the scraping straight edges and floats shall be not less than 3m long.

The straight edges and floats shall be operated from the side of the paving section by drawing them across the surface of the concrete towards and across the forms or slab edge. They shall maintain contact with the surface at all times and shall be slightly angled so that they can be drawn across the form to avoid a depression or ridge in the concrete adjacent to the form or slab edge.

When necessary, excess water and laitance shall be removed from the surface. The hand operated float shall be used to smooth and fill in open textured areas in the pavement surface. The surface shall also be tested for trueness with a 3m straight edge held in successive positions parallel and at right angles to the centreline of the pavement or any other direction and in contact with the surface and the whole area covered as necessary to detect variations. The straight edge shall be advanced along the pavement in successive stages of not more than one half the length of the straight edge.

Any depressions found during straight edge checking shall be filled with freshly mixed concrete, struck off, consolidated and refinished. Concrete used for filling depressions shall have all stones larger than nominal 20mm removed. Projections above the required level shall also be struck off and refinished.

The straight edge testing and finishing shall continue until the entire surface of the concrete is free from observable departures from the straight edge, conforms to the required grade and shape, and, when hardened, will satisfy the surface requirements specified.

9.3.7 Broom Texturing

Concrete pavements shall be broomed to provide a satisfactory surface texture. In the case of concrete base courses, the Superintendent may waive this requirement if traffic conditions or working restrictions make it impracticable or unnecessary to apply a broom finish to the intermediate pavement course.

When most of the water glaze or sheen has disappeared and before the concrete becomes non plastic, the whole surface of the pavement shall be coarsely broomed in a direction at right angles to the direction of the placing of the concrete. Brooms shall be at least 500mm wide with bristles of bass, nylon or flexible wire. At least two (2) brooms shall be available at all times. Brooms shall be washed thoroughly and dried at frequent intervals to prevent accumulation of dried mortar on the bristles. Brooming shall be from the edge of the paving section or preferably from bridges. Brooming shall be undertaken continuously from edge to edge of the paving lane.

Brooms shall be drawn in straight lines and successive strokes shall overlap about 50mm. The indentations in the pavement surface shall be uniform in appearance and approximately 2mm in depth without dislodging coarse aggregate particles.

9.3.8 Curing

a) General

Concrete shall be cured by protection against loss of moisture and rapid temperature changes for a period of not less than 7 days from the completion of the finishing operations. In the case of concrete base courses, the Superintendent may waive this requirement if traffic conditions or working restrictions make it impracticable or unnecessary to cure the intermediate pavement course.

Curing shall comprise initial curing, moist curing and membrane curing.

Application of curing medium shall commence on the sides of concrete slabs exposed by the removal of forms as soon as possible and no longer than 30 minutes after removal of forms in order to provide the exposed surfaces with continuous curing treatment.

b) Initial Curing

Immediately after the finishing operations have been completed and until the moist curing medium has been applied, the surface of the concrete shall be kept continuously damp by means of water fog or mist applied with approved spraying equipment.

c) Moist Curing

As soon as possible after the finishing operations have been completed and the concrete has set sufficiently to prevent marring the surface, the forms and entire surface of the newly laid concrete shall be covered with wetted hessian (burlap) or cotton mats. Cotton mats and hessian (burlap) strips shall have a width, after shrinkage, at least 300mm greater than necessary to cover the entire width and faces of the pavement lane. Provision shall be made to securely anchor the mats to ensure the mats remain in place in windy conditions. The mats shall overlap each other at least 150mm.

The mats shall be saturated before placing and shall be kept continuously saturated and in intimate contact with the pavement edges and surface for a period of not less than 24 hours and until the curing membrane is applied.

d) Membrane Curing

The entire exposed surface of the concrete, including edges, shall be uniformly coated with an approved white pigmented membrane curing compound. The concrete shall not be allowed to dry out before the application of the membrane. If any initial drying has occurred, the surface of the concrete shall be moistened with a fog spray of water.

The curing compound shall be applied to the finished surfaces by means of an approved mechanical spraying machine. The curing compound spraying machine shall have a motor driven pump or compressed air unit to provide displacement of the curing compound to the spray equipment. The machine shall be equipped with spraying nozzles that can be controlled and operated so as to completely and uniformly cover the pavement surface with the required amount of curing compound.

The curing compound in the storage drum used for the spraying operation shall be thoroughly and continuously agitated mechanically throughout the full depth of the drum during the application. Air agitation may be used only to supplement mechanical agitation.

Spraying pressure shall be sufficient to produce a fine spray and cover the surface thoroughly and completely with a uniform film. Spraying equipment shall be maintained in first class mechanical condition, and the spray nozzles shall be provided with an adequate wind guard.

The curing compound shall be applied in two applications at a total coverage of not less than 0.5 litres per square metre. Each application of curing membrane shall be applied to the pavement in opposing directions at a rate of not less than 0.25 litres per square metre.

The compound shall form a uniform continuous, cohesive film that will not check, crack or peel, and that will be free from pin holes and other imperfections. If discontinuities, pin holes, or abrasions exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above, at no additional cost to the Corporation.

In the event of mechanical failure of the spraying machine, either moist curing blankets or impermeable blanket curing shall be used.

Concrete surfaces to which membrane curing compounds have been applied shall be adequately protected until the end of the curing period. Any damage to the curing membrane due to joint sawing operations, if used; or surface tests, or any other cause which reduces the efficiency of the membrane, shall be immediately repaired by further application of the membrane curing compounds as specified.

e) Impermeable Blanket Curing

If the concrete is constructed during weather conditions which cause rapid temperature fluctuations in the curing concrete, impermeable blanket curing shall be used.

9.3.9 Joints

a) General

All joints shall conform to the details and shall be constructed in the locations shown on the Drawings. Transverse and longitudinal joints shall be straight and perpendicular to one another, continuous from edge to edge of the pavement throughout all paving sections that are connected in a single paved area, except where shown otherwise on the Drawings.

b) Construction Joints

Wherever concrete placing has stopped, and concrete has taken its initial set, this joint shall be deemed a construction joint. The location and detail of construction joints shall be as be as required or approved by the Superintendent. Dowels shall be installed in the longitudinal construction joints as required in accordance with the details shown on the Drawings, and in accordance with the sub-clause “Dowel Bars”.

Before placing new concrete against concrete which has set, the forms shall be tightened and the surface of the set concrete shall be roughened, cleaned of foreign matter, laitance and loose or porous material. The surface shall be covered uniformly with a thin coat of cement grout to the satisfaction of the Superintendent and concreting shall proceed immediately. This shall be in accordance with City of Melbourne Standard Drawing 1P 50405A.

c) Expansion Joints

Expansion joints, comprising dowel bars, polyethylene foam jointing material and sealant, shall be constructed between paving sections as detailed on the Drawings. One half of each dowel bar shall be painted with two coats of bituminous emulsion and capped prior to placing concrete.

d) Isolation Joints

Isolation joints, comprising polyethylene foam jointing material and sealant, shall be constructed against buildings and back of kerb, around all pits, covers, poles and at other locations as detailed on the Drawings.

e) Connection Joints

Connection joints shall be constructed at the interface between new and existing concrete pavements as detailed on the Drawings. The Contractor shall drill holes into the existing concrete base slab and embed one half of the length of each dowel bar into the existing concrete slab by injecting grout (or approved chemical product) into the holes prior to pouring the new concrete slab. This shall be in accordance with City of Melbourne Standard Drawing 1P 50405A.

f) Transverse Contraction Joints

Transverse contraction joints shall be sawn where indicated and detailed on the Drawings.

The width of the joint shall be nominally 3mm wide and shall be sawn to a depth as shown on drawings.

Sawing of contraction joints shall be carried out as soon as the concrete has attained sufficient strength to enable sawing without tearing the surface and prior to the concrete gaining a strength such that uncontrolled cracking occurs. Delays in sawing the transverse contraction joints will not be allowed. Sufficient sawing equipment including one complete standby unit shall be maintained on site in working condition at all times.

The suitability of the newly completed concrete for sawing shall be continuously monitored as the anticipated time for commencement of sawing approaches.

Since time is of the essence, alternate or third joints may be cut initially, or additional sawing equipment may be used simultaneously, to avoid exceeding the available time for this critical operation.

g) Sealing of Joints

Sawn joints shall, unless otherwise specified in the Drawings or approved by the Superintendent, be sealed with Dow Corning 888, silicone joint sealant or an approved equivalent.

h) Dowel Bars

Dowel bars shall be prepared and placed across joints where shown on the Drawings, correctly aligned, and securely held parallel to the surface of the finished pavement, and at right angles to the joint in plain view during placing and finishing operations.

Dowel bars shall be placed by the bonded in place method, whereby they are embedded in the freshly placed concrete. Installation by removing and replacing dowel bars in preformed holes, including their withdrawal to assist in form stripping, will not be permitted.

The spacing and vertical location of dowel bars shall be as specified on the Drawings. The following tolerances shall not be exceeded:

Horizontal Location: ±6mm

Vertical Location: +6mm

The spacing of dowel bars in longitudinal construction joints shall be as indicated on the Drawings except that where the planned spacing cannot be maintained because of form length or interference with form braces, closer spacing with additional dowel bars shall be used. Dowel bars in longitudinal joints shall be omitted when the centre of the bar would be located within a horizontal distance from a transverse joint equal to three quarters of the slab thickness, but not further than 200mm from the transverse joint.

Dowel bars in longitudinal and transverse construction joints shall be held securely in place by means of approved devices fastened to the forms. The unpainted ends of dowels shall be installed in the initially placed section.

The method used in holding dowels in position shall develop such accuracy that the error in alignment of any dowel from its fixed position after the pavement has been finished shall not be greater than 3mm. This method shall also ensure that any two consecutive dowel bars are parallel with each other within a tolerance of 3mm. An approved template shall be used for checking the position of the dowels.

The portion of each dowel intended to move in the concrete, including the dowel end, shall be clean and free from oil, grease, loose rust, and other foreign material and shall be painted with two coats of bituminous emulsion prior to placing concrete.

The unpainted portion of all dowel bars shall be clean and free from oil, grease, loose rust, and other foreign material when the concrete is placed to permit maximum bonding with the concrete.

9.3.10 Protection of Plastic and Hardened Concrete Pavement

The pavement shall be protected against all damage during the period that the site is occupied. Unless otherwise approved by the Superintendent, traffic shall be excluded from the pavement by erecting and maintaining barricades and signs until the concrete is at least 7 days old, or for a longer period if necessary to

prevent damage. Irrespective of age, trafficking of pavements by tracked or steel wheeled equipment shall only be permitted if protective matting or timbers are placed under their wheels or tracks.

As a construction expedient in paving intermediate lanes between newly paved lanes, operation of concrete transport vehicles will be permitted on the pavement after the concrete has been cured for seven days, provided:

- Evidence that the concrete strength is in excess of the stress developed by the construction equipment;
    - The joints have been sealed or otherwise protected; and
    - All foreign matter including aggregates and concrete are progressively and continuously removed from the area over which traffic is moving.

Upon completion of the new section of concrete and on the same day, the surface of adjacent concrete on which equipment has operated, shall be cleaned and barricades replaced.

Concrete finishing equipment and similar equipment may be permitted to ride upon the edges of previously constructed slabs provided the concrete is more than 72 hours old and has attained a minimum compressive strength of 25MPa, and provided further that adequate means are furnished to prevent damage to the slab edge, and no damage whatsoever to the completed pavement.

The pavement carrying traffic or equipment shall be kept continuously clean using power brooms or suction cleaners, and all spillage of materials or concrete shall be cleaned up immediately upon occurrence. Membrane curing shall be used on such pavements and any breaks or tears in the membrane shall be repaired by re application of the membrane curing compound.

9.3.11 Construction Requirements

a) Pavement Thickness

The concrete pavement shall not be less than the thickness shown on the drawings.

b) Finished Surface Levels

The finished surface levels on the concrete shall be within the tolerance of plus 7mm, minus 5mm of the specified or interpolated design level, and the surface of the concrete pavement shall not pond water.

c) Surface Shape

The finished surface of all concrete pavement shall not deviate from the testing edge of a 3m straight edge by more than 5mm.

9.4 Quality Assurance

9.4.1 Requirements

The Contractor shall implement a quality Assurance program in accordance with Section 2 of this Specification.

This program shall comprise Pre-Commencement Phase, Production and Process Control and Post-Construction phases as defined below:

9.4.2 Pre-Commencement Phase

a) Supply of Information on Materials Sources

The following information shall be supplied for the concrete:

- The supplier of the concrete;

- Location of the ready mix concrete plant; and
- A statement providing details of the concrete mix to be used.

9.4.3 Production and Process Control Phase

a) Program

The Contractor's production and process control program shall consist of sampling and testing the materials and product, and a continuous assessment of the adequacy of the production control. The Contractor is responsible for designing and implementing a control program which provides adequate and effective control over the works, however the minimum amount of control testing that shall be undertaken is set out in this section of the Specification.

If at any time during the production of materials the control program being undertaken by the Contractor is inadequate, the Superintendent may order the Contractor to cease production and/or the delivery of materials to the works.

The Contractor shall keep a record upon a plan of the works, of where each work shift's production has been incorporated in the works.

If the control results indicate that the materials being produced are not in accordance with the requirements of the Contract then the Contractor shall record a non-conformance and shall not incorporate the materials represented by those test results into the works. The Contractor shall modify the manufacturing process so that conforming materials are produced.

b) Slump

Concrete shall be tested for slump in accordance with the requirements of Section 5.2 of Australian Standard 1379.

c) Strength of Concrete

Concrete tested for strength as specified shall be assessed for compliance with the strength provisions of this Specification in accordance with the rules for project assessment of strength grade as detailed in Section 6.5 of Australian Standard 1379.

9.4.4 Post-Construction Phase

a) Finished Surface Levels

The finished surface of the concrete shall conform to the grades and levels specified within the tolerances specified in the above sub clause.

b) Surface Shape

The finished surface of the concrete shall conform to the specified tolerances in the above sub clause.

c) Quality Assurance Records

Within 3 weeks of completion of the Works, the Contractor shall supply two copies of a report detailing the results of all quality control and testing undertaken.

d) Non-Conforming Materials and Work

All non-conforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Specification.

10. Concrete for siteworks

10.1 General

10.1.1 Scope

This Section specifies requirements for supplying and placing Portland Cement concrete for miscellaneous site work structures such as pits, kerbing, minor footings, headwalls or similar.

10.1.2 Standards, Codes and Referenced Specifications

The following documents which are referenced in this section form part of this Specification only to the extent that they are referred to herein:

Australian Standards*:*

Australian Standard 1012.1 Methods of testing concrete

Australian Standard 1302 Steel reinforcing bars for concrete

Australian Standard 1303 Steel reinforcing wire for concrete

Australian Standard 1304 Hard-Drawn Steel Wire Reinforcing Fabric for Concrete

Australian Standard 1379 Specification and supply of concrete

Australian Standard 2758 Aggregates and rock for engineering purposes

Australian Standard 2758.1 Aggregates and rock for engineering purposes Concrete aggregates

Australian Standard 3600 Concrete structures

Australian Standard 3610.1 Formwork for Concrete

Australian Standard 3972 Portland and blended cements

10.1.3 Working near Public Trees

When working in the vicinity of public trees, an arborist from the Urban Forest and Ecology team must be notified, if:

- Roots are exposed during works
- Damage could occur, or has occurred, to tree roots
- Tree plot sizes require alteration
- Soil levels require alteration

10.2 Materials

10.2.1 General

Cement shall be normal Portland Cement Type GA complying with Australian Standard 3972.

Fine Aggregate shall conform to the requirements of Australian Standard 2758.1.

Coarse Aggregate shall comply with the requirements of Australian Standard 2758.1.

Ready Mixed Concrete shall comply with the requirements of Australian Standard 1379.

Steel reinforcement shall comply with the relevant standards Australian Standard 1302, Australian Standard 1303 and Australian Standard 1304 and shall be thoroughly cleaned of rust, scale and any other coating which may destroy bond with the concrete.

Cement grout shall consist of cement and water mixed to form a creamy consistency.

10.2.2 Concrete Properties

The concrete used in the work shall be ready-mixed concrete manufactured, supplied and delivered in accordance with Australian Standard 1379. Ready-mixed concrete shall be delivered to the site in trucks of the revolving drum type.

The concrete shall comply with the following requirements:

- Slump 100mm (unless otherwise specified)
    - Nominal maximum aggregate size 20mm
    - Suitable for placement by manual methods
    - Subject to production assessment of strength.

Notwithstanding the provisions of Australian Standard 1379, all concrete shall be completely discharged within 60 minutes of the introduction of the cement to either the aggregate or the mixer. There shall be no addition of water or any other material to the concrete on the site.

10.2.3 Water

Water for mixing and curing concrete shall be clean, fresh and free from injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances. Water approved by Public Health Authorities for domestic consumption will be accepted for use without being tested. Water of questionable quality shall be tested prior to use in the work.

10.2.4 Admixtures and Colourings

Where specified in the Drawings, ‘charcoal’ or grey coloured concrete shall be achieved by adding 15 kg/ cu m black oxide Bayer 318 or approved equivalent. Coloured rendering of the surface (only) will not be accepted.

The use of any other admixtures to the concrete shall be subject to the approval of the Superintendent.

10.3 Construction

10.3.1 General

Concrete work shall be constructed accurately in locations and to the dimensions and details shown.

10.3.2 Formwork

The design, fabrication, erection and strutting of formwork and falsework shall be in accordance with the requirements of Australian Standard 3610.1.

Formwork shall conform to the shape, lines, levels and dimensions required in the finished structure and shall be constructed of approved timber or metal. Forms shall be clean, substantial and the inside left clean, smooth, watertight and of sufficient strength to resist springing out of shape during and after the placing of concrete.

Dirt, chips, sawdust, nails or other foreign material shall be completely removed before any concrete is deposited. Before concrete is placed in forms, inside surfaces of the forms shall be thoroughly coated with oil or other approved agent which will permit the ready release of the forms and will not discolour or damage the concrete.

Unless otherwise shown, forms shall be chamfered for re-entrant angles and filleted for corners. The face of the bevel in each case shall be 20mm. Core holes and embedded items shall be installed where shown.

The formwork for each monolithic section of the work shall be completely constructed before concreting of that section is commenced.

Immediately before placing concrete, the forms shall be thoroughly wetted with water. Forms shall not be removed until the concrete has adequately hardened.

10.3.3 Placing of Reinforcement

Reinforcement shall be formed to the dimension and shapes shown in accordance with the requirements of Australian Standard 3600. Reinforcement shall be accurately placed in the positions shown and shall be securely held in position by wiring, or blocking from the forms and wired together at alternate intersections with annealed iron wire of not less than 1.6mm diameter so that it will not be displaced during the placing and compacting of concrete. Welding, tack welding or heating of reinforcement is prohibited.

Metal supports which extend to the surface of the concrete and wooden supports shall not be used. Placing bars on layers of fresh concrete as the work progresses and adjusting bars during placing of concrete shall not be permitted. Where necessary the reinforcement shall be spliced with the following minimum lap:

- Steel reinforcement – 40 times nominal diameter of bar.

Steel fabric reinforcement – 225mm measured between outer most wire of each sheet.

Unless otherwise shown, the minimum clear cover to reinforcement shall be 1.5 times the diameter of the bars with a minimum of 30mm.

10.3.4 Placing of Concrete

Concrete shall be transported and placed in accordance with the requirements of Australian Standard 1379.

Concrete shall be placed continuously against fresh concrete between approved or specified construction joints to form a monolithic section. Concrete shall be deposited as nearly as practicable in its final position. Free dropping of concrete from a height greater than 1 metre or depositing a large quantity to be worked along the forms for excessive distances shall not be permitted. Concrete shall be placed and compacted in such a manner as not to displace any reinforcement.

Concrete which has developed its initial set, or which is not placed in the forms and compacted within 20 minutes after discharge from the mixer, or which has been contaminated by foreign materials, shall not be used.

Placing of concrete shall not be commenced while the ambient air temperature is less than 10°C or higher than 30°C without prior approval from the Superintendent.

10.3.5 Compaction of Concrete

During and immediately after placing, concrete in formwork shall be compacted with approved high frequency internal vibrators and tamped. Finished concrete shall fill formwork with a dense homogenous mixture entirely free of voids.

Sufficient vibrators, including standby vibrators, shall be available on the site prior to the commencement of concreting. Vibrations shall not be applied directly or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration. Vibration

shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation.

10.3.6 Construction Joints

Wherever concrete placing has stopped, and concrete has taken its initial set, this joint shall be deemed a construction joint. The location and detail of construction joints shall be as required or approved by the Superintendent.

In the event of any emergency necessitating a special construction joint, mixing and concreting shall proceed until a location for the special construction joint approved by the Superintendent is reached. The placing of concrete shall proceed continuously from joint to joint.

Before placing new concrete against concrete which has set, the forms shall be tightened and the surface of the set concrete shall be roughened, cleaned of foreign matter, laitance and loose or porous material. The surface shall be covered uniformly with a thin coat of cement grout to the satisfaction of the Superintendent and concreting shall proceed immediately.

10.3.7 Protection and Curing

Exposed faces of freshly placed concrete shall be protected against loss of moisture or damage by rain, by covering with polythene film, wet hessian or other approved material, immediately following the finishing operation. The protection shall be maintained in place for a curing period of seven days, unless a shorter period is authorised by the Superintendent. Concrete surfaces not covered shall be kept moist by flushing or sprinkling.

Throughout the curing period hessian or similar covering shall be continuously maintained in a wet condition while waterproof coverings such as polythene shall be removed once each day and the concrete surface thoroughly wetted.

The concrete temperature of the surface of the setting concrete shall be maintained above 4.5□C.

Unless otherwise specified in the Contract documents or approved by the Superintendent, pedestrian traffic shall not be permitted on fresh concrete for a period of at least 24 hours nor vehicle traffic for a period of at least seven days. The Contractor shall provide, erect and maintain all necessary barriers, flags etc. to ensure traffic is controlled.

10.3.8 Finishing

Concrete surfaces shall be true and even, free from honeycombed surface, depressions or projections. Unexposed formed surfaces not specified to be rendered shall be given a Class 4 finish, and all exposed surfaces not specified to be rendered shall be given a Class 3 finish as specified in Australian Standard 3610.1.

10.4 Quality Assurance

10.4.1 Requirements

The Contractor shall implement a quality Assurance program in accordance with Section 2 of this Specification.

This program shall comprise Pre-Commencement Phase, Production and Process Control and Post-Construction phases as defined below:

10.4.2 Pre-Commencement Phase

a) Supply of Information on Materials Sources

The following information shall be supplied for the concrete:

- The supplier of the concrete;
- Location of the ready mix concrete plant;
- A statement providing details of the concrete mix to be used.

10.4.3 Production and Process Control Phase

a) Program

The Contractor's production and process control program shall consist of sampling and testing the materials and product, and a continuous assessment of the adequacy of the production control. The Contractor is responsible for designing and implementing a control program which provides adequate and effective control over the works, however the minimum amount of control testing that shall be undertaken is set out in this section of the Specification.

The Contractor shall keep a record upon a plan of the works, of where each work shift's production has been incorporated in the works.

b) Strength of Concrete

Concrete tested for strength as specified shall be assessed for compliance with the rules for Production Assessment of strength grade as detailed in Section 6.3 of Australian Standard 1379.

10.4.4 Post-Construction Phase

a) Tolerances

The deviation of any point on the surface of a concrete element from its position in space as shown shall not exceed 20mm.

The relative deviation of any two points on the surfaces of the concrete element from the position shown or directed shall not exceed 3.5mm.

The misalignment between face linings at the joints in the formwork facing panels and the size of fins and recesses at joints resulting from the formwork joint sealer not being flush with the formed surfaces shall not exceed 3.0mm.

b) Quality Assurance Records

Within 3 weeks of completion of the Works, the Contractor shall supply two copies of a report detailing the results of all quality control and testing undertaken.

c) Non-Conforming Materials and Work

All non-conforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Specification.

11. Kerb and channel units

11.1 General

11.1.1 Scope

This section specifies requirements for the supply and laying of bluestone and precast concrete kerb and channel units and bluestone pitcher channels.

11.1.2 Standards, Codes and Referenced Specifications

The following documents which are referenced in this section form part of this Specification only to the extent that they are referred to herein:

Australian Standards*:*

Australian Standard 1302 Steel Reinforcing Bars for Concrete

Australian Standard 1379 Specification and Supply of Concrete.

City of Melbourne:

Technical Specification: Sawn Bluestone Paving, Kerbing and Gutterstone Material:

https://www.melbourne.vic.gov.au/SiteCollectionDocuments/bluestone-paving-technical-specification.pdf

11.1.3 Working near Public Trees

When working in the vicinity of public trees, an arborist from the Urban Forest & Ecology team must be notified, if:

- Roots are exposed during works
- Damage could occur, or has occurred, to tree roots
- Tree plot sizes require alteration
- Soil levels require alteration

11.2 Materials

11.2.1 Bedding Concrete

Concrete shall be N20 standard strength grade, 30mm Slump, complying with the requirements of Australian Standard 1379.

11.2.2 Bluestone Kerb and Channel Units

a) Source Material

Bluestone kerb and channel units shall be the product of machining sound natural basaltic stone. The basalt stone used to produce kerb and channel units shall have the following qualities:

- Appearance shall be grey, sound, fine grained and free of veining, fracture lines or other defects considered injurious to strength;
- Secondary Minerals Content shall be maximum 2% by volume;
- Bulk Density shall be minimum 2.0 t/cu.m;

- Water Absorption shall be maximum 2.5% by weight;
- Flexural Strength shall be minimum 11MPa (both dry and soaked); and
- Abrasion Resistance shall be 30 (as determined by the Taber abrader method).

The basalt shall be quarried only with black powder or other approved soft blasting technique and not supplied from a quarry used for aggregate.

b) Surface Finish

Bluestone kerb and channel units shall be diamond sawn finished with a 2mm chamfer on all edges. The external (visible) face of each bluestone unit shall:

- have less than 30% surface perforations by area;
- have no cats paws exceeding 5mm in diameter;
- not exhibit any signs of mortar fill in surface perforations or vesiculations; and
- be free of saw marks, chips or other defects.

c) Standard Dimensions, Geometry and Tolerances

Bluestone kerb and channel, as specified in the Drawings, shall be manufactured in accordance with the following:

- Kerb stone standard unit dimensions and tolerances:
  - 300mm (wide) * 1mm x 300mm (deep) * 5mm
  - 200mm (wide) * 1mm x 300mm (deep) * 5mm
- Channel gutterstone standard unit dimensions and tolerances
  - 300mm (wide) * 1mm x 100mm (deep) + 5mm, -0mm
  - 250mm (wide) * 1mm x 100mm (deep) + 5mm, -0mm
- Kerb and channel unit length shall be no less than 800mm and no greater than 1200mm.
- The face edge of the top surface of kerb shall be finished with a 25mm radius bullnose.
- The ends of straight kerb and channel stones shall be cut square to the long edge such that the two diagonals across each face are equal in length.
- The ends of radial stones shall be cut along the radial line
- The radius of radial stones shall be measured to the face (outside edge) of the unit.
- Special pieces required for access ramps and overflow kerbs shall be cut to meet the requirements of the drawings

Bluestone suppliers must demonstrate, to the satisfaction of the Superintendent, an ability to produce material at the rate required to meet the Contractor's approved construction program and compliance with the technical requirements of this section of the Specification. The Contractor shall be responsible and liable for the timeliness and quality of the supplied material.

11.2.3 Bluestone Pitchers

Bluestone pitchers shall be worn, rounded second hand basalt blocks, approximate size 25x25x25 cm, and shall comply with City of Melbourne Bluestone Paving Technical Specification.

11.2.4 Cut Bluestone pitchers

Cut bluestone pitchers shall be specified with a maximum cut of 20mm to the top exposed face and laid in accordance with City of Melbourne Bluestone Paving Specification and CoM standard drawing 1P50410.

11.2.5 Over Exposed Aggregate Concrete Kerb

a) Concrete

Concrete shall be N40 standard strength grade complying with the requirements of Australian Standard 1379.

b) Reinforcement

Steel reinforcing bars shall comply with Australian Standard 1302.

c) Surface Finish

The appearance of the exposed aggregate concrete kerb shall be similar to the existing kerb at the following two intersections:

- Capel/Courtney Streets, North Melbourne; and
- King/Curzon/Victoria Streets, North Melbourne.

The following aggregate specification shall be adopted to produce the required exposed aggregate surface finish:

- Fine and course aggregates shall be bluestone colour only (mid to dark tone) and free of light coloured materials such as silica;
- Coarse aggregate shall be 14mm nominal size crushed basalt (bluestone); and
- Aggregates shall comprise at least 40% of the surface area of the top and front faces of the kerb and shall be exposed through either a wet or dry sandblast of the kerb faces to achieve the required surface appearance.

d) Standard Dimensions, Geometry and Tolerances

Precast exposed aggregate shall manufactured in accordance with Drawing No. 1D 13264 and the following:

- Kerb stone standard unit dimensions and tolerances:
    - Straight Units -200mm (wide) at top * 1mm x 300mm (deep) * 2mm x 1000mm (length) * 2mm
    - Corner Units -200mm (wide) at top * 1mm x 300mm (deep) * 2mm x 610mm (radius) * 2mm
- The face edge of the top surface of kerb shall be finished with a 40mm radius bullnose;
- The ends of straight units shall be square to the long edge such that the two diagonals across each face are equal in length;
- The ends of radial stones shall be along the radial line;
- The radius of radial stones shall be measured to the face (outside edge) of the unit;
- Special pieces required for access ramps and overflow kerbs shall be cut on site to meet the requirements of the drawings; and
- Closure units (residual pieces) or access ramps segments shall be no less than 500mm in length.

Suppliers must demonstrate, to the satisfaction of the Superintendent, an ability to produce material at the rate required to meet the Contractor's approved construction program and compliance with the technical requirements of this section of the Specification. The Contractor shall be responsible and liable for the timeliness and quality of the supplied material.

11.3 Construction

11.3.1 Setting

Kerb and channel units and bluestone pitchers shall be laid butted together on 20MPa, 30mm slump concrete of 75mm minimum thickness in accordance with the lines, levels and details shown on the Drawings.

Unless otherwise specified on the Drawings, multi-row bluestone pitcher channels shall be laid in a stretcher bond pattern.

The Contractor shall be responsible for setting out control lines to ensure that paving is not out of square before laying. Where paving pattern appears to be ambiguous or does not match adjoining paving, the Contractor must clarify the final layout with the Superintendent before laying.

11.3.2 Setting Tolerances

a) Kerb and Channel Units

The following tolerances shall apply to the setting of kerb and channel units:

- The allowable tolerance of the finished work from line or level at any point shall be + 5mm.
- The maximum allowable joint width between new units shall be 5mm
- The maximum allowable joint width between weathered, second hand units shall be 10mm

b) Bluestone pitchers

Pitcher paving surfaces shall be in accordance with the drawings specified in the Standard Drawing 1P 50407 and City of Melbourne Sawn Bluestone Paving, Kerbing and Gutterstone Materials technical specification and be finished in conformity with the lines, grades and cross sections shown on the drawings within the following limits:

- Paving shall be shaped to match the level of existing fixtures, (e.g. pit covers, kerb, edgings, existing building line) to within 5 mm. Elsewhere the deviation of the finished work from line or level shall not exceed 20 mm at any point, and the rate of change of deviation from line or level shall not exceed 20 mm in 10 m or 2 mm between adjacent blocks. Except on curves or in shaped areas, the deviation of the finished work from a 3 m straightedge shall not exceed 15 mm at any point.
- Unless otherwise specified, all paving shall be shaped to shed surface water from the entire paved area in the direction of natural slope or towards constructed surface drains. The slope at any point on the paving except on a ridge shall be not less than 1%.
- Cut Bluestone Pitchers

Where specified the paved surface may shall be cut bluestone pitchers in accordance with the drawing specified in Standard Drawing 1P 50410.

Where pitchers are to be supplied, their size shall be 250(W) x 300(L) x 250(D) and have a maximum of 20mm cut at the surface to achieve a smooth finish.

Where existing pitchers are to be used a maximum of 20mm cut at the surface shall be done to achieve a smooth finish.

11.3.3 Joints

a) Kerb and Channel Units

Joints between kerb units and between channel units shall not be grouted unless approved by the Superintendent. The Superintendent may permit the filling of joints in cases where short straight units are used to form long sweep radials. The fill material shall be an approved proprietary brand product.

b) Pitcher Channels

Joints between bluestone pitchers shall be filled with a plant mixed grout, comprising by weigh of 16% cement, 16% stone dust, 67% blended washed sand and 1% lime. “Readymix Bluestone Grout” or equivalent to be broomed or by other appropriate tools into the joints to the satisfaction of the Superintendent.

The pitcher surface shall be thoroughly washed and cleaned after the grouting has set in accordance to the Superintendent’s satisfaction to ensure no cement stains remain. Runoff from any such washing shall be directed away from Tree protection zones.

Where the channel pitchers or pitcher pavement adjoins a roadway, the Contractor shall take the necessary precautions to ensure that no washed-off materials are deposited / spilled to the adjoining surface.

11.3.4 Cutting

Cutting of kerb and channel units and pitchers may be required to suit the geometry of the work or to square off the ends of weathered, second hand kerb to meet setting tolerances specified above. The Contractor shall comply with the following requirements with respect to cutting of kerb and channel units:

- Closure units (residual pieces) or access ramps segments shall be no less than 500mm in length.
    - For all other applications, kerb and channel unit length shall be no less than 800mm in length
    - Units cut on site shall be cut wet in a contained area, to minimise nuisance caused by dust.

11.4 Quality Assurance

11.4.1 Requirements

The Contractor shall implement a Quality Assurance program in accordance with Section 2 of this Specification.

This program shall comprise a Post-Construction phase as defined below:

11.4.2 Post-Construction Phase

- **Tolerances**
    - The deviation of any point on the line or level of the kerb shall not exceed 7mm.
    - The deviation of the finished work from line or level at any point shall be + 5mm.
    - The maximum joint width between new units shall be 5mm
    - The maximum joint width between weathered, second hand units shall be 10mm

- **Quality Assurance Records**

Within 3 weeks of completion of the Works, the Contractor shall supply two copies of a report detailing the results of all quality control undertaken.

- **Non-Conforming Materials and Work**

All non-conforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Specification.

12. Cast-in-situ concrete kerb and channel

12.1 General

12.1.1 Scope

This Section specifies requirements for the supply of all materials and construction of kerb, kerb and channel, and spoon drain.

12.1.2 Standards, Codes and Referenced Specifications

The following documents which are referenced in this section form part of this Specification only to the extent that they are referred to herein:

Australian Standards*:*

Australian Standard 1152 Specification for Test Sieves

Australian Standard 1379 Specification and Supply of Concrete.

12.1.3 Working near Public Trees

When working in the vicinity of public trees, an arborist from the Urban Forest and Ecology team must be notified, if:

- Roots are exposed during works
- Damage could occur, or has occurred, to tree roots
- Tree plot sizes require alteration
- Soil levels require alteration

12.2 Materials

12.2.1 Concrete

Concrete shall be N20 standard strength grade complying with the requirements of Australian Standard 1379.

12.2.2 Bedding Material

Bedding material shall consist of crushed rock pavement material.

12.2.3 Colourings

Where specified in the Drawings, ‘charcoal’ or grey coloured concrete shall be achieved by adding 15 kg/cu.m black oxide Bayer 318 or approved equivalent. Coloured rendering of the surface (only) will not be accepted.

12.2.4 Render

Render shall consist of one part coarse sand, one part bluestone dust and one part cement measured by weight and mixed thoroughly with water to form a smooth paste.

Where applicable, Black oxide Bayer 318 (or approved equivalent) shall be added to the render, in appropriate proportions, to match the colouring of the grey concrete specified in the above sub clause.

12.3 Construction

12.3.1 Bedding Preparation

Where kerb, kerb and channel or open invert drain is located so that the underside will be located on compacted crushed rock pavement material with not less than 75mm thickness, the pavement material shall form the bedding and shall be trimmed to the appropriate levels and grades.

Elsewhere the material beneath the kerb shall be excavated to a minimum depth of 75mm and sand bedding material shall be placed and compacted to dry density ratio of 95 percent using Modified Compactive Effort to finish at the appropriate levels and grades.

The bedding shall be moistened immediately before concrete is placed. There shall be no free water on the surface of the bedding.

12.3.2 Profile Dimensions, Line and Level

Kerb, kerb and channel and spoon drain profile dimensions, lines and levels shall be in accordance with the details on the Drawings.

12.3.3 Formwork, Reinforcement, Placement and Compaction

Formwork, reinforcement, placement and compaction for the construction of kerb, kerb and channel and spoon drain shall be in accordance with ‘Concrete for Siteworks’ section of this specification.

12.3.4 Kerb Extrusion Machine

The Contractor may carry out all of the concrete edging works with an approved kerb making machine. This machine shall be capable of producing kerbing and channelling without the use of formwork of any kind.

The machine shall be operated under sufficient uniform restraint to forward motion to provide a well compacted mass of concrete free from surface pitting larger than 5mm diameter.

12.3.5 Jointing

Joints shall be provided:

- each side of each vehicular or perambulator crossing;
    - at the tangent point of all curves;
    - regularly at intervals not exceeding 2.5 metres throughout;
    - to match the joints in concrete road pavements; and
    - at each end of kerb transition zones.

Joints shall cut between 40% and 70% of the area of the section and shall be constructed by a method which does not damage or distort the adjacent surfaces.

The resultant slot shall be tooled to a depth of 20mm to produce a neat groove not less than 5mm wide.

12.3.6 Finishing – Rendered and Exposed Aggregate

a) Rendered Finish

Unless otherwise specified, the surface finish shall be obtained by applying 3mm maximum render to the exposed surfaces.

This rendering is to be trowelled within 30 minutes to a smooth surface, free from trowel marks, rough spots, irregularities or places which would pond water at any time.

Moulding and chamfering of angles as shown is to be done with trowels made for the purpose. On grades exceeding 3 percent the work shall proceed up the gradient so as to prevent creeping of concrete.

b) Exposed Aggregate Finish

Where exposed aggregate finish is specified on the Drawings, the surface finish shall be such that it matches Council's standard precast exposed aggregate kerb. The appearance of cast-in-situ concrete kerb shall be similar and comparable to the existing precast concrete kerb at the following two intersections:

- Capel/Courtney Streets, North Melbourne; and
- King/Curzon/Victoria Streets, North Melbourne.

The exposed aggregate surface finish may be obtained by gentle washing of the surface after initial set, by use of retardants or other approved method.

12.3.7 Protection and Curing

The Contractor shall make all the necessary provisions for the proper protection and curing of the concrete in accordance with 'Concrete for Site works' section of this specification.

12.3.8 Tolerances

The allowable tolerance of the finished work from line or level at any point shall be 7mm. The tolerance on all dimensions shall be +7mm.

12.4 Quality Assurance

12.4.1 Requirements

The Contractor shall implement a Quality Assurance program in accordance with Section 2 of this Specification.

This program shall comprise a Post-Construction phase as defined below:

12.4.2 Post-Construction Phase

a) Tolerances

The deviation of any point on the line or level of the kerb shall not exceed 7mm.

b) Quality Assurance Records

Within 3 weeks of completion of the Works, the Contractor shall supply two copies of a report detailing the results of all quality control and testing undertaken.

c) Non-Conforming Materials and Work

All non-conforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Specification.

12.5 Kerb Works and Protection Requirements around Existing Trees

12.5.1 Pre-Works Protection

Before working around trees, contact Council's Urban Forest and Ecology Arborist to conduct a pre-commencement works inspection. The trunks of all trees with a Tree protection zone within the works area are

to be wrapped with padding (such as hessian or equivalent) to prevent bark damage from blunt trauma, consistent with Australian Standard 4970. Vertical timber battens are then to be installed to a height of no less than 2m. The battens shall be placed no more than 30mm apart and will surround the entire trunk. These are to be secured with strapping (or equivalent); no nails or screws are to be used to attach the battens into trees.

12.5.2 Permeable Area

Construction activity should exclude all permeable areas (i.e. garden bed, tree plot or mulched area) that occur within the Tree protection zone of a public tree. For an explanation of a Tree protection zone, see: https://www.melbourne.vic.gov.au/sitecollectiondocuments/tree-protection-fact-sheet-service-contractors.pdf.

Materials, equipment, waste or soil must not be placed, stored or stockpiles within the permeable area. No refuelling of equipment can occur in this area. Existing soil heights within the permeable area must not be altered. All vehicles and machinery must traffic existing hard surfaces and must not park or drive across the permeable surfaces.

12.5.3 Demolition

Where tree roots are likely to be growing behind and under the existing kerb and under the existing asphalt, exercise care during kerb and asphalt demolition to prevent damage to roots. Remove sections of kerb by lifting and/or rolling sections away from the tree using an excavator (or equivalent). Hydraulic hammers must not be used. Saw cut kerb stone where necessary to reduce them to a suitable size for handling by machinery. Carefully strip asphalt surface.

12.5.4 Where Parts of the Tree Encase or Hold the Kerb Stone

The kerb is to be left in situ and saw cut close to the tree ensuring no damage occurs to any part of the tree. The kerb that is left in situ is to be buried within the works.

12.5.5 Large Tree Roots

If any roots over 30mm in diameter are encountered that may be impacted by the works, the contractor must stop and contact a City of Melbourne arborist (9658 8714) to inspect the levels of likely impact and advise on tree impact mitigation options.

12.5.6 Inspection

On completion of demolition, a City of Melbourne arborist must assess root growth and provide direction on where soil excavation can occur within the area of the new permeable area. Contact Council's Urban Forest and Ecology Arborist (9658 8714) to arrange the inspection, allowing at least five working days' notice.

12.5.7 Exposed Root Protection

Cover exposed roots to prevent them from drying out until soil is installed. Suitable covering materials include jute mesh or layers of hessian that are anchored in place and kept moist. Where contact with roots and concrete or corrosive materials may occur, a protective and waterproof membrane must be installed between the material and any exposed roots that are greater than 30mm in diameter.

12.5.8 Excavation in the Vicinity of Trees

All soil approved excavation must be toothless bucket on an excavator (or equivalent) to reduce damage to existing roots. Contact Council's Urban Forest and Ecology Team on 9658 8714 to arrange arborist supervision, allowing at least five working days' notice.

13. Block paving

13.1 General

13.1.1 Scope

This section specifies the requirements for paving footpaths and roadways using manufactured paving blocks.

13.1.2 Standards, Codes and Referenced Specifications

Australian Standards*:*

The following Australian Standard is referenced in this section of the Specification:

Australian Standard 1289 Methods of Testing Soils for Engineering Purposes.

13.1.3 Working near Public Trees

When working in the vicinity of public trees, an arborist from the Urban Forest and Ecology team must be notified, if:

- Roots are exposed during works
- Damage could occur, or has occurred, to tree roots
- Tree plot sizes require alteration
- Soil levels require alteration

13.2 Materials

13.2.1 Sand

Sand shall be natural or manufactured (crushed) material, complying with the properties herein specified.

The particle size distribution of the sand when tested in accordance with Australian Standard 1289 shall comply with the limits listed in the table below and shall be free from all clay, dirt, organic and other deleterious matter.

AS Sieve Size (mm)	Percentage Passing by Mass
9.5	100
4.75	95-100
2.36	80-100
1.18	50-85
0.600	25-60
0.300	10-30
0.150	5-15
0.075	0-10

Single size or gap-graded sands, or sand containing an excess amount of fines shall not be used. The sand particles shall be sharp, not rounded. Sand shall be washed free of soluble salts or other contaminants which can cause or contribute to efflorescence.

13.2.2 Cement

Cement shall be normal Portland Cement Type GA complying with Australian Standard 3972.

13.2.3 Water

Water used for mixing mortar, grout or slurry materials shall be clean, fresh and free from injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances. Water approved by Public Health Authorities for domestic consumption will be accepted for use without being tested. Water of questionable quality shall be tested prior to use in the work.

13.2.4 Bedding Mortar

The mortar bed shall consist of, in measures by volume;

- 2 parts Fine Washed Sand;
    - 1 part Brick Sand; and
    - 1 part Portland Cement Type GA.

Mixing shall be performed in a cement mixer, free of fresh or loose mortar residues, by adding the aggregates to the liquid (which shall initially be proportioned as one part by volume) whilst mixing continuously to ensure a homogeneous consistency free of lumps.

Water may be added in specified proportions to impart to the mix a consistency such that it may be loosely hand shaped into a “cricket ball” which will remain whole when released whilst leaving hand slightly moist (not wet).

The amount of mix shall not exceed the quantity to lay pavers within 45-60 minutes, depending on climatic conditions.

All components shall be measured by means of calibrated containers.

13.2.5 Bonding Slurry

A bonding slurry shall be applied at the interface of the in-situ concrete base and the bedding mortar and at the interface of the bedding mortar and the paver.

The bonding slurry shall consist of, in measures by volume;

- part Fine Washed Sand; and
    - part Portland Cement Type GA.

Mixing shall be performed either by hand, using a clean container and mixing tool, or in a cement mixer by adding sand and cement to the liquid (which shall be initially proportioned as one part by volume) whilst mixing continuously to ensure a smooth, homogeneous consistency, free of lumps.

The amount of mix shall not exceed the quantity to lay pavers within 45 to 60 minutes, depending on climatic conditions.

All components shall be measured by means of calibrated containers.

13.2.6 Joint Grout

The joint grout shall be a dry mix bagged proprietary brand fine aggregate/cement/admixtures type grout, DURABED Ormonoid or approved equivalent, with high flow and low shrink properties, non-staining in the course of its application and of a compressive strength in excess of 20 MPa at 7 days. Mixing shall be in accordance with manufacturer’s specifications.

DURABED Ormonoid is distributed by Davco Construction Materials Ltd, 237-239 Frankston-Dandenong Road, VIC 3175. Tel 61-3-9706 8577

Site mixed grout shall not be used to fill joints.

13.2.7 Bluestone Paving Units - Refer to Section 20

13.2.8 Bluestone Pitchers

Bluestone pitchers shall be worn, rounded second hand basalt blocks, approximate size 25x25x25 cm, similar to pitchers found extensively throughout the City of Melbourne.

13.2.9 Precast Concrete Paving Units

a) Surface Finish

Precast concrete paving units shall have an exposed aggregate finish to match existing pavers laid along the Southbank Promenade in Melbourne.

The wearing surface of each precast concrete unit shall not exhibit any signs of mortar fill in surface imperfections and shall be free of chips, scratches or other defects.

b) Dimensions and Tolerances

Precast concrete paving units, as specified in the Drawings, shall be manufactured to the following dimensions and tolerances:

- 500mm * 1.5mm (length) x 500mm * 1.5mm (width) x 50mm (thick) + 32mm, –0mm

Precast concrete paving units shall have both diagonals equal and all surfaces square to each other. The units shall have a nominal 3mm chamfer on all edges.

The maximum deviation from a 350mm straight edge placed in a central position on the wearing surface of each unit shall not exceed 3mm.

c) Concrete Strength

The minimum 28 day characteristic compressive strength of the concrete shall be 40MPa.

The maximum tensile stress in the concrete units resulting from fabrication, handling or stacking shall be not be greater than 1.95MPa, so that no cracking occurs.

d) Approved Suppliers

Approved suppliers must demonstrate, to the satisfaction of the Superintendent, an ability to produce paving units at the rate required to meet the Contractor's approved construction program and compliance with the technical requirements of this section of the Specification. The Contractor shall be responsible and liable for the timeliness and quality of the supplied material.

13.3 Construction

13.3.1 General – Block Tile Paving

Block tile paving units shall be laid on a 25mm nominal thickness mortar bed over a concrete base pavement in accordance with the Drawings and relevant sections of this Specification.

13.3.2 Paving Layout

Tile paving units shall be laid perpendicular to the alignment of the kerb. Unless otherwise stated on the Drawings, the paving pattern shall be stretcher bond commencing with half and whole pavers from the back of kerb. The Contractor shall be responsible for setting out control lines to ensure that paving is not out of square before laying. Where paving pattern appears to be ambiguous or does not match adjoining paving, the Contractor must clarify the final layout with the Superintendent before laying. Where applicable, paving shall commence from the street corner to match corner herringbone pattern.

13.3.3 Surface Finish

All surfaces shall be finished in conformity with the lines, grades and cross sections shown on the drawings or specified within the following limits:

Paving shall be shaped to match the level of existing fixtures, (e.g. pit covers, kerb, edgings, existing building line) to within 5 mm. Elsewhere the deviation of the finished work from line or level shall not exceed 20 mm at any point, and the rate of change of deviation from line or level shall not exceed 20 mm in 10 m or 2 mm between adjacent blocks. Except on curves or in shaped areas, the deviation of the finished work from a 3 m straightedge shall not exceed 15 mm at any point.

Unless otherwise specified, all paving shall be shaped to shed surface water from the entire paved area in the direction of natural slope or towards constructed surface drains. The slope at any point on the paving except on a ridge shall be not less than 1%.

Where median or other surfacing is to be constructed between edge sections of substantially the same level, the paving shall be crowned to produce a cross fall towards the edges not exceeding 3% and not less than 1%.

13.3.4 Laying Tile Paving Units

Tile paving units shall be:

- Fully bedded in a sand/cement mortar mix of a nominal compacted thickness of 25mm and a maximum compacted thickness of 50mm;

Placed so that the units are spaced 5mm apart (joint width = 5mm);

Laid within 2 hours from the time the cement is mixed with the sand and

Laid in accordance with the following installation procedure:

  - Sweep the concrete base pavement and remove all foreign materials
  - Dampen the concrete base pavement with clean water. Using a hand broom, apply the slurry mix, approx. 1mm thick, to the base pavement area about to be paved
  - With the slurry still wet, place the mortar mix into position and loosely screed so that combined bed and stone thickness is higher than desired surface level by approximately 5mm
  - Bed down dry stone (moist is acceptable but not soaked) and hit evenly over whole stone surface with a rubber mallet to approximately 2mm higher than desired finished surface level
  - Remove stone, by means of lifting tool or by hand, fill voids with additional mortar and then loosen up bed slightly by criss-crossing hand trowel through bed
  - Apply coating of slurry to underside of the paver ensuring that the initial application is stiffly brushed into the stone in a rotating motion, and build up slurry to approximately 1mm thickness
  - Bed down stone as per step (5) to finished surface level.
  - Fill any voids with mortar at front edge and/or front corners of stone with a trowel

13.3.5 Grouting of Joints

Joints between tile paving units shall be grouted, no less than 12 hours after paving, in accordance with the following procedure:

- Remove all foreign materials within the joints;
  - Dampen joints with sponge and pour grout mix into joints ensuring full penetration for the thickness of the paving slab by lightly tamping down a trowel edge into the grouting mix;

- Using a rubber squeegee or similar tool, spread grout evenly into all joints until filled flush with the top of the paving unit;
- Remove excess grout, allow initial set and lightly broom off remaining excess perpendicular to joints; and
- Wipe paving units clean with damp sponge.

13.3.6 Bluestone Pitcher Paving

Unless otherwise specified on the Drawings, bluestone pitchers shall be laid butted together in a stretcher bond pattern on 20MPa, 30mm slump concrete of 75mm minimum thickness in accordance with the lines, levels and details shown on the Drawings.

The Contractor shall be responsible for setting out control lines to ensure that paving is not out of square before laying. Where paving pattern appears to be ambiguous or does not match adjoining paving, the Contractor must clarify the final layout with the Superintendent before laying.

a) Surface Finish

Pitcher paving surfaces shall be finished in conformity with the lines, grades and cross sections shown on the drawings within the following limits:

- Paving shall be shaped to match the level of existing fixtures, (e.g. pit covers, kerb, edgings, existing building line) to within 5 mm. Elsewhere the deviation of the finished work from line or level shall not exceed 20 mm at any point, and the rate of change of deviation from line or level shall not exceed 20 mm in 10 m or 2 mm between adjacent blocks. Except on curves or in shaped areas, the deviation of the finished work from a 3 m straightedge shall not exceed 15 mm at any point.
- Unless otherwise specified, all paving shall be shaped to shed surface water from the entire paved area in the direction of natural slope or towards constructed surface drains. The slope at any point on the paving except on a ridge shall be not less than 1%.

b) Joints

The joints between pitchers shall be filled with a plant mixed grout, comprising by weigh of 16% cement, 16% stone dust, 67% blended washed sand and 1% lime. “Readymix Bluestone Grout” or equivalent to be broomed or by other appropriate tools into the joints to the satisfaction of the Superintendent.

The pitcher surface shall be thoroughly washed and cleaned after the grouting has set in accordance to the Superintendent’s satisfaction to ensure no cement stains remain.

Where the channel pitchers or pitcher pavement adjoins a roadway, the Contractor shall take the necessary precautions to ensure that no washed-off materials are deposited or spilled to the adjoining surface.

13.3.7 Cutting and Grinding

The Contractor is deemed to have made due allowance in his tender price for the cutting of paving units at and around covers, trees surrounds, kerbs, building line and access ramps etc. and the grinding of bluestone paved surfaces to eliminate lips between paving units, particularly at grade transitions. Paving units shall be cut and ground wet to control dust. Diagonal cuts in paving shall not be permitted unless approved by the Superintendent.

13.3.8 Opening of Pavement to Pedestrians

Prior to acceptance for opening to pedestrians all surfaces and pavement structures shall be true to levels, grades, thicknesses and cross-sections shown on the Drawings. All pavements shall be finished to lines and levels nominated to ensure positive drainage to all drainage outlets.

Wooden boards, or similar, shall be placed over paving which is subject to pedestrian traffic within the first 12 hours of curing. No vehicular traffic shall be allowed on the finished pavement for at least 7 days after the pavers have been laid.

13.4 Quality Assurance

13.4.1 Requirements

The Contractor shall implement a Quality Assurance program in accordance with Section 2 of this Specification.

This program shall comprise Pre-Commencement Phase, Production and Process Control and Post-Construction phases as defined below:

13.4.2 Pre-Commencement Phase

Supply of Information on Materials Sources

The following information shall be supplied for the filter material:

- Supplier of paving units;
- Delivery program for paving units; and
- Supplier of grout material.

13.4.3 Production and Process Control Phase

a) Program

The Contractor's production and process control program shall consist of sampling and testing the materials and product, and a continuous assessment of the adequacy of the production control. The Contractor is responsible for designing and implementing a control program which provides adequate and effective control over the works, however the minimum amount of control testing that shall be undertaken is set out in this section of the Specification.

The Contractor shall keep a record upon a plan of the works, of where each work shift's production has been incorporated in the works.

The finished surface shall be tested for smoothness by the Contractor using hand-held straight edges as soon as possible after completion or as required, but not later than the next working day following completion of the block paving. Joints at service intrusions, etc., and joints between the block paving and edge restraints shall be tested immediately on completion using the hand-held straight edge.

Straight edge tests shall be carried out as directed on longitudinal lines parallel to each other and to the centreline of the pavement at not more than two (2) metre intervals.

The transverse smoothness shall be tested at right angles to the centreline of the pavement using a hand-held straight edge at two metre intervals or as directed.

13.4.4 Post-Construction Phase

- **Tolerances**
    - General
        - Each layer shall, after final completion, conform within the following limits to lines, levels, grades, thicknesses and cross-sections specified or shown on the drawings.

- Level
    - The top of each layer shall not vary from the specified level by more than 5mm.
- Shape
    - No point on the finished surface shall lie more than 3mm below a 3m straight edge laid in either the longitudinal or transverse direction of the pavement.

b) Quality Assurance Records

Within 3 weeks of completion of the Works, the Contractor shall supply two copies of a report detailing the results of all quality control and testing undertaken.

c) Non-Conforming Materials and Work

All non-conforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Specification.

14. Stormwater drainage

14.1 General

14.1.1 Scope

This Section specifies requirements for supply of all materials, excavation, installation of drainage pipes, construction of pits and other drainage structures and backfilling necessary to construct the stormwater drainage system.

14.1.2 Overflow Kerb Type Units

City of Melbourne uses predominately two types of overflow kerbs associated with drainage pits, they are:

(a) Bluestone Overflow Kerb - to be used where existing surrounding kerb type is bluestone or proposed kerb is bluestone refer CoM std dwg 1P50320

(b) Precast concrete overflow kerbs to be sourced from manufacturer SVC (refer product code 15.281) with exposed aggregate finish unless noted otherwise

They can be identified by the following codes and description:

(a) Charc. = Charcoal Colour, Off Mould finish

(b) Exp. = Exposed Agg. Standard concrete colour

This shall be in accordance with S.V.C. specifications.

14.1.3 Standards, Codes and Referenced Specifications and Drawings

The following documents which are referenced in this section form part of this Specification only to the extent that they are referred to herein:

Australian Standards*:*

Australian Standard 1289 Methods of testing soil for engineering purposes

Australian Standard 1304 Welded Wire Reinforcement Fabric for Concrete

Australian Standard 1646 Rubber joint rings for water supply, sewerage and drainage purposes.

Australian Standard 3600 Concrete Structures

Australian Standard 3972 General Purpose and Blended Cements

Australian Standard / New Zealand Standard 4058 Precast Concrete Pipes (Pressure and Non-Pressure)

Australian Standard 4139 Fibre Reinforced Concrete Pipes and Fittings

Australian Standard1428.1 Design for Access and Mobility – General Requirements for Access – New Building Work

Australian Standard 4586 Slip Resistance classification of new pedestrian surface materials

Australian Standard / New Zealand Standard 3500.3 Plumbing and Drainage – Stormwater Drainage

Australian Standard / New Zealand Standard 3725 Design for Installation of Buried Concrete Pipes

VicRoads:

Section 701 Underground Stormwater Drains

Section 705 Drainage Pits

Drainage

Stormwater Drainage Design Guidelines:

https://www.melbourne.vic.gov.au/SiteCollectionDocuments/stormwater-drainage-design-guidelines.docx

https://www.melbourne.vic.gov.au/SiteCollectionDocuments/stormwater-drainage-design-guidelines.pdf

Concrete Pipe Association of Australia:

Drawing No. 3 – The Installation of Steel Reinforced Concrete Pipes

14.1.4 Working near Public Trees

When working in the vicinity of public trees, an arborist from the Urban Forest and Ecology team must be notified, if:

- Roots are exposed during works
- Damage could occur, or has occurred, to tree roots
- Tree plot sizes require alteration
- Soil levels require alteration

14.2 Materials

14.2.1 Grated Covers and Trench Grates within Paved Areas

Where located in pedestrian paths, grated covers shall have compliant openings with slots not greater than 13mm orientated transverse to the dominant direction of travel. Where slotted openings are less than 8mm, the length of the slots may continue across the width of path of travel. (Australian Standard 1428.1-2009, Cl 7.5).

Slip resistance rating shall, as a minimum, match the slip resistance of the surrounding pavement to Australian Standard 4586.

14.2.2 Concrete Pipes

Unless otherwise shown on the Drawings, concrete pipes for stormwater drainage shall be rubber ring jointed Class 4 pipes, complying with Australian Standard / New Zealand Standard 4058, Precast Reinforced Concrete Drainage Pipes

Rubber rings for use with rubber ring joints shall be those supplied by the manufacturer of the pipes and shall comply with, Rubber Joint Rings for Water Supply, Sewerage and Drainage Purposes.

14.2.3 Fibre Reinforced Cement (FRC) Pipes

Unless otherwise shown on the Drawings, FRC pipes and fittings shall be Class 4 rubber ring jointed, complying with Australian Standard 4139, Fibre Reinforced Concrete Pipes.

14.2.4 High Density Polyethylene (HDPE) Pipes

HDPE pipes shall be installed as a substitute to RC pipes in accordance with Australian Standard 2033 and to the satisfaction of Council, Council approval must be sought for the installation of HDPE pipes in lieu of concrete pipes.

14.2.5 Box Culverts

Box culvert inverts and lids shall be precast reinforced concrete, complying with Australian Standard 1597.1.

14.2.6 Cement Mortar

Cement mortar shall consist of one part of cement mixed with three (3) parts of sand measured by weight, mixed with sufficient water to achieve an approved consistency. The cement shall be Type GA cement complying with the requirements of Australian Standard 3972, Portland and Blended Cements.

14.2.7 Bedding and Backfill Materials

Bedding material shall be a crushed rock complying with the following grading:

Sieve Size (mm)	Percent Passing (%)
19.0	100
2.36	50-100
0.60	20-90
0.30	10-60
0.15	0-25
0.075	0-10

Backfill material under pavements shall be VicRoads Class 2 Crushed Rock. Backfill material under landscape zones shall be general fill that is free from perishable matter.

14.2.8 Concrete

Concrete for other than pipes shall comply with the requirements of Australian Standard 1379 and Australian Standard 3600.

The concrete shall have the following properties:

- Grade N25
    - Slump 100mm
    - Nominal maximum aggregate size 20mm.

14.2.9 Reinforcement

Reinforcement for other than pipes shall comply with the requirements of Australian Standard 1304.

14.3 Construction

14.3.1 Excavation

a) Excavation for pipe

Trenches, pits and other drainage structures shall be carried out accurately to the lines, levels and grades required in whatever materials or conditions are encountered.

Pipe trenches shall be excavated to a vertical sided rectangular cross section extending at least 600mm above the barrel of the pipe or to formation level whichever is the lesser.

The minimum width of vertically sided trenches shall be the outside diameter of the pipe plus 300mm or 600mm total, whichever is the greater. In no case shall the clear width of vertically sided trench exceed the above minimum by more than ten percent.

Where pipes are to be placed in or under fills, the fill shall be constructed to a height of at least 600mm above the barrel of the pipe or to formation level whichever is the lesser before the pipe trench is excavated.

No trench shall be opened up until sufficient pipe sections are on the site ready for laying.

14.3.2 Pipe Bedding

Bedding material shall be provided and placed for the full width of the trench. The compacted thickness of bedding material following any shaping necessary shall be not less than:

- 100mm where D < 1500mm
    - 200mm where D > 1500mm

where D is the nominal pipe diameter or culvert height.

When the pipe sections are in position, an additional layer of bedding material shall be placed to a height equal to 30% of the nominal pipe diameter. This material shall be placed between the pipe and the outer limits of the lower layers of bedding, and shall be compacted to a dry density ratio of not less than 95% using Modified Compactive Effort.

14.3.3 Pipe Laying

Pipe laying shall commence at the downstream end of the work. Pipe sockets and rebates shall point upstream. All pipes shall be laid separately and the barrel shall bear evenly on prepared bedding. Where required, socket holes shall be cut into the bedding of such size and depth as to allow the joints to be properly made.

Pipes shall be laid accurately to the lines, levels and gradients shown on the Drawings and with the top uppermost where indicated by the manufacturer. Any pipes not laid within 10mm of the design invert level and 25mm of the correct alignment shall be removed and re-laid. The maximum tolerance in relative gradient or alignment of adjacent pipes shall be 3mm per pipe length.

Holes provided for lifting or handling purposes shall be plugged with concrete plugs and damage done to pipes in handling shall be made good to the approval of the Superintendent. Any pipes damaged beyond repair shall be removed from the Works.

On completion of each drainage line, all pipes shall be free from dirt, debris, mortar droppings or other impediments to the free and uninterrupted flow of water.

To allow for pits, manholes, bends, junctions and other pipes being constructed in the required positions, pipes shall be cut where necessary. Cut pipes shall be finished to a smooth surface by sawing or by rendering the chipped surface with render.

Properly fitting stoppers shall be provided and used to close the ends of all uncompleted pipelines. The stoppers shall be removed only when additional pipes are to be laid and jointed.

14.3.4 Minimum Cover Requirements for Steel Reinforced Concrete Stormwater Pipes

The minimum pipe cover for the live loads of various construction equipment during construction shall be in accordance with the table below from the Australian Standard / New Zealand Standard 3725 and the Concrete Pipe Association of Australia.

Minimum Heights of Fill over Class 2, 3 and 4 Buried Pipes for Various Construction Equipment Live Loadings (H2/HS2 Bedding Support Type)

Note: This Table has been sourced from Concrete Pipe Association of Australia publication, *The Installation of Steel Reinforced Concrete Pipes, Minimum cover required for various compactors,* dated 27 November 1999.

Class 2

Construction Equipment description[2]	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 300mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 375mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 450mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 525mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 600mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 750mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 900mm**
Pedestrian vibrating plate (up to 135 kg)	125	125	125	125	125	125	125
Vibratory trench roller (up to 2.0 T)	400	400	400	350	250	200	200
Vibratory rammer (up to 75 kg)	450	450	450	400	350	300	300
15 T excavator and compaction wheel	700	700	700	650	650	650	550
Vibratory smooth drum roller (7 T)	700	700	700	650	650	650	550
Vibratory smooth drum roller (10 T)	900	900	900	900	850	800	750
25 T excavator and compaction wheel	1050	1050	1050	1050	1000	900	800

Class 3

Construction Equipment description[2]	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 300mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 375mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 450mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 525mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 600mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 750mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 900mm**
Pedestrian vibrating plate (up to 135 kg)	125	125	125	125	125	125	125
Vibratory trench roller (up to 2.0 T)	250	250	200	200	200	200	200
Vibratory rammer (up to 75 kg)	300	300	300	300	250	200	200
15 T excavator and compaction wheel	500	500	500	450	450	350	250
Vibratory smooth drum roller (7 T)	450	450	450	450	350	200	200
Vibratory smooth drum roller (10 T)	550	550	550	500	500	200	200
25 T excavator and compaction wheel	650	650	650	650	650	600	550

Class 4

Construction Equipment description[2]	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 300mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 375mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 450mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 525mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 600mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 750mm**	**Compacted fill over DN 300 – DN 900 concrete pipe[1]: 900mm**
Pedestrian vibrating plate (up to 135 kg)	125	125	125	125	125	125	125
Vibratory trench roller (up to 2.0 T)	200	200	200	200	200	200	200
Vibratory rammer (up to 75 kg)	250	250	250	200	200	200	200
15 T excavator and compaction wheel	350	350	350	350	300	200	200
Vibratory smooth drum roller (7 T)	350	350	350	200	200	200	200
Vibratory smooth drum roller (10 T)	400	400	400	400	200	200	200
25 T excavator and compaction wheel	550	550	650	650	500	400	350

Notes:

1. Material over pipe compacted to 95% at maximum dry density for standard compaction.
2. Minimum fill over pipe includes material being compacted, as measured after compaction.
3. The bedding support type chosen has little or no effect on the pipe class for low fills and high traffic loads.

The minimum pipe cover for the live loads of various road traffic design loads shall be in accordance with the table below obtained through the use of the CPAA pipe selection software 'PipeClass'.

Required Cover Thickness (Millimetre) Min.) – City of Melbourne Pavement Types

Road (1P 50405A) – HS2

Pipe Class	Pipe Nominal Diameter (mm)	Concrete (mm)	Asphalt (mm)
2	300	600 (up to 6,300)	600 (up to 6,500)
2	375	600 (up to 4,800)	600 (up to 4,900)
2	450	600 (up to 4,400)	600 (up to 4,400)
2	525	600 (up to 4,200)	600 (up to 4,300)
2	600	600 (up to 4,000)	600 (up to 4,000)
2	675	600 (up to 3,900)	600 (up to 3,900)
2	750	600 (up to 3,800)	550 (up to 3,800)
2	825	600 (up to 3,800)	550 (up to 3,800)
2	900	600 (up to 3,500)	500 (up to 3,600)
2	1050	600 (up to 3,300)	500 (up to 3,300)
4	300	400 min	400 min
4	375	400 min	400 min
4	450	400 min	400 min
4	525	400 min	500 min
4	600	400 min	500 min
4	675	400 min	500 min
4	750	400 min	500 min
4	825	400 min	600 min
4	900	400 min	600 min
4	1050	400 min	600 min

Road (1P 50402) – HS2

Pipe Class	Pipe Nominal Diameter (mm)	Bluestone Pitcher (mm)
2	300	650 (up to 6,300)
2	375	650 (up to 4,800)
2	450	650 (up to 4,400)
2	525	650 (up to 4,200)
2	600	650 (up to 4,000)
2	675	650 (up to 3,900)
2	750	650 (up to 3,800)
2	825	650 (up to 3,800)
2	900	650 (up to 3,500)
2	1050	650 (up to 3,300)
4	300	450 min
4	375	450 min
4	450	450 min
4	525	500 min

Pipe Class	Pipe Nominal Diameter (mm)	Bluestone Pitcher (mm)
4	600	500 min
4	675	500 min
4	750	500 min
4	825	600 min
4	900	600 min
4	1050	600 min

Footpath (H2) – 1P 50405B

Pipe Class	Pipe Nominal Diameter (mm)	Concrete (mm)	Asphalt (mm) (Non CBD)	Asphalt (mm) (CBD)	Asphalt (mm) (Parks)
2	300	300 min	300 min	300 min	400 min
2	375	300 min	300 min	300 min	400 min
2	450	300 min	300 min	300 min	400 min
2	525	300 min	300 min	300 min	400 min
2	600	300 min	300 min	300 min	400 min
2	675	300 min	300 min	300 min	400 min
2	750	300 min	300 min	300 min	400 min
2	825	300 min	300 min	300 min	400 min
2	900	300 min	300 min	300 min	400 min
2	1050	300 min	300 min	300 min	400 min
4	300	NA	NA	NA	NA
4	375	NA	NA	NA	NA
4	450	NA	NA	NA	NA
4	525	NA	NA	NA	NA
4	600	NA	NA	NA	NA
4	675	NA	NA	NA	NA
4	750	NA	NA	NA	NA
4	825	NA	NA	NA	NA
4	900	NA	NA	NA	NA
4	1050	NA	NA	NA	NA

Footpath (H2) – 1P 50402

Pipe Class	Pipe Nominal Diameter (mm)	Bluestone (mm)
2	300	400 min
2	375	400 min
2	450	400 min
2	525	400 min
2	600	400 min
2	675	400 min
2	750	400 min
2	825	400 min
2	900	400 min

Pipe Class	Pipe Nominal Diameter (mm)	Bluestone (mm)
2	1050	400 min
4	300	NA
4	375	NA
4	450	NA
4	525	NA
4	600	NA
4	675	NA
4	750	NA
4	825	NA
4	900	NA
4	1050	NA

Pipe Class	Pipe Nominal Diameter (mm)	Landscape & Nature strips (mm) (H2)
2	300	300 min
2	375	300 min
2	450	300 min
2	525	300 min
2	600	300 min
2	675	300 min
2	750	300 min
2	825	300 min
2	900	300 min
2	1050	300 min
4	300	NA
4	375	NA
4	450	NA
4	525	NA
4	600	NA
4	675	NA
4	750	NA
4	825	NA
4	900	NA
4	1050	NA

Notes:

1. HS2 Bedding support with bedding factor of 2.5
2. H2 Bedding support with bedding factor of 2
3. NA pipe class not to be used
4. For cover levels greater than specified, a higher class pipe is to be adopted

14.3.5 Drainage Pits

Cast in place reinforced concrete pits or approved precast pits may be used.

Reinforced concrete pits shall be constructed in accordance with the Drawings or, if not detailed, in accordance with the VicRoads Specification Section 705 – Drainage Pits. Steel reinforcement shall comply with A.S. 1304.

Pit frames and grates shall be Grade 250 steel, manufactured in accordance with the Drawings, and painted with one coat of Wattyl Killrust Black Enamel for Metal (or approved equivalent).

Junction pit covers shall, unless otherwise specified on the drawings, be Heavy Duty Gatic type or approved equivalent.

The surrounds of all frames and grates and cover cells shall be infilled and finished with full depth charcoal coloured concrete. The concrete shall be 32 MPa and the colour achieved by adding 15 kg/cu m black oxide Bayer 318 or approved equivalent. Coloured rendering of the surface (only) will not be accepted.

14.3.6 Downpipe Connections

Downpipes shall, in order of preference or as specified and detailed on the Drawings, be connected to:

- the back of drainage pits

the existing underground drain, refer CoM standard drawings 1P50303 and 1P50304

the street channel, through the kerb, refer CoM standard drawing 1P50315

Downpipes requiring connection to a discharge point and not indicated on the Drawings shall be brought to the attention of the Superintendent at the time of discovery.

Downpipes shall be 100mm diameter galvanised wrought iron, reinforced concrete, fibre reinforced concrete or earthenware unless otherwise approved by the Superintendent.

Downpipes shall be laid at a minimum fall of 3% towards the discharge point on a bedding layer of not less than 25mm compacted crushed rock.

14.3.7 Interfering Services

Existing services interfering with the specified level or alignment of a new drain shall be brought to the immediate attention of the Superintendent for direction. The Contractor shall make immediate enquiries to ascertain the ownership of the interfering service and exercise its best endeavours to maintain satisfactory progress of the works whilst a direction is being formulated.

14.3.8 Proximity to other services and obstructions

The minimum proximity for Council stormwater drains to other services and obstructions shall be in accordance with Australian Standard 3500.3 (Cl 6.2.6).

14.3.9 Backfilling

Under pavements the trench shall be backfilled with Class 2 Crushed Rock. Under landscape areas the trench shall be backfilled with Class 2 Crushed Rock to a level of 0.3m above the top of the pipe and with general fill material above that. Backfilling shall be placed, spread and compacted in even layers, not exceeding 150mm uncompacted thickness. Backfill under pavements shall be compacted to a dry density ratio of not less than 95% using modified compactive effort. General fill shall be compacted to a dry density ratio of not less than 98% using standard compactive effort.

During filling, the maximum difference between filling placed on opposite sides of the culvert shall not exceed one-quarter the height of the culvert or 0.5m, whichever is the lesser.

Filling shall not be placed within 2m of an exposed culvert end where a further section is to be placed.

Filling land or stockpiling soil (more than 100 m3 with an average of at least 05.m) over in situ Potential acid Sulfate Soils; these activities can force the underlying Australian Standards above the water table at the margins of the added soil. This shall comply with council specification Roadworks – Contaminated Soil Management Procedure 2015.

Insitu potentially contaminated ballast material may be specified as a source of backfill by the superintendent. Pipes shall have a minimum of 100mm of new compacted class 2 crushed rock cover prior to use of insitu materials and a minimum of 200mm of class 2 compacted crushed rock base to any asphalt pavements, unless shown otherwise of drawings. General fill shall be compacted to a dry density ratio of not less than 98% and must be approved by City of Melbourne Council.

Stabilised sand shall only be used in exceptional circumstances and are to be approved by council with a certified design. The minimum cement content shall be 3%.

14.3.10 Trench Reinstatement

Unless otherwise specified, hot mix asphalt, of similar size, type and thickness to the existing adjacent asphalt, shall be placed and compacted over the opening in the roadway and/or footpath to match the existing surface level. Trenches to be widened 150mm either side at the asphalt surface to allow for a stepped reinstatement. Refer CoM standard drawings 1P 50518and 1P 50519.

Cold mix asphalt may be used in areas requiring temporary reinstatement for public safety. Cold mix shall consist of 94% grit (not greater than 3 mm size), 5% bitumen Class 170 and 1% fuel oil complying with the requirements of VicRoads Standard Specification Section 407. A coating of sand shall be broomed over the cold mix asphalt surface to reduce stickiness.

Where a trench edge is 600mm or less from the edge of existing channel edge, the reinstatement shall be extended in width to include the area to the channel.

14.3.11 Decking Over Open Trenches

To maintain pedestrian and/or vehicular access and flow where required, or when directed by the Superintendent, decking to the approval of the Superintendent shall be provided. Plans and computations shall be submitted in advance for approval. Approved thin (25mm maximum thickness) steel plate with a non-slip surface decking may rest on the surface but any timber decking for vehicular traffic shall be set flush with the adjacent surface. A suitable warning sign indicating "Caution" or "Hump" shall be provided on each approach.

14.4 Quality Assurance

14.4.1 Requirements

The Contractor shall implement a Quality Assurance program in accordance with Section 2 of this Specification.

This program shall comprise Production and Process Control and Post-Construction phases as defined below:

14.4.2 Production and Process Control Phase

a) Program

The Contractor's production and process control program shall consist of sampling and testing the materials and product, and a continuous assessment of the adequacy of the production control. The Contractor is responsible for designing and implementing a control program which provides adequate and effective control over the works, however the minimum amount of control testing that shall be undertaken is set out in this section of the Specification.

The Contractor shall keep a record upon a plan of the works, of where each work shift's production has been incorporated in the works.

b) Concrete Pipes

Pipes shall be laid true to the alignments and grades shown within the following tolerances:

± 5mm in level

±10mm in line

Any defects in the pipes, discrepancies in levels or alignment in excess of the allowable tolerances, and defective joints shall be corrected.

c) Bedding and Backfilling

The Contractor shall test the bedding and backfill material at the following minimum frequency:

Compaction

One field density test shall be taken per 300mm depth for each 100m of the trench bedding and backfill placed.

d) Hold Point

The following Hold Point shall be incorporated into the Contractor's Construction Program.

Following completion of laying of the pipe/culvert and prior to any backfilling.

14.4.3 Post-Construction Phase

a) As-Constructed Details

An as-constructed survey by a licensed or competent surveyor of the stormwater drainage system shall be submitted to the Superintendent.

The survey shall detail the following:

- Location and cover level of pits.
- Bearing of side entry pits.
- Invert level of pipes.

The as-constructed information shall be submitted on A1 sized plans.

b) Quality Assurance Records

Within 3 weeks of completion of the Works, the Contractor shall supply two copies of a report detailing the results of all quality control and testing undertaken.

c) Non-Conforming Materials and Work

All non-conforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Specification.

15. Subsoil drainage

15.1 General

15.1.1 Scope

This Section specifies requirements for supply of materials, excavation, and installation of pipes, filter material, geofabric and backfilling necessary to construct subsoil drainage systems.

15.1.2 Standards, Codes and Referenced Specifications

The following documents which are referenced in this section form part of this Specification only to the extent that they are referred to herein:

Australian Standards*:*

Australian Standard 1152 Test Sieves

Australian Standard / New Zealand Standard 1254 PVC-U Pipes and Fittings for Stormwater and Surface Water Applications

Australian Standard 2439.1 Perforated Plastics Drainage and Effluent Pipe and Fittings

Australian Standard 3500.1 National Plumbing and Drainage Code

Australian Standard 3500.3 National Plumbing and Drainage Code – Stormwater Drainage

VicRoads:

Section 702 Subsurface Drainage

15.1.3 Working near Public Trees

When working in the vicinity of public trees, an arborist from the Urban Forest and Ecology team must be notified, if:

- Roots are exposed during works
- Damage could occur, or has occurred, to tree roots
- Tree plot sizes require alteration
- Soil levels require alteration

15.2 Materials

15.2.1 Pipes

Pipes for subsoil drainage shall be perforated plastic pipes complying with Australian Standard 2439.

Pipes under paved areas and behind kerb and channel shall be Class 1000. Pipes in other locations shall be Class 400.

15.2.2 Flushout Risers

Flushout riser installation shall comply with VicRoads standard drawing SD 1631

15.2.3 Filter Material

Filter material shall be screened crushed rock having a Los Angeles Abrasion Loss of not more than 45 percent and shall be 5mm nominal size uniformly graded within the following limits:

Sieve Size to AS 1152	Percent Passing by Mass
9.50	100
4.47	70-100
2.36	0-50
1.18	0-10
0.3	0-5
0.75	0-3

15.2.4 Geotextile Fabric

Geotextile fabric shall be “Terram 1000” or an approved equivalent.

15.3 Construction

15.3.1 Excavation

Pipe trenches shall be excavated to the dimensions and lines as shown on the Drawings. The depth of the invert level of subsoil drains shall be as shown.

Excavated material shall be disposed of in accordance with the requirements for Spoil in the “Site Preparation and Earthworks” section of this specification.

15.3.2 Geofabric

Geofabric shall be installed in accordance with the details shown and the manufacturer’s recommendations. Following compaction of filter material, the geofabric shall be neatly laid across the trench with a lap as shown on drawing.

15.3.3 Pipe Laying

Pipes shall be laid true to line and on a grade at least parallel to the finished surface, but at no place shall the pipe gradient be less than 1 in 200. Pipes shall be laid and jointed strictly in accordance with the manufacturer’s recommendations.

15.3.4 Placing of Filter Material

After the pipe has been installed, filter material shall be placed and compacted to the level shown.

Any portion of the filter material in the backfilling which has become mixed with foreign material shall be removed and replaced with clean material.

Filter material shall be compacted to a dry density ratio of 95% using Modified Compactive Effort.

15.3.5 Backfilling

After the filter material has been placed and compacted and covered with geofabric, the trench shall be carefully backfilled by means which avoid risk of damage to the fabric. The backfill shall be placed in maximum 150mm thick layers and compacted to a dry density ratio of 95% using Modified Compactive Effort.

15.4 Quality Assurance

15.4.1 Requirements

The Contractor shall implement a Quality Assurance program in accordance with Section 2 of this Specification.

This program shall comprise Pre-Commencement Phase, Production and Process Control and Post-Construction phases as defined below:

15.4.2 Pre-Commencement Phase

Supply of Information on Materials Sources

The following information shall be supplied for the filter material:

- Location of source of the filter material
- Particle size distribution of the filter material
- Supplier and grade of the pipes to be used
- Supplier and type of Geofabric to be used.

15.4.3 Production and Process Control Phase

a) Program

The Contractor's production and process control program shall consist of sampling and testing the materials and product, and a continuous assessment of the adequacy of the production control. The Contractor is responsible for designing and implementing a control program which provides adequate and effective control over the works, however the minimum amount of control testing that shall be undertaken is set out in this section of the Specification.

The Contractor shall keep a record upon a plan of the works, of where each work shift's production has been incorporated in the works.

b) Pipes

Pipes shall be laid true to the alignments and grades shown within the following tolerances:

+/- 5mm in level

+/- 10mm in line

Any defects in the pipes, discrepancies in levels or alignment in excess of the allowable tolerances, and defective joints shall be corrected.

15.4.4 Post-Construction Phase

a) Quality Assurance Records

Within 3 weeks of completion of the Works, the Contractor shall supply two copies of a report detailing the results of all quality control and testing undertaken.

b) Non-Conforming Materials and Work

All non-conforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Specification.

16. Traffic and parking signs and pavement markings

16.1 General

16.1.1 Scope

This Section specifies requirements for the supply and installation of Traffic and Parking Signs and Pavement Markings.

16.1.2 Standards, Codes and Referenced Specifications

The following documents which are referenced in this section form part of this Specification only to the extent that they are referred to herein:

Australian Standards*:*

Australian Standard 1742.1 Manual of uniform traffic control devices

Australian Standard 1743 Road signs - specification

Australian Standard 1744 Standard Alphabets for Road Design

Australian Standard / New Zealand Standard 2009 Glass Beads for Pavement-Marking Materials

Australian Standard 4049.1 Paints and Related Materials – Pavement Marking Materials

Australian Standard 4049.2 Paints and Related Materials – Pavement Marking Materials

VicRoads:

Section 714 Sign Installation

Section 722 Painted Pavement Markings New Installations

Section 724 Long life Pavement Markings New Installations

16.1.3 Definitions

Road marking is the term used to define all transverse lines and markings such as Stop/Give Way lines, pedestrian lines, arrows, and legends.

Line marking is the term used to define all longitudinal lines such as centre, lane, edge, turn and continuity lines.

Pavement marking is the term used to define all line marking and road marking.

16.1.4 Working near Public Trees

When working in the vicinity of public trees, an arborist from the Urban Forest and Ecology team must be notified, if:

- Roots are exposed during works
- Damage could occur, or has occurred, to tree roots
- Tree plot sizes require alteration
- Soil levels require alteration

16.2 Materials

16.2.1 Traffic and Parking Signs, Posts and Sockets

Signs and Sign supports shall comply with the requirements of VicRoads Traffic Engineering Manual Volume 2 – Signs and Markings and VicRoads Standard Specification for Roadworks and Bridgeworks.

Unless otherwise specified on the Drawings, sign posts for regulatory parking signs shall be 60.3mm outside diameter galvanised pipe, 3mm wall thickness and 3.0 metres in length.

Parking control signs shall be mounted with the following clearances to the bottom edge:

- A minimum of 2.0m above the footpath – to avoid obstruction to pedestrians.
    - 2.2m above the road surface – to reduce interference from parked vehicles.

In typical locations where signs are installed close to a kerb they should not be mounted parallel to the kerb but turned through 30º ±10º to partially face oncoming traffic (on the near side on a two-way roadway).

Sockets shall be in accordance with Drawing No. 1P50400

16.2.2 Pavement Marking Materials

Unless otherwise specified on the Drawings, all pavement markings shall be painted using a white water-borne or solvent-borne chlorinated rubber paint approved by the Superintendent and approved under the Australian paint Approval Scheme (APAS).

16.2.3 Pavement marking materials shall be in accordance with the following:

a) Paint

Paints shall comply with the requirements of Australian Standard 4049.1 and VicRoads Standard Specification Section 722.04.

b) Long-life Materials

Thermoplastic, Cold –Applied Plastic materials and Pliant Polymer Marking Tape shall comply with the requirements of Australian Standard 4049.2 and VicRoads Standard Specification Section 724.04

c) Glass Beads

Glass beads used on markings shall comply with the requirements for drop-on beads in Australian Standard 2009 and VicRoads Standard Specification Sections 722.04 and 724.04 as appropriate.

Coloured pavement surfaces used for bicycle lanes shall comply with the requirements of section 5.2.5 of the VicRoads Design Guidance for strategically important cycling corridors and Australian Standard 2700.

Unless specified otherwise, green surface treatment for bike lanes shall be ‘Colour Track’ by MPS paving systems or approved equivalent.

16.3 Construction

16.3.1 Traffic and Parking Signs, Posts and Sockets

Traffic and parking signs and posts shall be installed where shown on the Drawings in accordance with the requirements of Australian Standard 1742.1, Australian Standard 1743 and Australian Standard 1744, VicRoads Standard Specification Section 714 and City of Melbourne Drawing No. 1P 50400 for sockets.

Posts and sockets shall be set vertically to within a tolerance of 1 in 250.

16.3.2 Inground Parking Bay Sensors and or Parknet Relay Stations Present

Where works disrupt or require the removal of inground parking bay sensors during construction, contractor must advise City of Melbourne On-Street compliance with a minimum of 7 days’ notice prior to commencement of works.

Note:

- Any changes to the parking sign posts (removal, relocation and replacement) my impact on Parknet relay stations and therefore, Parknet asset must be removed before any works can proceed.
    - Contractor must not paint over inground sensors when applying linemarking or green treatment, sensors must be covered by means of masking tape or similar to avoid concealment.

16.3.3 Pavement Marking Installation

Pavement marking installation shall be in accordance with the following:

a) Layout of markings

The set out for pavement markings shall be as detailed on the Drawings.

b) Paint

Two coats of paint shall be applied to all markings. The first coat shall be applied immediately following completion of works to the pavement wearing surface.

The painting of pavement markings shall comply with the requirements of Australian Standard 4049.1 and VicRoads Standard Specification Section 722 except for period of repainting, which shall be within two (2) to four (4) weeks after the initial treatment.

The Contractor may be required to install temporary markings to suit his construction program.

c) Long-life Materials

The application of Thermoplastic, Cold –Applied Plastic materials and Pliant Polymer Marking Tape shall comply with the requirements of Australian Standard 4049.2 and VicRoads Standard Specification Section 724

16.3.4 Removal of Existing Pavement Marking

Redundant line marking shall be removed by grinding to the satisfaction of the Superintendent.

16.4 Quality Assurance

16.4.1 General Requirements

The Contractor shall implement a Quality Assurance program in accordance with Section 2 of this Specification.

This program shall comprise Pre-Commencement Phase and Post-Construction phases as defined below:

16.4.2 Pre-Commencement Phase

- Supply of Information on Materials
- The following information shall be supplied for the Pavement Marking Materials:
- Product name and type
- Manufacturer's name
- Product specification

16.4.3 Post-Construction Phase

a) Quality Assurance Records

Within 3 weeks of completion of the Works, the Contractor shall supply two copies of a report detailing the results of all quality control undertaken.

b) Non-Conforming Materials and Work

All non-conforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Specification.

17. Street furniture

17.1 General

17.1.1 Scope

This Section specifies requirements for the supply and installation of street furniture items for this contract.

17.1.2 Materials

17.1.3 Fabrication and Approved Suppliers

Furniture items shall be fabricated in accordance with the City of Melbourne Industrial design/City Design Studio Standard Drawings

17.2 Construction

17.2.1 Handling and Storage of New and Existing Street Furniture

Where applicable, the Contractor shall remove any existing street furniture with care and store on site for later re-use.

The Contractor shall be responsible for the security, handling and storage of street furniture and shall be liable for any damage caused during its removal, handling, storage and installation.

17.2.2 Working near Public Trees

When working in the vicinity of public trees, an arborist from the Urban Forest and Ecology team must be notified, if:

- Roots are exposed during works
- Damage could occur, or has occurred, to tree roots
- Tree plot sizes require alteration
- Soil levels require alteration

17.2.3 Installation

Street furniture shall be installed in the positions shown on the Drawings or as directed by the Superintendent. The Contractor shall contact the Superintendent two days prior to commencement of street furniture installation to confirm the final exact locations of all new street furniture. Poles and street furniture posts, legs and sockets shall be set vertically to within a tolerance of 1 in 250.

Unless otherwise specified in the Drawings, sockets shall be set flush with the finished pavement surface. Concrete foundations for street furniture and sockets shall be in accordance with the Drawings.

17.3 Quality Assurance

17.3.1 General Requirements

The Contractor shall implement a Quality Assurance program in accordance with Section 2 of this Specification.

This program shall comprise Pre-Commencement Phase and Post-Construction phases as defined below:

17.3.2 Pre-Commencement Phase

a) Supply of Information / Prototype

The following shall be supplied for furniture items:

- Manufacturer’s name
- Prototype (if “Approved Standard” not achieved by the supplier)
- Location where MCC approved prototype (benchmark sample) is kept.

17.3.3 Post-Construction Phase

a) Quality Assurance Records

Within 3 weeks of completion of the Works, the Contractor shall supply two copies of a report detailing the results of all quality control undertaken.

b) Non-Conforming Materials and Work

All non-conforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Specification.

18. Granitic gravel

18.1 Bonded Granitic Gravel

18.1.1 Description

Permeable layer of bound granitic gravel on a compacted crushed rock base course.

18.1.2 Material

Base course: minimum depth 75mm compacted class 2 fine crushed rock, formed and compacted in two layers to achieve a minimum density of 98% modified relative compaction. The thickness of the fine crushed rock sub base shall decrease to 50mm within a 5-metre radius of trees

18.1.3 Finishing Course

50mm compacted thickness layer of fine grained, yellow/brown, granitic gravel of low plasticity, with a ph range of 4-7, and a maximum silt content of 6% (by volume) as specified in as 1141-33. Contractor to provide a 2kg sample for approval by the landscape architect prior to the preparation of a sample panel on site.

18.1.4 Binding Agent

Granitic gravel material shall be mixed with a nontoxic organic soil additive to bind and create a hard-wearing surface. The binding agent shall be a colourless, odourless powder such as Stalok™ or a similar approved material. The binding agent shall be mixed with the granitic gravel in a mechanical drum mixer to ensure an even content through the entire mix. The binding agent to be applied at a ratio of 2% to the dry weight of the gravel being applied as per manufacturer specification. The bonding agent shall be mixed by mechanical means into the gravel prior to placement and compaction.

18.1.5 Finish

As described

18.1.6 Indicative Locations

As shown

18.1.7 Acceptable Supplier

Essendon Quarries - (03) 9337 9280

18.1.8 Binding Agent

Evergreen Stabiliser Solution - (03) 5945 2100

18.1.9 Installation

Binding agent to be applied to form bonded gavel. City of Melbourne preferred product is ‘soilbond’. The pre-mixed gravel material shall be laid over the compacted FCR sub base and well-watered (without saturation). Water activates Stalok™ so it is essential that the full depth of stabilised material is moistened. The gravel shall then be levelled and compacted to achieve the required fall and levels. Compaction shall be a static roller to a tolerance of plus or minus 5mm of the finished surface level when measured with a 3m straight edge. The finished surface shall be free draining, not liable to ponding and flush with all adjoining edges. Compaction shall commence only after wetting of the entire gravel profile, ensuring the material is moist, but before any surface water becomes evident. The material shall be moist but not wet. Compact to a minimum density of

98% modified relative compaction. Refer geotechnical engineers' documents for detail relating to pavement compaction requirements.

When working in the vicinity of public trees, an arborist from the Urban Forest and Ecology team must be notified, if:

- Roots are exposed during works
- Damage could occur, or has occurred, to tree roots
- Tree plot sizes require alteration
- Soil levels require alteration

18.1.10 Hold Point

Provide 1000mm square sample for approval by the superintendent's representative. When the superintendent's representative has approved the quality and standard, the sample shall be used as the benchmark for the standard and quality of the remainder of the granitic gravel paving works.

18.1.11 Notes

The contractor shall be responsible for programming of the works to ensure that trees within the gravel areas are planted and protected prior to the spreading and compaction of the FCR base course and the granitic gravel. Refer City of Melbourne Design Standard 201.04.

18.2 Normal Granitic Level

18.2.1 Base Course

The base course shall consist of a minimum depth of 100mm compacted Class A crushed rock, to be formed and compacted in 2 Nos. 50mm layers to achieve a minimum density of 98% Mod Rel Compaction.

The thickness of the crushed rock shall decrease to 50mm within 4.5m radius of any tree.

18.2.2 Granitic Gravel Course

This shall consist of a minimum 75mm compacted thickness layer of 'Tooborac' fine grained, yellow/brown, granitic gravel of low plasticity approved by the Engineer with a pH range of 4-7 and a maximum silt content of 6% (by vol) as specified by Australian Standard 1141-33.

A 2kg sample shall be provided by the Contractor for approval by the Engineer prior to delivery and placing on site.

18.2.3 Binding Agent

The approved granitic gravel material shall be mixed with a non-toxic organic soil additive to bind and create a hard-wearing surface. The binding agent shall be a colourless, odourless powder approved by the Engineer.

The binding agent shall be mixed with the granitic gravel in a mechanical drum mixer to ensure an even content through the entire mix. The binding agent shall be mixed with the gravel at a rate of 4.5kg per tonne of granitic gravel (dry).

The pre-mixed gravel material shall be laid over the compacted crushed rock sub-base and well-watered (without saturation). Water activates the Stabiliser TM so it is essential that the full depth of stabilised material is moistened. The gravel shall then be levelled and compacted to achieve the required fall and levels

18.2.4 Compaction

Compaction shall be by static roller to a tolerance of plus or minus 5mm of the designed finished surface level when measured with a 3m straight edge. The finished surface shall be free draining, not liable to ponding and flush with all adjoining edges. Compaction shall commence only after wetting of the entire gravel profile, ensuring the material is moist, but before any surface becomes evident. The material shall be moist but not wet and compacted to a minimum density of 98% Modified Relative Compaction.

As directed by the Engineer test/s shall be arranged by the Contractor to include laboratory compaction (modified) and field density tests in accordance with Australian Standard 1289. Costs associated with the tests shall be borne by the Contractor.

19. Streetscape turf establishment

19.1 Introduction

Streetscape improvement and maintenance ‘works’ are deemed to be ‘complete’ when all structural and presentation components are finalised. A key presentation component is turf surfaces. This specification details turf establishment requirements that are expected to be undertaken and finalised at the time of the works. The following specifications are included in the main scope of the required services.

19.2 Background

High quality street tree and streetscape presentation is considered a primary outcome of Melbourne’s public spaces presentation and management program. Trees are a key structural element of the street and ensuring that immediate root zone surrounds are functional and of high quality can enhance their influence.

Street sites are generally considered to be sensitive in terms of their tree root content and therefore there is an expectation that all works will be conducted in a manner that ensures protection.

The texture of ground cover material has a significant influence on root environments and to this end grass is considered to be a highly desirable finish. The long-term effective contribution and value of grass is largely determined by the successful installation.

19.3 Scope

This specification covers ground preparation, supporting infrastructure treatment, soil and grass supply and installation for centre road medians, traffic control treatments, nature strips and other street layouts that consist of grass cover.

Due to the presence of mature trees in many locations it is expected that where these are present the soil preparation will be conducted with hand tools or small machines.

19.3.1 General requirements

Prior to the contractor commencing grassing works, all other hard infrastructure works shall have been completed and any damage to irrigation services shall have be acknowledged and repaired.

The grassing Contractor shall liaise with the irrigation and any other relevant Contractors, prior to commencement of any work, to identify information that may affect the success of the project. Irrigation if present must be tested and operational prior to commencement of the grassing phase. Any damage to the irrigation system caused by the street work program must be repaired in accordance with the irrigation standards and specifications prior to the commencement of the grassing contractor. The grassing contractor shall be responsible for the completeness and operational aspects of the system from that point on.

Prior to the final hand-over to Council of any section of the turf contract work, Council must inspect the appropriate area and confirm that the works are in conformance to the contract specification prior to approval being supplied.

The Contractor shall protect the turf surface against trespass and traffic by installing warning signs and other appropriate measures until the grass is well established. This period will vary according to season variations, but will be determined to the satisfaction of Council that the turf is of sufficient strength and resilience to be open to normal public usage.

19.3.2 Working near Public Trees

When working in the vicinity of public trees, an arborist from the Urban Forest and Ecology team must be notified, if:

- Roots are exposed during works
- Damage could occur, or has occurred, to tree roots
- Tree plot sizes require alteration
- Soil levels require alteration

19.3.3 Topsoil

It is an expectation that on most sites the local site soil will be used and amended as required. If imported soil is required then the following material shall be used.

a) Imported Topsoil

The material will have the following characteristics.

- **pH (water):** 6.0-7.5
- **Total salts:** less than 800ppm
- **Friability:** soil must form some structure, and fit the classification of loam or sandy clay loam, as approved by Council.

Imported topsoil shall be clean loam or sandy clay loam similar in character to the existing site material and fulfil the general requirements as listed in Section 5 of Australian Standard 4419 with respect to toxicity, weed content, large particles and extraneous materials.

In most cases this means that sandy material is not acceptable.

b) Soil Testing

Laboratory testing of proposed topsoil samples for pH, salts and soil texture shall be conducted prior to commencement of the project at the contractor's cost. Tests are to be conducted in accordance with Australian Standard 4419 where possible.

A 0.5-kg sample of soil proposed for restoration or import is to be submitted to Sportsturf Consultants (9558 6514) for testing two weeks prior to anticipated delivery or commencement of works.

Soil materials delivered to the site will be checked for uniformity and quality.

c) Topsoil Placement

Imported topsoil is to be placed where indicated by the client to bring the soil profiles to specified levels and to provide additional growing medium to the existing site material.

When there is less than 100mm depth imported this is to be spread and mixed with existing site material by use of a rotary hoe or power harrows.

d) Soil Amendments

Incorporate the following on the final run of the hoe or power harrows.

	Rate/100sq metres
Agricultural Lime	as determined by soil test
Gypsum	20 kg may be modified to account for calcium in lime
Magnesium Sulphate	2 kg
Potassium Sulphate	2 kg
Pivot 900 NPK (16.8.9) or similar	3 kg

19.4 Grassing

Note: seeding is to only occur where damage to a nature-strip or grass area that is deemed by Council's Parks Services Team to be minimal. Where damage, wear or size of the areas to be grassed is deemed by Council's Park Services Team to be significant, grassing using Kikuyu Sod Will be necessary.

19.4.1 Materials

a) Seed

Mixtures: Provide seed mixtures which are thoroughly pre-mixed with a bulking material such as safflower meal. Deliver to the site in bags marked to show weight, seed species and supplier's name. Provide fresh, clean, uncoated new seed. Do not provide wet, mouldy, or otherwise impaired seed.

Seed mid: Rye grass mix with 5% kikuyu seed by weight

Purity (minimum): 98%.

Germination viability (minimum): 86%.

Age (maximum) from date of harvest: 2 years.

b) Turf

Instant Kikuyu Sod on a loam mix. Not to be washed.

c) Fertiliser

General: Provide proprietary starter fertilizers, delivered to the site in sealed bags marked to show manufacturer or vendor, weight, fertilizer type, N:P:K ratio, recommended uses and application rates.

d) Fertiliser schedule

Fertiliser	**N:P:K ratio**	**Application rate**
Starter Fertiliser	5.6.5 or similar	2.5kg per 100m2

e) Soil

Soil type to be Sandy Loam or Loamy Sand in composition and to meet Australian Standard 4419-2003.

19.4.2 Execution

a) Grassing by seed

(Where area to be grassed is deemed by Council to be significant)

(i) Preparation

Cultivate area to be seeded to a depth of 150mm.

(ii) Top Dressing Soil

Spread and rake Sandy Loam or Loamy Sand evenly and level over cultivated bed.

(iii) Sowing

Conditions: Do not sow if frost is likely before the plant has reached an established state, or in periods of extreme heat, cold or wet. Provide even distribution. Lightly rake the surface to cover the seed.

(iv) Grass seeding

Sow seeded grass to areas at a rate of 2.5kg per 100m2

(v) Fertilising

Spread a starter fertiliser evenly over the sown area and then water in.

(vi) Watering

Before germination: Water the seeded area with a fine spray until the topsoil is moistened to its full depth. Continue watering until germination to keep the surface damp and the topsoil moist but not waterlogged.

After germination: Water to maintain a healthy condition and for a minimum of 6 weeks or longer if seasonal conditions require.

(vii) Germination

Reseeding: If germination has not been attained within one month, reseed any bare areas.

(vii) Protection

General: Protect the newly sown areas against traffic until well established.

Protection method: fencing or rope and pins.

(ix) Mowing

Height: Mow to maintain the grass height within the required range. Do not remove more than one third of the grass height at any one time. Carry out the last mowing within 7 days before the end of the planting establishment period. Remove grass clippings from the site after each mowing.

(x) Maintenance Period

The Contractor will be responsible to undertake any and all necessary maintenance works to ensure a full grass cover to the satisfaction of Council's Parks Open Space Contractor. Maintenance period will be for a period of up to 12 weeks or as agreed by Council's Park Services Team.

b) Grassing using kikuyu sod (instant turf)

(Where area to be grassed is deemed by Council to be significant)

(i) Preparation

General: Prepare the areas to be turfed by cultivating and de-compacting existing soil to a depth of 150mm.

(ii) Top Dressing Soil

Spread and rake Sandy Loam or Loamy Sand evenly and level over cultivated bed.

(iii) Turfing

Sod is to be good quality Kikuyu (not washed sod) placed on a level and well-prepared base. Strips are to be laid so that the sod covers all underlying soil and joints are staggered.

(iv) Fertilising

Spread a starter fertilizer evenly over the turf area and then water in.

(v) Watering

Water the newly turfed areas with a fine spray until the topsoil is moistened to its full depth. Continue watering to keep the surface damp and the topsoil moist but not waterlogged. Water will be required for a minimum 6 weeks or longer if seasonal conditions require.

(vi) Protection

General: Protect the newly turfed areas against traffic until well established.

Protection method: fencing or rope and pins.

(vii) Mowing

Height: Mow to maintain the grass height within the required range. Do not remove more than one third of the grass height at any one time. Carry out the last mowing within 7 days before the end of the planting establishment period. Remove grass clippings from the site after each mowing.

(viii) Maintenance Period

The Contractor will be responsible to undertake any and all necessary maintenance works to ensure a full grass cover to the satisfaction of Council's Parks Open Space Contractor. Further top dressing may be required to fill in low spots and depressions prior to handover. Maintenance period will be for a period of up to 12 weeks or as agreed by Council's Parks Services Team.

19.5 Street Tree Traffic Island Soil and Planter Specification

19.5.1 General Observations

a) Excavation

Planter to be excavated to a depth as specified on CoM standard drawing 1P 50517. All soil material from the planting hole to be removed unless specified otherwise.

b) Treatment

The exposed clay subsoil in the bottom of the planting hole is to be treated with gypsum at a rate of 500 g/m2. If possible, the clay should be broken up, to a depth of the 150mm after application of the gypsum, before installation of planter soil. This could be done with a small bucket backhoe or with a ripper tyne on an excavation arm.

19.5.2 The Soil is to meet the Following Specification:

The rootzone medium is to be a sand, loamy sand or coarse sandy loam soil of <1% organic matter by weight. This soil is to be installed in 150mm lifts and compacted gently by foot or with one pass of a plate compactor. After compaction it should be still possible to push a metal spike into the soil or to dig into the soil with a spade with minimal effort. The landscape contractor is not to add any organic matter to the soil without first seeking approval from City of Melbourne. The soil used for the rootzone medium is to have a saturated hydraulic conductivity of between 20mm/hr and 50mm/hr, determined using the methods set out in Australian Standard 4419 Soils for Landscape and Garden Use.

Soils used shall have a pH of between 5.5 and 7.0 and a maximum electrical conductivity (before the addition of fertilizer materials) of 0.5 ds/m (1:5 soil water extract). The pH of the soil is to be corrected before delivery to the site.

Unless specified differently above, the soil is to conform to all criteria for natural soils and soil blends in Australian Standard 4419 for landscape and garden use.

The surface 200mm is to have fine composed organic matter added at ta rate 20% by volume. Any compost used should conform to the description of composted soil conditioner in Australian Standard 4454. The landscape contractor is not to add any other organic matter to the soil without first seeking approval from the landscape architect.

Samples of all soil, organic matter to be tested by an approved laboratory prior to supply and final approval from the landscape architect is required before any of these materials are installed.

19.5.3 Fertilizer Specifications

A1: Surface 200mm

Before delivery to the site, this soil is to have added to it the following fertilizer materials

Potassium Nitrate	250 g/m3
Ammonium Nitrate	400 g/m3
Superphosphate	400 g/m3
Micromax ®Trace Element Mix	300 g/m3
Gypsum	500 g/m3*
Magnesium Sulphate	400 g/m3*

*These ingredients are not necessary if pH has been corrected with dolomitic limestone or dolomite or if soil chemical analysis indicated no requirement.

After planting, apply osmocote 12-14 months slow release fertilizer (or equivalent) to the surface of the planted areas of the bed at 500 g/m2. Ideally this fertilizer should be applied to the soil surface prior to any mulch application, however, in the event that the mulch is already applied, then apply to the surface of the mulch.

In the event that an alternative fertilizer program is proposed by the contractor, approval must first be sought from the landscape architect before use.

20. Bluestone paving specification

For bluestone paving specification please refer to City of Melbourne Sawn Bluestone Paving, Kerbing and Gutterstone Materials technical specification.

21. Miscellaneous works

21.1 Miscellaneous Works

21.1.1 Conversion of Fire Hydrants to Ground Plugs

Where specified in the Contract documents, the Contractor shall make the necessary arrangements with the relevant Water Authority to have existing fire hydrants converted to ground plugs, flush with final surface level. The Contractor is deemed to have included in his tender the total cost of the work including, Water Authority costs, co-ordination costs and Contractor’s margin.

21.1.2 Abrasive Blasting of Bluestone Access Ramps

The surface of the bluestone access ramp, including splays and top of kerb, shall be abrasive blasted to provide a non-slip surface and visible contrast between the access ramps and surrounding pavements.

Abrasive blasting performed on site shall comply with the noise and dust control requirements specified elsewhere in this Contract document.

21.1.3 Pavement Lights

Pavement lights shall not be disturbed. Construction of bluestone pavements to have a 100mm wide fill depth charcoal coloured concrete surround around all sides of pavement lights including the installation of full depth expansion material and suitable silicon sealant at surface.

21.2 Removal of Trees

If a tree is proposed for removal, contact the Urban Forest and Ecology Team on 9658 8714 for an arborist to assess the tree. If the tree is approved for removal, then contact Council's Parks, Properties and Waterways to arrange the approved removal. Stumps will be excavated and removed up to 300mm below existing pavement level and large surface tree roots will also be removed

The Contractor is responsible for consulting and coordinating and proposed tree removal works with a minimum 6 weeks' notice.

21.3 Tactile Ground Surface Indicators

Tactile ground surface indicators shall be designed, manufactured in accordance with Australian Standard 1428 and installed in accordance with the manufacturer's specification and as specified in standard drawing 1P50200 for asphalt footpaths and 1P50201 for bluestone footpaths. Any variations to the tactile products require the prior approval from City of Melbourne superintendent.

21.3.1 General Application

Approved Granite hazard and directional tactile ground surface indicators by Eigen Stone, Signature Stone or other approved suppliers shall be used on bluestone and asphalt paved surfaces as per the above Standard Drawings unless otherwise approved by Council

Where access ramp grades are shallower than 1 in 8.5, tactile ground surface indicators are required to be installed in accordance with AS 1428.4.1.

21.3.2 False kerbs

At locations where, new kerbs are to be set over an existing service covers which cannot be relocated or adjusted, false kerbs shall be installed over the kerbs. False kerbs shall comply with City Design Studio standard drawing 95113.

21.4 Service Lowering or Alteration

As shown on the design plans a number of existing property sewer, gas, potable water and drainage connections will need to be lowered to provide improved cover over the road lowering. The contractor shall ensure that all relevant service authorities are consulted, required applications and permits are submitted and works carried out by authorised sub- consultants

21.5 Golden Mile Markers

Golden Mile markers shall be installed in accordance with Council Standard Drawing 1P 50523

21.6 General Tree Protection

When working in the vicinity of public trees, an arborist from the Urban Forest and Ecology team must be notified, if:

- Roots are exposed during works
- Damage could occur, or has occurred, to tree roots
- Tree plot sizes require alteration
- Soil levels require alteration

For tree protection requirements, refer to the City of Melbourne Urban Forest and Ecology's Tree Protection factsheet to tree protection requirements: Information for service and contractors undertaking woks near council trees. https://www.melbourne.vic.gov.au/sitecollectiondocuments/tree-protection-fact-sheet-service-contractors.pdf. Where required, Tree protection zones, in accordance with this factsheet and Australian Standard 4970 Protection of trees on development site, shall be established prior to the commencement of work and remain in place until the all works are completed.

All work allowed within a Tree protection zone must be under the supervision of an Australian Qualifications Framework Level 5 arborist, and work methods must be approved by the arborist in compliance with Australian Standard 4970.

All other construction activity shall be excluded from Tree protection zones at all times, including the storage of equipment and materials, as detailed in the factsheet information for service providers and contractors undertaking works near public trees.

Consistent with Australian Standard 4970 Protection of trees on development sites, all tree roots within Tree protection zones must remain undamaged with bark in-tact. If roots trimming is unavoidable and approved by Council's Urban Forest and Ecology Team, arborist supervision is required. All root pruning must comply with the Australian Standard 4373 Pruning of amenity trees.

Lifting and relaying of pitchers must be undertaken in a root-sensitive manner that does not damage the roots.

Any excavation allowed within a Tree protection zone must be undertaken using root-sensitive, non-destructive excavation techniques, such as: manual excavation using non-mechanical hand-held tools: or, low-pressure hydro-excavation.

Where tree roots are found, they must remain in-tact and undamaged.

Where possible and practical, modify work methods to accommodate for tree roots. For instance, shave or cut pitchers when re-instating over tree roots; or, use less crushed rock when re-instating asphalt rather than pruning tree roots.

Example of Tree protection zone radii based on trunk diameter.

Trunk Diameter at Breast Height Tree protection zone radius from centre of trunk:

<16cm	2m
20cm	2.4m
40cm	4.8m
75cm	9m
100cm	12m

125cm	15m (except where crown protection is required)

The Tree protection zone for Palms at least 1m outside the crown's projection.

21.7 Structural Soils

The use and application of structural soil to be as shown in the drawings. Structural soil to have the following characteristics;

Structural soil mix is to be a thoroughly combined mix of aggregate and filler soil mix in a ratio of 5:1 (by weight), to the structural requirements of the project civil engineer as follows:

21.7.1 Filler soil mix

Filler soil shall be a thoroughly combined mix of a clay loam or similar soil (Burdett's mountain soil blend may be suitable) and 5% by volume of composted green waste, screened to less than 12mm, with the following properties.

Submit sample for approval.

- Organic matter <1% by weight
    - Ph in water 5.5 - 6.5
    - Electrical conductivity <1.2 ds/m
    - Ammonium 20-200mg/kg
    - Phosphorous 10-50mg/kg

21.7.2 Additives:

To the above filler soil components, the following additions are required (to be confirmed during testing of samples for approval).

- Magrilime or a 50/50 lime/dolomite mix to bring pH to 5.5 - 6.5
    - Trace element mix 100g/ cubic metre
    - Potassium nitrate 300g/ cubic metre
    - Nitram (ammonium nitrate) 300g/ cubic metre
    - Superphosphate 300g/ cubic metre
    - Iron sulphate 500g/ cubic metre
    - Controlled release fertiliser (8-9 month osmocote) 1.5kg/ cubic metre
    - Gypsum 300g/ cubic metre
    - Magnesium sulphate (Epsom salts) 150g/ cubic metre

These additives must be mixed with the filler soil and tested for compliance with the specification. Filler soil mix shall be installed as detailed.

21.7.3 Aggregate:

Shall be 40mm crushed basalt. Gravel shall be clean and free from clay and other matter. Submit sample for approval. The aggregate shall be of the following particle size distribution:

A.S. sieve percent passing

53.0100

37.5 90-100

26:5 0-75

19.0 <15

13.2 <2

9.5 <2

6.7 <2

4.75 <2

2.360

Transporting: soil mixes must be delivered to site pre-blended. The soil mix must be transported in a moist condition to prevent segregation of components.

21.8 Water Sensitive Urban Design Works

Water Sensitive Urban Design specifications for the preferred Water Sensitive Urban Design typologies for City of Melbourne are available in urbanwater.melbourne.vic.gov.au/industry/blue-green-infrastructure-design-typologies-for-streetscapes:

Each design package includes:

- Planning and design guidance
- Engineering drawings
- Construction and establishment advice

Some of the drawings associated with these typologies are not yet included in the Engineering Standard Drawings. You will need to work with our Infrastructure and Assets team and Urban Forest team to finalise your design and obtain relevant approvals.

21.8.1 Raingarden Tree Pit

This is the most common typology in the CBD and due to the unique nature of raingarden tree pits, their construction should be as per design documentation. Further information may be obtained from the Blue Green Infrastructure Design Typologies for Streetscapes and the Engineering Standard Drawings.

Drainage rates and water ponding duration of a raingarden tree pit must not limit species selection for the plot. Please refer specification to the Urban Forest and Ecology Team for review prior to installation.

The image shows a tree protected by a tree guard and at ground level a tree pit frame and lid as per design standard 706.03. There is a bluestone overflow kerb to one side of the tree pit (in keeping with design standard 301.03) and paving on the other side. On the kerbside, there is a steel grated inlet between the kerb and road. The illustration shows a fall on this side that captures water for the tree.

There is a layer of approved ‘fast draining’ filtration soil around the roots of the tree. Under this layer, there is a transition layer of approved ‘drainage sand’ followed by a drainage layer of approved gravel, underneath a slotted PVC pipe connects to the stormwater network. An underground slotted PVC pipe is shown around three sides of the tree plot (does not run along the kerb side of the plot).

A standard bluestone kerb and channel in keeping with design standard 301.01 are shown as a line drawing to one side of the tree plot. Cattle rail bollards are installed on two sides of the tree and in parallel to the kerb (design standard 704.05). There is a steel inlet grate adjacent to the tree plot which covers the channel and some of the road surface (design standard 304.01). Bluestone paving is used around the tree plot.

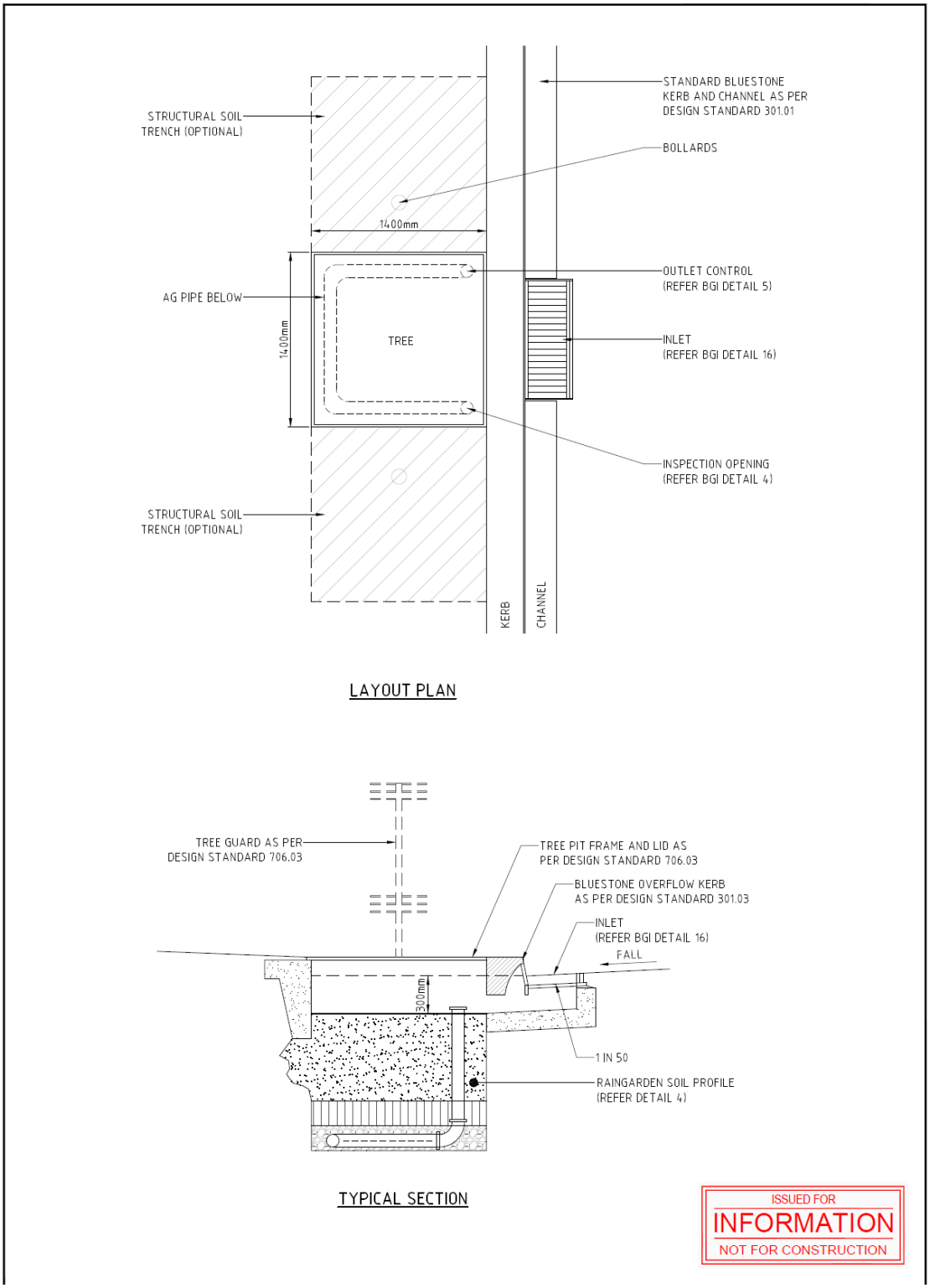

Figure 21.8.1: Raingarden tree pit. Go to https://urbanwater.melbourne.vic.gov.au to access the referred detail drawings.

Note 1: Extended Detention Depth

Depth of temporary ponding (from invert of gutterstone to top of filtration layer) shall be not less than 100 mm.

Note 2: Filtration Layer

The depth of the soil filtration layer is variable and is subject to the depth of the adjoining stormwater drain.

The soil filtration layer is to be made up according to "Adoption guidelines for stormwater biofiltration systems: Cities as water supply catchments – sustainable technologies" (Cooperative Research Centres Program Water Sensitive Cities, 2015), available at https://watersensitivecities.org.au/content/stormwater-biofilter-design/ and in accordance with the City of Melbourne Tree Planter Soil Specification (contact Urban Forest team).

Key sample specifications:

- The rootzone medium is to be composed of a sand, loamy sand or coarse sandy loam soil of <1% organic matter by weight.
- This soil is to be installed in 150 mm lifts and compacted gently by foot or with one pass of a plate compactor.
- After compaction it should still be possible to push a metal spike into the soil or to dig into the soil with a spade with minimal effort. The soil used for the rootzone medium is to have a saturated hydraulic conductivity of between 20 mm/hr and 50 mm/hr, determined using the methods set out in Australian Standard 4419 Soils for Landscape and Garden Use.
- The soil used shall have a pH of between 5.5 and 7.0 and a maximum electrical conductivity (before the addition of fertilizer materials) of 0.5 dS/m (1:5 soil water extract). The pH of the soil is to be corrected as such before delivery to the site.

A sample of the soil filtration media together with the relevant test certificate/s from an approved test laboratory showing conformance to the above specification shall be submitted to the Superintendent for approval prior to commencement of any bioretention tree plot works

The soil media shall be only minimally compacted (lightly, using hand tools only) where necessary to avoid subsidence and preferential flows.

No mulch is used on the filter media surface.

Note 3: Transition layer

A 150 mm to 200 mm of coarse sand 'transition layer' shall be provided.

Particle size distribution - bridging criteria – the smallest 15% of sand particles must bridge with the largest 15% of filter media particles (Water by Design, 2009; VicRoads, 2004): D15 (transition layer) ≤ 5 x D85 (filter media) where: D15 (transition layer) is the 15th percentile particle size in the transition layer material (i.e.,15% of the sand is smaller than D15 mm), and D85 (filter media) is the 85th percentile particle size in the filter media. The best way to compare this is by plotting the particle size distributions for the two materials on the same soil grading graphs and extracting the relevant diameters (Water by Design, 2009).

Refer to the Adoption guidelines for stormwater biofiltration systems: Cities as water supply catchments – sustainable technologies" (CRCWSC, 2015), available at https://watersensitivecities.org.au/content/stormwater-biofilter-design/ for more details.

Note 4: Drainage layer

A 150mm to 200 mm gravel layer shall be provided around the perforated pipe (see Note 5), using fine clean (washed) gravel, such as 2-5mm screenings.

Particle size distribution – bridging criteria - D15 (drainage layer) ≤ 5 x D85 (transition media) where: D15 (drainage layer) - 15th percentile particle size in the drainage layer material (i.e., 15% of the aggregate is smaller than D15 mm), and D85 (transition layer) - 85th percentile particle size in the transition layer material.

Refer to the Adoption guidelines for stormwater biofiltration systems: Cities as water supply catchments – sustainable technologies" (Cooperative Research Centres Program Water Sensitive Cities, 2015), available at https://watersensitivecities.org.au/content/stormwater-biofilter-design/ for more details.

Note 5: Perforated Pipe

Perforated pipe of 100 mm diameter with orifice area of 2100 mm^2/m. Pipe shall be laid as per drawing to prevent sediment deposition, and to reduce the risk of root incursion (by preventing sitting water). Pipe to be continued up through to surface to allow inspection/cleaning operations.

Electrical Conduit

Supply and install 100mm dia heavy duty orange electrical conduit (where specified in this contract document)). The conduit to be laid on min 75mm compacted crushed rock or stabilised sand with minimum 600mm cover to the new design surface level. Backfill in 150mm layers with crushed rock Class 2 to the underside of the concrete base for the bluestone paving. Supply and lay marking tape at 300mm above the top of the conduit.

21.8.2 Other Water Sensitive Urban Design Typologies

Specifications for other Water Sensitive Urban Design typologies are available in in urbanwater.melbourne.vic.gov.au/industry/blue-green-infrastructure-design-typologies-for-streetscapes and consist of:

Rectangular back of kerb raingarden

- Large outstand raingarden
- Small outstand raingarden
- Bluestone channel raingarden tree pit
- Side of road passive irrigation tree trench
- Outstand with surrounding permeable pavement
- Permeable Footpath

Some of the drawings associated with these typologies are not yet included in the Engineering Standard Drawings. You will need to work with our Infrastructure and Assets team and Urban Forest team to finalise your design and obtain relevant approvals.

21.8.3 Water Sensitive Urban Design Construction Hold Points

Hold points must be noted on construction drawings so construction supervisors can easily ensure that key staff are invited to hold point inspections.

- **Excavation and Installation of slotted pipe (Inspect trench prior to pipe install, inspect pipe install).** Ensure adequate depth for subsequent layers, liners are in place (as required), underdrain is correct size, laid flat and connected to the outlet/overflow pit, inspection risers are in place and ensure overflow pit is installed at correct height (if required).
- **Placement of filter material (inspect prior to backfill).** Ensure filter media is to specification. Ensure drainage and transition layer are to specification and installed at the correct depths.
- **Kerb inlet construction to ensure levels are correct**. Ensure water can flow in from the kerb invert and there is sufficient extended detention depth above the filter media and/or mulch layer.

- **Practical completion – or post planting.** Reinspect levels, underdrain outlet, pits and inspection riser(s) are accessible. Ensure plant health, planting density and plant species are correct. Inspect kerb, tree guards and other protective infrastructure to ensure they have been installed to specification and will achieve the desired outcome.

It is the contractor's responsibility to provide a minimum of 24 hours weekday's notice (unless agreed to prior) to the superintendent to arrange for an inspection for the hold points. Contact the Engineering Services or the Water Sensitive City Lead to organise the hold points.

21.9 Security Bollards

For security bollard details refer to City of Melbourne for further advice due to the sensitive nature of the product.

21.10 Kerbside Café Markers

Kerbside café markers are to be installed as per standard drawing 1P 50522.

22. Vibration management

22.1 General

22.1.1 Scope

This Section specifies the requirements for vibration produced by construction or demolition works associated with transport infrastructure, public utilities, and/or traffic (including earthworks).

22.1.2 Description of Vibration

Vibration is an oscillatory motion of particles that propagates in the form of characteristic waves (for example, compression, shear and surface waves). Vibration may be described by:

- Displacement – the distance that an element moves away from its static position.
    - Velocity – the instantaneous speed of an element.
    - Acceleration – the rate of change of the speed of an element.

Velocity and acceleration are often used to characterise the expected response of humans, structures and equipment to vibration levels. They are normally described in units of metre per second (m/s) and metre per second squared (m/s2) respectively.

Construction activities involving blasting, pile-driving, tunnelling equipment and large compressors, as well as heavy transportation such as trucks and trains, can create significant levels of vibration.

Construction can occur in close proximity to sensitive receptors including residential properties, educational facilities, hospitals and community facilities. The effects from exposure to excessive levels of vibration may include:

- Sleep disturbance
    - Annoyance (impacts on recreation, including relaxation/conversation)
    - Inhibited concentration, leading to difficulties in studying or learning
    - Building damage (including impacts on sensitive equipment/utilities/activities).

22.1.3 Reference Documents

The following document, which is referenced in this Section, forms part of this Specification only to the extent that it is referred to within;

Australian Standard 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance and demolition sites

ISO 14837-1 Mechanical Vibration – Ground-borne noise and vibration arising from rail systems

Australian Standard 2187.2-1993 Explosives - Storage and use - Use of explosives

Australian Standard 2187.2:2006 Explosives - Storage and use - Use of explosives

Australia and New Zealand Environment Council 'Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration', 1990

Environmental Protection Act (2018) Noise Control guidelines, Publication 1254, section (2)

Environmental Protection Act (2018) Publication 480 – Best Practice Environmental

Management – Environmental Guidelines for Major Construction Sites

22.1.4 General

The Contractor is responsible for managing Work under the Contract to avoid Environmental Harm or Environmental Nuisance to Sensitive Receptors and Critical Facilities, Infrastructure or Utilities. For the purpose of this Specification potential vibration impacts are categorised in two forms:

- Human comfort vibration management relates to managing vibration to avoid nuisance to public, residents or people utilising the area in the vicinity of the Site.

Building / Structural vibration management relates to managing vibration to avoid structural damage to buildings and structures within and beyond the Site. This also includes to managing impacts on building contents and surrounding utilities and services.

This Technical Specification does not address vibration impacts to native fauna. In addition to the Sensitive Receptors and Critical Facilities, Infrastructure and Utilities identified in Section 22.3.1(b), the Contractor shall be responsible for identifying Sensitive Receptors and Critical Facilities, Infrastructure and Utilities likely to be affected by Construction vibration through the application of the performance requirements outlined in Section 22.3.2.

22.1.5 Plant and Equipment

The plant and equipment used in the Works shall be appropriate for the execution of the tasks and shall be maintained in satisfactory working condition at all times while operating.

22.2 Requirements and Materials

This section describes the methods and standards required when conducting vibration measurements of construction activities. It is important to note that for any measurement, the instrumentation must be properly protected from unintended vibration or electromagnetic interference. As a general rule when conducting measurements, it is essential to ensure that the equipment is located in a stable position secured appropriately and properly isolated from obvious sources of interference.

22.2.1 Performance Requirements

The Contractor shall at all times take reasonable and practicable Management Measures to mitigate:

- Vibration impacts associated with Work under the Contract so as not to cause Environmental Harm and Environmental Nuisance in accordance with Environmental Protection Act 1994 (Human comfort Vibration), and

Environmental Harm to structures, premises, services and buildings within or beyond the boundary of the Site as a result of Work under the Contract. (Building / Structural Vibration).

The Contractor shall document the reasonable and practicable Management Measures either in a standalone Vibration Management Plan or the EMP(C). The Contractor shall review the Vibration Management Plan and update and implement additional Management Measures where:

- directed by the Administrator
    - in response to a justifiable complaint caused by the Work under the Contract
    - in the event of structural / building damage caused by the Work under the Contract, or
    - when changes in the equipment/work method, intensity, location, duration or timing of impacts that are expected to increase vibration impacts are foreseen.

The performance requirements of the Contract are dependent on the vibration risk level specified in Section 22.4.

22.2.2 Vibration measurement

This section describes vibration measurements for ground-borne vibration only. It does not prescribe any methods to measure airborne vibration.

Instrumentation and methodologies required for vibration measurement will depend on the type of vibration and whether human comfort or structures/contents are being considered. Requirements may also vary based on the types of ground, buildings or structures on which measurement is undertaken.

Instrumentation utilised for vibration monitoring should be of sufficient sensitivity to allow comparison with the criteria specified in Chapter 22.3. Instrumentation should also comply with the minimum requirements contained in:

- for human perception and blasting – Australian Standard 2187.2-1993 Appendix J, or
- the relevant standard under which those limits were developed (for example, British Standard BS 7385-2 and German Standard DIN 4150-3).

While standards may state additional requirements the following three sections provide general requirements for calibration, instrumentation performance and coupling to substrate.

a) Instrumentation

Vibration measurement may be conducted using either geophones (seismic velocity transducers) or accelerometers, in a triaxial transducer arrangement, so that each of the three component vibration velocities or accelerations can be measured. In all cases the particular transducer orientation should be properly recorded and documented. This should specifically include the transducer orientation with respect to the source and to the surface on which it is fixed.

The instrumentation selected should have a frequency range meeting the particular assessment requirements.

b) Calibration

Testing and recalibration of geophones, accelerometers and other vibration measurement instrumentation should be conducted by a National Association of Testing Authorities certified calibration laboratory at intervals of 12 months.

c) Coupling to substrate

To ensure the vibration measurement accuracy, it is critical to maintain effective and secure coupling of the transducers to the ground, building foundations, other structural elements or substrates on which measurement is undertaken.

The following guidelines should be followed:

- for geophones – the guidance given in the International Society Explosives Engineers Field Practice Guidelines for Blasting Seismographs
- for accelerometers – the guidance given in Australian Standard 2775-2004.

The preferred coupling method depends on site conditions. Where there is a rigid surface (for example, concrete or rock), adhesive or mechanical bonding can be used. Where the surface is soil, the transducer can be embedded or fixed to an embedded mount (for example, 300 mm concrete cube or similarly sized cylinder). If measurements are repeated at the same location, an embedded mount is particularly justified for consistency of results.

Coupling with soil spikes in soft conditions and in non-cohesive soils may lead to exaggerated measurements and is not recommended.

d) Human perception

Measurements for gauging human perception should be conducted to determine the Resultant PPV and meet the following requirements:

- Measurements on the ground should be representative of ground motions at the subject building or structure, but at sufficient distance from the building or structure to avoid undue interference from that structure.
- Measurements within a structure should be located on the floor of the room where any complaint originates or where the greatest adverse impact is predicted.
- One or two measurement points in a suitable available area, preferably in the central part of the room, will typically be sufficient in most cases.
- Measurement should be conducted during construction activity for a representative two-day period to determine vibration exposures.

e) Structural damage/building contents

Measurement of Prestressed Concrete Pressure Vessel and Resultant PPV for assessing structural damage and building contents should be:

- located at the base/foundation of the structure as required by the standard
    - also located at the horizontal plane of the highest floor of a structure, if required
    - located to be representative of sensitive building contents

22.3 Construction

This section defines working hours, sensitive/critical receptors and criteria/limits that should be considered when assessing vibration impacts from construction activities.

22.3.1 Sensitive receptors, work hours and activities

a) Sensitive land uses

Sensitive land uses have the potential to be impacted by construction vibration. Sensitive land uses/receptors considered in this Specification include:

- a dwelling (detached or attached) including house, townhouse, unit, reformatory institution, caravan park or retirement village
- a library, child care centre, kindergarten, school, school playground, college, university, museum, art gallery or other educational institution, hospital, respite care facility, nursing home, aged care facility, surgery or other medical centre
- a community building including a place of public worship
- a court of law
- a hotel, motel or other premises which provides accommodation for the public
- a commercial (office) or retail facility
- a protected area, or an area identified under a conservation plan as a critical habitat or an area of major interest under the Nature Conservation Act 1992
- an outdoor recreational area (such as public park or gardens open to the public, whether or not on payment of a fee, for passive recreation other than for sport or organised entertainment) or a private open space.

Other receptors which may at times be sensitive to construction vibration include industrial premises, other infrastructure and utilities/services.

b) Critical facilities, infrastructure and utilities

Critical facilities, infrastructure and utilities (critical receptor) as those buildings, infrastructure and utilities which, by their nature or by the nature of the activities conducted therein, are particularly sensitive to disruption due to construction vibration effects, or where the consequences of such disruption would be severe. Critical facilities, infrastructure and utilities are a subset of sensitive receptors and include the following:

- Critical facilities include medical/health buildings, educational/research facilities, courts of law and community buildings. The latter three are only considered when in use. Critical facilities are usually sensitive to construction vibration.
- Critical infrastructure and utilities include dams, electrical and telecommunications facilities (including railway signalling systems), oil and gas pipelines and other petrochemical installations and utilities such as water mains and sewers. Critical infrastructure and utilities are typically sensitive to construction vibration.
- Other facilities, infrastructure or utilities (for example bridges) which may be deemed to be of critical importance on a project-specific basis.

Ordinary residential sites and other vibration sensitive sites are not considered to be critical facilities or infrastructure. Similarly, heritage listed sites are not automatically included in the definition of critical facilities and infrastructure, but may be included as such on a project-specific basis.

Where critical facilities, infrastructure or utilities are likely to be affected by construction activity, specific assessment to determine appropriate construction vibration controls are required in all cases.

c) Construction activities and work periods

Construction activities are those occurring within the project area, which include the following:

- general construction (for example, pile driving and compaction, work sites, earthworks)
- construction traffic
- blasting.

Table 22.3.1 defines different work periods of the day used in this Specification for construction activities, taken from the Activities Local Law 2009 (Local Law)

Table 22.3.1: Work periods for construction activities

Work Period	General Construction & Construction Traffic	Blasting
Standard hours	Monday – Friday 7:00 am to 7:00 pm Saturday 8:00 am to 3:00 pm	Monday – Friday 9:00 am to 5:00 pm Saturday 9:00 am to 1:00 pm
Non-Standard hours – day/evening	Monday – Friday 6:00 pm to 10:00 pm Saturday 1:00 pm to 10:00 pm Sunday 7:00 am to 10:00 pm	Generally, blasting is not to be conducted outside standard hours. Any blasting outside of standard hours must be approved by the City of Melbourne prior to blasting. It is noted that reduced limits may be required to be achieved.
Non-Standard hours – night time	Monday – Sunday 10:00 pm to 7:00 am	Generally, blasting is not to be conducted outside standard hours. Any blasting outside of standard hours must be approved by the City of Melbourne prior to blasting. It is noted that reduced limits may be required to be achieved.

Note: Public holiday periods are taken to be the same periods as defined for Sunday.

Construction activities with the potential for significant impacts should be discouraged if possible in the night time. The use of high impact machinery such as pile driving, vibratory rollers and impact devices (rock breakers and jackhammers) should be avoided where possible for night work construction in residential or other vibration sensitive areas. Where night work is required in the vicinity of residential or other sensitive sites, careful planning is required and a higher level of control is recommended, to mitigate potential complaints of sleep disturbance.

If the use of high impact machinery is unavoidable, the level of vibration from activities involving the use of the machinery must be properly assessed before approval for any activities outside Standard working hours is given by the City of Melbourne.

22.3.2 Construction vibration criteria

Vibration criteria in this Specification relate to both human comfort and structural/building damage. All reasonable and practicable control measures are still required to meet the criteria as part of best practice. If all reasonable and practicable control measures are applied and vibration levels exceed the nominated criterion

values, the contractor will need to negotiate directly with the affected person or community for further mitigation measures (for example, respite periods or alternative mitigation/work method).

Vibration criteria are defined for the following vibration emissions categories:

- Ground-borne vibration (general construction and blasting).
- Airborne vibration.

The determination of vibration criteria for this Specification is based on the review of Australian and international standards and guidelines.

a) Ground-borne vibration

Vibration criteria for both human comfort and building damage due to ground-borne vibration caused by construction activities (for example, pile driving, compaction and blasting) are provided in this section. It should be noted that in most cases compliance with the human comfort criteria would also achieve the building damage criteria.

(i) Human comfort

General construction and construction traffic

For human comfort, to minimise annoyance due to ground-borne construction vibration, this Specification adopts vibration levels with lower and upper limits as presented in Table 22.3.2(a). The lower limits are generally considered to be just perceptible. The upper limits are considered to cause significant annoyance if exceeded.

All reasonable and practicable measures should be implemented to achieve the lower limit. Exceedance of the upper limit requires immediate action and extensive community consultation to determine further mitigation measures.

Table 22.3.2(a): Human comfort vibration limits to minimise annoyance

Building	**Work Period**	**Resultant PPV, mm/s - Lower limit**	**Resultant PPV, mm/s - Upper limit**
Dwellings (including hotels and motels)	Standard hours	1.0	2.0
Dwellings (including hotels and motels)	Non-Standard hours – evening	0.3	1.0
Dwellings (including hotels and motels)	Non-Standard hours – night time	0.3	1.0
Medical/health buildings (wards, surgeries, operating theatres, consulting rooms)	All	0.3	1.0
Educational facilities (rooms designated for teaching purposes)	While in use	0.3	1.0
Court of Law (Court rooms)	While in use	0.3	1.0
Court of Law (Court reporting and transcript areas, Judges' chambers)	While in use	0.3	1.0
Community buildings (libraries, places of worship)	While in use	1.0	2.0
Commercial (offices) and retail areas	While in use	1.0	2.0

(ii) Building damage

The vibration criteria for building damage due to blasting is considered the same as that induced by transient ground-borne vibration due to general construction activities.

British Standard BS 5228-2 presents guidance on the significance of vibration impacts in terms of structural response, these are presented in Table 22.3.2(b) below;

Table 22.3.2(b): Guidance on Impacts of Vibration Levels on Building Structures

Building Type	**Peak Component Particle Velocity in Frequency Range of Predominant Pulse - 4 Hz to 15 Hz**	**Peak Component Particle Velocity in Frequency Range of Predominant Pulse - 15 Hz and above**
Reinforced or framed structures Industrial and heavy commercial buildings	50mm/s at 4 Hz and above	50mm/s at 4 Hz and above
Unreinforced or light framed structures Residential or light commercial buildings	15mm/s at 4 Hz increasing to 20mm/s at 15 Hz	20mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above

NOTE 1: Values referred to are at the base of the building.

NOTE 2: At frequencies below 4 Hz, a maximum displacement of 0.6mm (zero to peak) is not to be exceeded.

(iii) Minimum working distances from sensitive receptors

As a guide, minimum working distances from sensitive receivers for typical items of vibration intensive plant are listed in Table 22.3.2(b). The minimum distances are quoted for both “cosmetic” damage (refer BS 7385) and human comfort (refer OH&E’s Assessing Vibration - a technical guideline). The minimum working distances for cosmetic damage must be complied with at all times, unless otherwise approved by the City of Melbourne or under the environmental license as relevant. DIN 4150 has criteria of particular reference for heritage structures.

Table 22.3.2(c): Recommended minimum working distances for vibration intensive plant from sensitive receiver

Plant Item	**Rating / Description**	**Minimum Working Distance - Cosmetic Building Damage**	**Minimum Working Distance - Human Response**
Vibratory Roller	< 50kN (Typically 1-2 tonnes)	5m	15m to 20m
Vibratory Roller	< 100kN (Typically 2-4 tonnes)	6m	20m
Vibratory Roller	< 200kN (Typically 4-6 tonnes)	12m	40m
Vibratory Roller	< 300kN (Typically 7-13 tonnes)	15m	100m
Vibratory Roller	> 300kN (Typically 13-18 tonnes)	20m	100m
Vibratory Roller	> 300kN (> 18 tonnes)	25m	100m
Small Hydraulic Hammer	(300kg – 5 to 12t excavator)	2m	7m
Medium Hydraulic Hammer	(900kg – 12 to 18t excavator)	7m	23m

Plant Item	Rating / Description	Minimum Working Distance - Cosmetic Building Damage	Minimum Working Distance - Human Response
Large Hydraulic Hammer	(1600kg – 18 to 34t excavator)	22m	73m
Vibro Pile Rig	Sheet piles	2m to 20m	20m
Pile Boring	≤ 800mm	2m (nominal)	4m
Jackhammer	Hand held	1m (nominal)	2m

(iv) Building contents, services and structural impacts

For building contents including sensitive instruments and electronics, vibration criteria should be established based on Human Comfort guidelines as set out in section 22.3.2(a) (i).

Where third party utilities and facilities (for example, bridges, cables, pipes, and so on) are in the vicinity of the project the owners should be consulted to determine their specific requirements in relation to vibration exposure. In the absence of third-party advice, guidance may be taken from the limits set out in section 22.3.2(a) (ii).

22.4 Quality Assurance and Assessment

It is the responsibility of the construction entity and its representatives to ensure that a Quality Assurance Program in the form of a Noise and Vibration Management Plan and a construction vibration assessment report have been prepared prior to any construction works.

22.4.1 Type of assessments

Construction vibration assessments are generally conducted at two stages of a project:

- pre-construction stage
    - construction stage.

The type of construction vibration assessments required is dependent on a number of factors such as the purpose of the assessment, the scale and type of works, and the separation distance to sensitive and critical receptors. Screening assessments and detailed assessments are normally required during the pre-construction stage, while planned assessments, complaint assessments and trial assessments may be required during the construction stage. Table 22.4.1 provides a brief description of the types of assessments.

Table 22.4.1: Vibration assessment types

Stage	Assessment Type	Description
Pre-construction	Screening Assessment	A simplified assessment which gives a robust set of mitigation and management measures for inclusion in a Noise and Vibration Management Plan. Typically, a screening assessment does not include measurement or detailed computer modelling.
Pre-construction	Detailed Assessment	A detailed assessment which gives a robust set of mitigation and management measures for inclusion in a Noise and Vibration Management Plan. A detailed assessment requires measurement and detailed computer modelling to determine impacts.

Stage	Assessment Type	Description
Construction	Planned Assessment	Assessment and reporting as a result of planned monitoring triggered by a specific requirement within a Noise and Vibration Management Plan. If adverse impacts are determined then any changes to mitigation and management should be incorporated into the Noise and Vibration Management Plan.
Construction	Complaint Assessment	Assessment and reporting typically as a result of monitoring in response to a complaint. If adverse impacts are determined then any changes to mitigation and management should be incorporated into the Noise and Vibration Management Plan.
Construction	Trial Assessment	Assessment and reporting as a result of monitoring in response to a trial of a particular work activity. Trial Assessments may be required where there is insufficient knowledge available to predict the resulting impacts with a reasonable level of confidence. If the impacts are considered to be acceptable, the description of works, impacts and mitigation and management should be incorporated into the Noise and Vibration Management Plan.

For each type of assessment, the following two tasks are generally required:

a) Identification of construction works

This is required to identify each type of work conducted within the project area. Descriptions should include tabulations of type and number of machines used, time periods of use and where the works are to be conducted within the project area.

b) Identification of sensitive and critical receptors

This is required to identify sensitive and critical receptors including critical facilities. The identification may need to consider surrounding services and utilities which may be impacted by works. Once the identification is completed, the sensitive and critical receptors should be represented graphically in relationship to the project area. This may be conducted through vibration modelling and/or predictive impact zones if sensitive modes are located within 20m of dynamic vibration sources or 50m of transient vibration sources.

Pre-construction assessment aims to identify potential vibration impacts and propose necessary mitigation measures. The types of assessment and reporting will be determined by the level of risk. The construction entity and its representatives will be expected to nominate in writing to the City of Melbourne the project's vibration risk level. Suitable justification in the form of an adequate screening assessment (see section 22.4.2(a)) should be provided with the risk application. The risk level of the project must be reassessed in response to a justifiable complaint or in the event of structural/building damage caused by the project's activities, or when changes in the equipment/work method, intensity, location, duration or timing of impacts are expected to increase vibration impacts. Where the vibration risk level is increased it is the responsibility of the construction entity to conduct additional assessments and revise the Noise and Vibration Management Plan. Any revision to the Noise and Vibration Management Plan should be accepted by the City of Melbourne. It is at the discretion of the City of Melbourne (i.e. project manager) whether construction continues prior to the acceptance of a revised Noise and Vibration Management Plan.

Where this vibration risk level is accepted to be medium to high, further assessment to inform the Noise and Vibration Management Plan may be required in the form of a detailed assessment.

The pre-construction assessment and resulting Noise and Vibration Management Plan may need to be supported by periodic monitoring conducted during the construction stage in response to planned actions, complaints and trial works. It should be noted that a complaint assessment may only be required where preliminary investigations cannot quickly resolve the issue and the complaint is justifiable.

The interaction of assessment types and the Noise and Vibration Management Plan is presented in Figure 22.4.1.

Figure 22.4.1: Assessment types and Noise and Vibration Management Plan

Figure 22.4.1 shows a flow chart with assessment types and Noise and Vibration Management Plan (noise and vibration management plan). Pre-construction: A screening assessment is undertaken followed by a risk assessment. If the risk assessment identifies high risk, a detailed assessment will need to be undertaken and mitigation measures put in place. If the risk is medium or low, a detailed assessment is not required, but mitigation measures must be put in place. A Noise and Vibration Management Plan must then be produced prior to construction. During construction mitigation measures must be put in place and then planned assessment, complaint assessment and trial assessments may all be undertaken. Information from these assessments will be used to improve, update the mitigation measures as construction progresses.

22.4.2 Assessment during pre-construction stage

At the pre-construction stage a screening and/or detailed assessment may be conducted for projects. Screening assessments may be conducted to:

- determine vibration risks and necessary mitigation/management requirements
- determine the need for a detailed assessment

If the screening assessment results for vibration are below the criteria in Chapter 22.3 and the vibration impacts are accepted by the City of Melbourne to be low risk, then the screening assessment results can be used to prepare a basic Noise and Vibration Management Plan by incorporating necessary mitigation and management requirements. Where the screening assessment results show that the criteria might be exceeded and the vibration impacts are considered significant, a detailed assessment may be required to determine mitigation/management requirements of a more detailed Noise and Vibration Management Plan.

A further detailed assessment should only be conducted where:

- screening results show that the criteria might be exceeded, and/or
- measurements are likely to change the criteria, and/or
- the differences between screening and detailed predictions are significant

a) Screening assessment

A screening assessment may be used to initially assess the impacts and understand suitable mitigation and management requirements. Whilst simpler than a detailed assessment, a screening assessment should result in a robust set of mitigation and management measures.

The screening assessment should include the following as presented in Table 22.4.2(a).

Table 22.4.2(a): Screening assessment requirements

Item	Requirements
Identification of all relevant work practices and equipment	Review all stages of the construction project to identify all vibration generating construction works and activities including (but not limited to): • work sites • construction traffic • excavation and blasting • underground works.
Identification of sensitive and critical receptors and services/structures	Identify all sensitive receptors and critical facilities within and in the vicinity of the project area. Included should be any services, structure and utilities which may be sensitive to vibration impacts.
Identification of the relevant vibration issues	Based on the above, identify whether the following issues are to be included within the assessment: • ground-borne vibration (including blasting) • airborne vibration (including air blast overpressure).
Measurement requirements	Measurements are not typically required for a screening assessment. If conducted they may be used to: • justify the construction vibration criteria • provide a benchmark for existing vibration exposure. Section 2 provides methods for vibration measurement, if required.
Prediction requirements	Predictions for a screening assessment may rely on spreadsheet calculations and may not require the use of detailed computer models. Predictions should consider worst case operations for each of the identified work practices during the various phases of a given construction project. Predictions should be made for construction, construction traffic and blasting.
Reporting requirement	In addition to the reporting requirements within Section 22.4.4 of this Specification, the following should be included: • justification for the use of a screening assessment as opposed to a detailed assessment.

b) Detailed assessment

A detailed assessment requires a greater level of information than that required for a screening assessment. It results in a better understanding of the vibration impacts and the necessary mitigation and management requirements. A detailed assessment would normally be required for high risk and some medium risk construction projects.

The general assessment method is similar to that required for a screening assessment. However, it is supported by measurements and detailed computer modelling to determine impacts, mitigation and management.

The detailed assessment should include the following as presented in Table 22.4.2(b).

Table 22.4.2(b): Detailed assessment requirements

Item	Requirements
Identify all relevant work practices and equipment	Review all stages of the construction project to identify all relevant vibration generating construction works and activities including (but not limited to): • work sites • construction traffic • excavation and blasting • underground works.
Identify sensitive and critical receptors and services/structures	Identify all sensitive receptors and critical facilities within and in the vicinity of the project area. Included should be any services, structures and utilities which may be sensitive to vibration impacts.
Identify the relevant vibration issues	Based on the above, identify whether the following issues are to be included within the assessment: • ground-borne vibration (including blasting) • airborne vibration (including air blast overpressure).
Measurement requirements	If relevant, conduct ambient pre-construction vibration monitoring. Sensitive receptors should be grouped by location and a representative location selected for each group. This data is used to provide an existing benchmark for comparison to construction vibration exposure. Section 22.2 provides methods for vibration measurements. While requirements for geo-technical investigations are not within the scope of this Specification, it is noted that the results of such investigations are highly relevant to the choice of construction method and also to the understanding of ground propagation conditions and ground related vibration susceptibilities at the site.
Prediction requirements	Predictions for a detailed assessment require the use of specific algorithms or detailed computer models. Typically, a greater level of detail is required to conduct the assessment (for example, structural foundations, ground characteristics, water table, topography, meteorology, external facade construction/orientation of critical facilities). Predictions should consider worst case operations for each of the identified work practices during the various phases of a given construction project. Where screening assessments for vibration show that impacts from vibration are unlikely, detailed vibration predictions may not be required. Predictions should be made for construction, construction traffic and blasting.
Reporting requirements	In addition to the reporting requirements within Section 22.4.4 of this Specification, the following should be included: • construction scheduling/timelines.

22.4.3 Assessment during construction stage

Vibration assessments during construction stage may be proactive or reactive. Proactive assessments are in the form of planned measurements conducted as a requirement of a Noise and Vibration Management Plan. Proactive assessments may also be conducted where the impacts from a work activity are unknown or difficult to predict. Thus, a trial assessment may be required to determine the likely impacts.

Reactive assessments are typically conducted in response to complaints received during construction. A complaint assessment should determine whether the construction impact creates a justifiable concern and is typically managed under the community consultation provisions within the Noise and Vibration Management Plan.

a) Planned assessment

A planned assessment is conducted in response to planned measurement as a requirement of a Noise and Vibration Management Plan. A planned assessment requires the activity to be routinely monitored and reported to determine compliance with Noise and Vibration Management Plan requirements.

The planned assessment should include the following as presented in Table 22.4.3(a).

Table 22.4.3(a): Planned assessment requirements

Item	Requirements
Identification of all relevant work practices and equipment	Identify all work practices and equipment to which the complaint monitoring relates.
Identification of sensitive and critical receptors and services/structures	Identify all sensitive receptors, critical facilities, services, structures and utilities within and in the vicinity of the project area to which the complaint monitoring relates.
Identification of the relevant vibration issues	Based on the above, identify whether the following issues are to be included within the assessment: • ground-borne vibration (including blasting) • airborne vibration (including air blast overpressure).
Measurement requirements	Justify the selection of monitoring locations. Locations should be selected to adequate represent all identified sensitive and critical receptors and services/structures/utilities. Section 2 provides methods for vibration measurements. The duration of the measurements will be specified within the Noise and Vibration Management Plan. Alternatively, the duration of the measurements may be agreed with the affected parties. As a minimum, monitoring should cover vibration worst case operations.
Reporting requirements	In addition to the reporting requirements within Section 22.4.4 of this Specification, the following should be included: • justification of the duration of measurements and how worst-case construction impacts were included within the assessment.

b) Complaint assessment

A complaint assessment typically involves measurement of particular work activities which are perceived by sensitive and critical receptors as being annoying. A complaint assessment requires the impact of the activity to be measured, predicted or a combination of both, to determine likely impacts during worst case construction and environmental conditions.

A complaint assessment should be conducted for a justifiable complaint only when preliminary investigations and communication cannot quickly resolve the issue.

The complaint assessment should include the following as presented in Table 22.4.3(b).

Table 22.4.3(b): Complaint assessment requirements

Item	Requirements
Identification of all relevant work practices and equipment	Identify all work practices and equipment to which the complaint monitoring relates.
Identification of sensitive and critical receptors and services/structures	Identify all sensitive receptors, critical facilities, services, structures and utilities within and in the vicinity of the project area to which the complaint monitoring relates.
Identification of the relevant vibration issues	Based on the above, identify whether the following issues are to be included within the assessment: • ground-borne vibration (including blasting) • airborne vibration (including air blast overpressure).
Measurement requirements	Justify the selection of monitoring locations. Locations should be selected to adequate represent all identified sensitive and critical receptors and services/structures/utilities. Section 2 provides methods for vibration measurements. The duration of the measurements will be specified within the Noise and Vibration Management Plan. Alternatively, the duration of the measurements may be agreed with the affected parties. As a minimum, monitoring should cover vibration worst case operations.
Reporting requirements	In addition to the reporting requirements within Section 22.4.4 of this Specification, the following should be included: • justification of the duration of measurements and how worst-case construction impacts were included within the assessment.

22.4.4 Assessment reporting requirements

All assessment reports should be prepared by or supervised by a suitably qualified person with relevant experience.

General reporting requirements for each of the assessment types include:

- Description of construction works.
    - Review of sensitive and critical receptors (see Section 22.3.1 of this Specification). Typically, a pre-construction survey or surveys are used to ensure that all buildings, building contents, services and utilities and ground and landform elements susceptible to vibration induced disruption or damage are identified prior to commencement of any construction activity at the site.
    - Identification of issues for consideration – ground-borne vibration (including blasting), and airborne vibration (including air blast overpressure) from all construction activities including work sites, construction traffic, excavation and blasting and underground works.
    - Description of measurements conducted – reporting requirements as presented in Section 22.4.
    - Determination of vibration criteria as per Section 22.3.
    - Details of source data used in the determination of vibration emissions
    - Details of vibration prediction methods including formulae or algorithms used to determine exposure at sensitive and critical receptors.
    - Results of vibration predictions.

- Assessment of construction vibration predictions and/or measurements against construction vibration criteria.
- Review of mitigation and management options considering practicality and reasonableness.
- Identify areas where building/structure/utilities condition surveys are required. These condition surveys should be conducted based on guidance presented in Section 22.4.5 of this Specification.
- Provision of a conclusion with a summary of requirements to be incorporated into a Noise and Vibration Management Plan. Sufficient detail should be contained within the assessment report to either prepare a Noise and Vibration Management Plan during pre-construction assessment (Section 22.4.2 of this Specification) or support the Noise and Vibration Management Plan following construction assessments (Section 22.4.3 of this Specification).

22.4.5 Condition surveys

Building condition surveys are required for all buildings and structures in the vicinity of the construction activity which would be subject to vibration impacts at levels that could cause building damage. Building contents investigations are required on a more limited basis, but are needed in all cases where vibration sensitive critical facilities (such as hospitals and research institutions) are involved. Additional detailed site investigations may be required where sensitive infrastructure, services and utilities are located in the vicinity of the proposed works. Section 22.3.2(a) (ii) notes the recommended minimum working distances for vibration intensive plant from sensitive receivers.

In some cases, building condition surveys may result in the identification of particularly vibration sensitive building structures or contents that were previously unknown to the project team. The condition survey information obtained could then be used to develop appropriate vibration mitigation measures and limits for inclusion in specifications and in the project Noise and Vibration Management Plan.

a) Building condition

The building condition survey program provides the mechanism by which the prior condition of buildings and other structures in an area likely to be affected at a significant level by construction vibration can be documented.

This is essential for purposes of ensuring that:

- building condition (or ‘state of repair’) is known prior to the onset of any construction vibration effects, and
- the proper degree of vibration control can be exercised during the period of construction.

Properly conducted, the building condition survey process also provides an effective means of establishing necessary contacts with the affected community well before commencement of any vibration related disruption.

Requirements for condition surveys should normally be determined on the basis of the results and recommendations of a vibration assessment.

All condition surveys and subsequent reporting should be conducted by or supervised by a suitably qualified person with relevant experience (that is a suitably qualified Engineer).

Building condition survey reports should be submitted to the City of Melbourne prior to commencement of construction. Subsequent to completion of the works, post-construction condition surveys should be conducted. Post-construction condition survey reports detailing the results of the inspections shall be submitted to the City of Melbourne following completion of the relevant activity.

b) Building contents

Where vibration sensitive building contents are identified as likely to be present in buildings or other structures, a building contents investigation should be conducted to ensure that the relevant items and their particular vibration susceptibilities are properly described and considered.

c) Infrastructure, services and utilities

Similar detailed site investigations may be needed where buried services or other critical infrastructure that may be susceptible to vibration induced disruption are present. While such services and infrastructure are usually substantially more robust than is the case with equipment which would be classed as ‘vibration sensitive’, site investigation is often necessary. In particular with such services and infrastructure, it may be very important to establish the actual condition of the item to be protected prior to construction vibration specifications being finalised.

Appendix 1

Melbourne Water Conditions

For all connections to Melbourne Water drainage assets, please refer to Melbourne Water conditions and contractor to obtain all necessary approvals.