PART E – TECHNICAL SPECIFICATION

TfNSW
Specification for
Cardiff Railway Station
Easy Access Upgrade
March 2012

Revision C
Tender Issue
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Preamble</td>
<td>4</td>
</tr>
<tr>
<td>E2</td>
<td>Scope of Works</td>
<td>6</td>
</tr>
<tr>
<td>E3</td>
<td>General requirements</td>
<td>18</td>
</tr>
<tr>
<td>E4</td>
<td>Adhesives, sealants and fasteners</td>
<td>34</td>
</tr>
<tr>
<td>E5</td>
<td>Fire-stopping</td>
<td>40</td>
</tr>
<tr>
<td>E6</td>
<td>Metals and prefinishes</td>
<td>44</td>
</tr>
<tr>
<td>E7</td>
<td>Sundry items</td>
<td>48</td>
</tr>
<tr>
<td>E8</td>
<td>Roof access safety systems</td>
<td>52</td>
</tr>
<tr>
<td>E9</td>
<td>Demolition</td>
<td>55</td>
</tr>
<tr>
<td>E10</td>
<td>Site management</td>
<td>61</td>
</tr>
<tr>
<td>E11</td>
<td>Earthwork</td>
<td>73</td>
</tr>
<tr>
<td>E12</td>
<td>Stormwater – site</td>
<td>81</td>
</tr>
<tr>
<td>E13</td>
<td>Pavement base and subbase</td>
<td>86</td>
</tr>
<tr>
<td>E14</td>
<td>Asphaltic concrete</td>
<td>90</td>
</tr>
<tr>
<td>E15</td>
<td>Sprayed bituminous surfacing</td>
<td>96</td>
</tr>
<tr>
<td>E16</td>
<td>Concrete pavement</td>
<td>101</td>
</tr>
<tr>
<td>E17</td>
<td>Segmental pavers</td>
<td>114</td>
</tr>
<tr>
<td>E18</td>
<td>Pavement ancillaries</td>
<td>121</td>
</tr>
<tr>
<td>E19</td>
<td>Service trenching</td>
<td>125</td>
</tr>
<tr>
<td>E20</td>
<td>Fences and barriers</td>
<td>130</td>
</tr>
<tr>
<td>E21</td>
<td>Landscape – gardening</td>
<td>133</td>
</tr>
<tr>
<td>E22</td>
<td>Landscape – maintenance</td>
<td>145</td>
</tr>
<tr>
<td>E23</td>
<td>Piling</td>
<td>154</td>
</tr>
<tr>
<td>E24</td>
<td>Concrete formwork</td>
<td>157</td>
</tr>
<tr>
<td>E25</td>
<td>Concrete reinforcement</td>
<td>159</td>
</tr>
<tr>
<td>E26</td>
<td>Concrete in situ</td>
<td>161</td>
</tr>
<tr>
<td>E27</td>
<td>Concrete finishes</td>
<td>163</td>
</tr>
<tr>
<td>E28</td>
<td>Structural steel</td>
<td>167</td>
</tr>
<tr>
<td>E29</td>
<td>Steel – protective paint coatings</td>
<td>172</td>
</tr>
<tr>
<td>E30</td>
<td>Steel – hot-dip galvanized coatings</td>
<td>182</td>
</tr>
<tr>
<td>E31</td>
<td>Light steel framing</td>
<td>183</td>
</tr>
<tr>
<td>E32</td>
<td>Waterproofing – external and tanking</td>
<td>187</td>
</tr>
<tr>
<td>E33</td>
<td>Roofing</td>
<td>192</td>
</tr>
<tr>
<td>E34</td>
<td>Cladding</td>
<td>197</td>
</tr>
<tr>
<td>E35</td>
<td>Windows</td>
<td>200</td>
</tr>
<tr>
<td>E25</td>
<td>Doors</td>
<td>208</td>
</tr>
<tr>
<td>E26</td>
<td>Overhead doors</td>
<td>213</td>
</tr>
<tr>
<td>E27</td>
<td>Door hardware</td>
<td>215</td>
</tr>
</tbody>
</table>
Contents

E28 Insulation and sarking membranes .................................................. 220
E29 Lining ......................................................................................... 223
E30 Suspended ceilings ...................................................................... 227
E31 Joinery ....................................................................................... 231
E32 Fabricated metalwork .................................................................. 239
E33 Extinguishers and blankets ........................................................... 245
E34 Cementitious toppings ................................................................. 247
E35 Waterproofing – wet areas ............................................................. 253
E36 Ceramic tiling .............................................................................. 259
E37 Resilient finishes ......................................................................... 268
E38 Painting ....................................................................................... 274
E39 Textured coatings ........................................................................ 281
E40 Signs and display ......................................................................... 285
E41 Finishes Schedule ........................................................................ 290

Other Documents comprised in Part E

Door Hardware Schedule
Mechanical Services Specification
Electrical Services Specification
Hydraulic Services Specification
E1 PREAMBLE

E1.1 GENERAL

E1.1.1 GENERAL

TfNSW proposes to construct Easy Access facilities and other upgrading works at Cardiff Railway Station to meet the expectation from the community for better access and improved facilities at the station.

It is planned to provide access for mobility impaired persons from the existing station entry points to train boarding points. The work includes provision of new easy access lifts, new stairs at the western side, new ticket office with a family accessible toilet, extension of existing footbridge, new balustrade and anti-throw screens, new concrete footpath, and regrading of existing paths, provision of disabled persons' car spaces, and other miscellaneous improvements.

These upgrading works shall be required to impact minimally on the existing station and train operations. New and current technologies for construction that will achieve minimal impact are preferred to traditional methods. Throughout the course of the works, the Station is to remain fully operational and contractor shall provide any required temporary facilities (e.g. temporary footpath, lighting, power, alteration to existing ramp etc.) and maintain continuous and safe access for passengers and staff.

TfNSW proposes to appoint a company to undertake the construction work up to and including the commissioning of the upgraded facilities.

E1.1.2 COMPLIANCE

This RFT shall be read as a complete document (Parts A to E inclusive with all attached appendices). The Contractor is required to successfully deliver the project in accordance with these Technical Requirements and achieve the following outcomes:

- Maintain safety for workers, station staff and public during construction.
- Comply with all aspects of these Technical Requirements and accompanying drawings;
- Comply with all relevant RTA and TfNSW standards;
- Minimise the impact and inconvenience to the local community during construction;
- Maximise the quality of the completed project and hence benefit to the local community;
- Minimise the time for completion;
- Maximise value for money for TfNSW;
- Minimise the risks and costs to TfNSW.

E1.1.3 COMPLIANCE WITH REVIEW OF ENVIRONMENTAL FACTORS

An REF Application has yet to be assessed. Conditions contained within the pending approval documents are to be complied with by the Contractor.

E1.1.4 ADDITIONAL INFORMATION

The Appendices to this RFT provide additional information on the Work and a number of TfNSWs requirements and installations. Unless otherwise specified elsewhere in the RFT, the Work of the RFT must comply with the standards, materials and methods defined in these Appendices.

E1.1.5 INFORMATION NOT PROVIDED IN THE RFT

If the Contractor discovers that the documents provided by the Principal are not correct or are incomplete, the contractor must submit a Request for Information (RFI) to the Principal’s Representative, that:
- Gives full details of the error or omission; and
- Lists the date for Practical Completion is not to be delayed, and
- For items that are within the expertise of the Contractor, suggests a resolution.
The Principal's Representative will either:
- Provide the information requested; or
- Accept the resolution suggested by the Contractor; or
- Instruct the Contractor to carry out further investigation and report on options for resolution.
E2 SCOPE OF WORKS

E2.1 GENERAL

E2.1.1 SURVEY & SETOUT
Requirement: At the commencement of the contract the Contractor shall set out the works. Confirm levels of all lift entrances at all levels. Confirm the distances between external sides of lift shafts and the corners of the platform building with the platform edge. Refer to TfNSW document TSR Q1 Quality Management Clause 7.4 for details of set-out and survey requirements.

E2.1.2 EXISTING SERVICES
Requirement: Before excavation, the Contractor shall locate all underground railway services in the line of proposed excavations. The Contractor shall locate the existing services by services search require, sonar or electronic means, and any other method necessary to locate the position of these existing services, and report their findings to the Principal's Representative before commencing excavation. The Contractor shall allow for the expenses and up to six weeks for the issue of railway services search and marking on site. Existing public utility services outside the station site and in the path of proposed excavation shall also be located and the Contractor shall arrange with the authorities responsible for these services to determine the exact location of these services prior to commencing excavation. No mechanical excavation will be allowed within one (1) metre of the centre of existing services. Obtain approval by relevant service providers for any excavation nearby public utility services. The Contractor must rectify, at his own cost, all damage to any services that has occurred during the course of the works.

The Contractor shall be responsible for the relocation or protection, or any other works required to treat utility services impacted by the works to comply with all legislative requirements and those requirements of the relevant service authority and/or owner. The Contractor shall make provision for the liaison, design, approvals, construction and commissioning of relocated utility services, and any other utility services works required to complete the works in accordance with the Drawings.

E2.1.3 ENQUIRIES
The Contractor and their sub-consultants shall not discuss the works, progress, etc. with the public local businesses or any media representations, but will direct all enquiries to the Principal's Representative.

E2.1.4 QUALITY ASSURANCE
Requirement: Where there is a recognised quality assurance program applicable to a specified product, provide assurance of product quality under the authority of that program. The program shall be one in which the manufacturer has in place a quality control management system that is subject to continual monitoring through quality audits by a recognised independent organisation.

E2.1.5 QUALITY MANAGEMENT
Provide quality management in accordance with the following TfNSW documents:
- TCA Standard Requirements
- TSR Q1 – Quality Management
- CM-ST-177/1.0
E2.1.6 DILAPIDATION SURVEY

The Contractor must provide to the Principal’s Representative a complete dilapidation survey of all existing buildings, structures, and services before commencing work on site, including the immediate adjoining buildings that share a common boundary with the site.

The survey must clearly identify and record in writing and photographs the state of buildings, structures and services. Any existing damage must be recorded.

The dilapidation survey will form the basis of assessment of damages to existing buildings, structures or services during and at the completion of the works.

The Contractor must rectify, at their own cost, all damage that has occurred during the course of the works.

E2.1.7 ON-SITE COMMUNICATION

The Contractor shall be responsible for managing all communication on site.

Prior to commencement on site, prepare a ‘Communication and Customer Relation Plan’ and deliver it to the Principal’s Representative. The plan must be approved by the Principal’s Representative prior to work commencing on site. This will include communication with the following:

- 600) Station Manager:

Use of existing station compound for site and construction access and storage.

Arranging a suitable time for work with a minimum of four weeks’ notice of the commencement date of these works.

Relocation of existing platform furniture affected by the new work and its reinstatement at existing or new locations.

Supply and erect a total of two (2) billboards of a size not less than 1200 mm high and 2400 mm wide, to a specification supplied by TfNSW through the Principal’s Representative. The name of the Principal Contractor and its 24 hour emergency contact number shall be prominently displayed on the site. They shall be erected two weeks prior to commencing on site.

Supply and erect Information Update Board of A1 size, advising the public of progress of the construction work. This is to be updated monthly throughout the currency of work on site. Each board and each update thereafter shall show:

- Altered access arrangements.
- Uneven floor surfaces.
- Warning signs for items such as cranes and material handling.
- Unsafe or non-accessible areas.

When the work on site is likely to cause disruption by altered traffic, noise, dust, night work, work outside permitted hours etc., to the surrounding community, a letter box drop must be undertaken to nearby residents and businesses to advise the:

- Nature of the disruption.
- Length of the disruption.
- Action being undertaken to minimise disruption.
- Contact telephone numbers for enquiries.
- An apology on behalf of TfNSW.

Design of all signs and written communication shall be approved by the Principal’s Representative before commissioning of signwriting or printing.

E2.1.8 NOTICE

Advise the Principal’s Representative a minimum of four (4) weeks prior to any commissioning of new facilities for public use, to enable TfNSW Management to adequately advise community and stakeholders.

The Contractor must give the Principal’s Representative written notice of intended work to TfNSW’s equipment in order to facilitate coordination of the services and relevant personnel as per the following time schedule.

Telephone, alarms, P.A. systems, CCTV, CountryLink or CityRail equipment: 28 days.
Scope of Works

Temporary relocation of railway services: 16 weeks (proposal to relocate railway services must be agreed to by the Principal’s Representative).
Request for midnight to dawn possessions: 16 weeks (no guarantee that such request will be granted).

<table>
<thead>
<tr>
<th>Certifier</th>
<th>Hold/Witness Point</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geotechnical Engineer</td>
<td>Witness</td>
<td>Inspect bearing capacity of foundation.</td>
</tr>
<tr>
<td>Structural Engineer</td>
<td>Hold</td>
<td>Inspection of lift shaft pit reinforcement.</td>
</tr>
<tr>
<td>Structural Engineer</td>
<td>Hold</td>
<td>Inspection of steel reinforcement to concrete columns, beams and slabs.</td>
</tr>
<tr>
<td>Structural Engineer</td>
<td>Hold</td>
<td>Submit work shop drawings for steelwork.</td>
</tr>
<tr>
<td>Structural Engineer</td>
<td>Witness</td>
<td>Inspection of fabricated steelwork prior to hot dipped galvanising.</td>
</tr>
<tr>
<td>Architect</td>
<td>Witness</td>
<td>Erected Steelwork.</td>
</tr>
<tr>
<td>Architect</td>
<td>Witness</td>
<td>Structural steel 50% Completion.</td>
</tr>
<tr>
<td>Architect</td>
<td>Witness</td>
<td>Structural steel 100% Completion.</td>
</tr>
<tr>
<td>Architect</td>
<td>Witness</td>
<td>Internal Finishes 100% Completion.</td>
</tr>
<tr>
<td>Architect</td>
<td>Witness</td>
<td>Cladding Painting 100% Completion.</td>
</tr>
<tr>
<td>Electrical Engineer</td>
<td>Witness</td>
<td>25% Completion – Inspection of wiring prior to covering up.</td>
</tr>
<tr>
<td>Electrical Engineer</td>
<td>Witness</td>
<td>50% Completion – Testing Electrical Switchboard.</td>
</tr>
<tr>
<td>Electrical Engineer</td>
<td>Hold</td>
<td>100% Completion – Final Testing including TfNSW testing.</td>
</tr>
<tr>
<td>Hydraulics Engineer</td>
<td>Witness</td>
<td>25% Completion checking invert levels.</td>
</tr>
<tr>
<td>Hydraulics Engineer</td>
<td>Hold</td>
<td>50% Testing Drainage.</td>
</tr>
<tr>
<td>Hydraulics Engineer</td>
<td>Hold</td>
<td>100% Completion and testing system.</td>
</tr>
<tr>
<td>Mechanical Engineer</td>
<td>Hold</td>
<td>100% Completion and testing system.</td>
</tr>
<tr>
<td>Architect</td>
<td>Hold</td>
<td>Submit shop drawings as detailed in the Trade Specifications</td>
</tr>
<tr>
<td>Architect</td>
<td>Hold</td>
<td>Submit or prepare samples as detailed in the Trade Specifications</td>
</tr>
</tbody>
</table>

E2.1.9 SCHEDULE OF HOLD AND WITNESS POINTS

Notify Principal’s Representative giving a minimum of four working days notice for hold and witness points nominated at each trade Section.

E2.1.10 STANDARDS AND APPROVALSCONDITIONS

The Contractor shall comply with the requirements of the Building Code of Australia, Australian Standards, TfNSW Standards, CityRail Station Design Guide CSR006 Vol 1 & 2, March 1996 and the conditions of the REF Assessment.

E2.2 SCOPE OF WORK

E2.2.1 GENERAL

The scope of work to be carried out at Cardiff Railway Station broadly includes, but is not limited to, the provision of two new lifts, the extension of the existing footbridge and the provision of a new balustrade and anti throw screens, new stairs at the western side, new ticket office with a family accessible toilet, raising of the level of the existing platforms, new concrete footpath, and regrading of existing paths, provision of disabled persons’ car spaces, and other miscellaneous improvements.

The construction works under this Contract shall comprise the provision of all labour, materials, plant and equipment for completing the upgrading works and handing over of the total Contract Works to a standard that is acceptable by TfNSW.

E2.2.2 SITE ESTABLISHMENT AND PRELIMINARIES

Relocation of all existing services where affected by the works including water, electrical, telephone, PA, sewer and stormwater drainage, as necessary to carry out the works.
Scope of Works

Provision of all site establishment, including hoardings, sheds/buildings, amenities, temporary services, temporary lighting, etc. as necessary to carry out the works.

Provision of, including maintenance thereof, of all temporary works including hoardings, barricading, signage, lighting as necessary to maintain station operations and safe and convenient access to the public. The hoarding shall be constructed to TfNSW standard and in such a way to maintain minimum platform width of 2000 mm. Hoarding shall be checked regularly for structural integrity and maintained free of graffiti.

Provision of all mandatory safety signage, station identification signage, and communication signage as required and specified.

Allowance for all necessary after-hours access and safeworking requirements. Any construction work, in particular electrical work, which may affect normal station operation shall be undertaken after hours or on weekends.

Support and maintain the operation of lights and other railway services in the vicinity of where demolition and construction works will be undertaken. Temporary lighting shall be provided to maintain satisfactory illumination level acceptable to the Principal's Representative and Station Manager.

Assess all existing services with respect to their current capacity. The Contractor will be responsible to upgrade existing services, such as existing stormwater services and electrical services, to accommodate the proposed works.

Prior to work commencing, shop drawings for electrical work, structural steel and lift works shall be submitted to TfNSW for review and acceptance.

Determine the location of existing services and drains in the vicinity of new works and demolition area; disconnect, cap and seal and remove redundant services.

Disconnect, make safe and remove redundant electrical apparatus.

Provide for the complete management and coordination with the TfNSW's personnel regarding disconnection and relocation/reconnections/expansion of any services (e.g. Telephones, P.A. systems, CountryLink, CityRail equipment and CCTV).

Obtaining of permission from Council and payment of fees and bond for tree removals, road/drainage work, parking for construction purpose and any associated inspection of Council officer.

Preparation and submission of traffic management plans to relevant authorities if public road access and position of bus stops/taxi stands are to be altered due to construction work.

The Contractor must install all mandatory, safety, and communications signage as specified, including road signage.

The Contractor must allow for the management and coordination of the installation of new station signage by others.

**E2.2.3 SUMMARY SCOPE OF NEW WORKS**

**General**

The scope of the new works is as defined in this RFT, the drawings and specification and all relevant TfNSW regulations. It includes, but is not limited to the items listed below. Refer to Clause 2.10 for demolition works.

**Lift shafts**

Construct two new lift shafts of concrete and steel framed construction, steel framed roof and Colorbond clad roofing panels, and fibre cement cladding panels with fixed glazing to the walls.

Construct new canopies at Footbridge Level.

Provide all services required in connection with the new work including guttering and downpipes, connection to stormwater drainage, electrical services etc.

**Platform**

Raise level of existing platform as indicated.

Extend platform as shown on drawings.

Re-install furniture and signage, and provide new furniture and signage as detailed.

Provide new edge coping, and tactile and yellow pavers to edge of platforms as detailed and to the requirements of TfNSW.
Scope of Works

Platform building
Construct new building comprising Ticket Office, Staff Amenities, Family Accessible Toilet and awnings on two sides.
Provide all services to new building as required.

Footbridge
Extend existing footbridge to new lifts.
Provide balustrading to footbridge extensions.
Remove existing balustrades and provide new balustrading and anti throw screens to both sides of existing footbridge.

Existing stairs
Remove and replace existing balustrades. Provide new tactile tiles and stair nosings.

New Stairs
Provide new concrete stairs from Footbridge Level to Car Park Level, complete with balustrades, handrails and tactile tiles.

Site work generally
Provide new paths and re-grade existing paths where shown.
New paving at Upper Accessway Level,
Re-construct existing crib block wall on the west side as required by new ground profile and levels.
Construct new retaining walls.
Convert 5 existing parking spaces to 3 spaces for disabled surfaces, including linemarking and signage.
New concrete paving at Lift entries at Upper Access Level and Lower Parking level, including balustrades and other ancillary works.
Provide new fencing where indicated.
Provide new bicycle racks.

Temporary works
Provide temporary stair from Footbridge Level to Car Park level, including balustrades,

Making good
The contractor shall make good any damage to existing structures, surfaces and other building elements resulting from demolition or new work.
The Contractor shall make good any damaged surfaces resulting from demolition of the redundant drainage pits and existing concrete path in the Upper Accessway as shown on the Drawings

General
Provide metalwork installations as required to complete the project, including grated drainage, steel mesh and pipe-rail balustrades, grated aluminium lift shaft ceilings, fixtures and fittings, ventilation louvres, stainless steel handrails, fencing, platform seats and bins and signage.
Provide all required guttering and support systems, downpipes and connection to stormwater drainage.
Paint line-marking to door thresholds of platform building and platform copings for the full length of the platforms, including night-safe zone as directed by the Principal's Representative. Allow for linemarking of the carpark.

E2.2.4 ELECTRICAL SCOPE OF WORK
Refer to the electrical specification for the electrical scope of work for the project.

E2.2.5 HYDRAULIC SCOPE OF WORK
Supply and install sanitary drainage and plumbing and sanitary fixtures.
Install gutters to the new roofs, downpipes and drainage to service these gutters as shown on the Contract Drawings.
Allow to restore all disturbed concrete and make good.
Supply and install rainwater reuse tank to the platform with connection to ticket office services.
Allow for preparation of Workshop and As Built drawings.
Work shall be carried out to cause minimal disruption.
E2.2.6 MECHANICAL SCOPE OF WORK

Refer to the mechanical services specification for the mechanical scope of work for the project.

E2.2.7 LIFT SCOPE OF WORK

Provide two (2) Liftronic lifts, 17-person capacity and hoisting speed with air-conditioned car and internal car fitout complying with disabled access requirements, including installation of handrails. Supply and install a Services Termination Box on top of each lift control box for the termination of lift phone and CCTV camera. The style and finishes of the termination box shall match the lift control box to be supplied by the lift contractor.

E2.2.8 CIVIL ENGINEERING SCOPE OF WORK

Works required for the regrading of the Upper Accessway and provision of disabled parking in the Lower Car Park, including but not limited to, the provision of all necessary materials, equipment and labour associated with the removal and disposal of existing pavement, construction of new pavement, footpath, kerb and channel, guardrail, linemarking of car spaces, provision of signage, utility service relocation, signage, demolition and removal of redundant pits.

The Contract requires completion of all activities including provision of all necessary materials, equipment and labour associated with and relevant to the construction of civil works to the car park. Activities may include but are not limited to clearing and grubbing, erosion and sedimentation control, demolition, earthworks, retaining walls, road works, stormwater drainage, fencing, and any other ancillary works that may be required. Refer to Contract Documents for particular requirements.

E2.2.9 TRAFFIC MANAGEMENT

The safe and effective management of traffic is a key requirement of the Contract, and the Contractor shall:
- minimise impacts on traffic and cater for the needs of all traffic, where ever possible;
- provide a safe environment for the travelling public and construction personnel;
- provide advance notification of traffic events to the public; and
- communicate the arrangements for and impacts of any item of works affecting traffic.

The Contractor shall comply with performance requirements for Traffic Management including as a minimum AS 1742 and all standards, guidelines or other requirements of the RTA and Lake Macquarie Council.

Performance Requirements

The Contractor shall conduct all operations so as to minimise obstruction and inconvenience to the public, and shall be responsible for all works associated with traffic management including but not limited to any drainage, pavement, line marking, signing, traffic barriers, communication, and any temporary works.

Unless agreed otherwise by the Principal, the Contractor shall maintain all existing pedestrian movements within the Limit of Works at all times. Temporary pathways, as required, shall be provided and maintained by the Contractor to provide smooth, free-draining, clean and unimpeded access.

The Contractor shall also plan and implement its works so as not to affect traffic on public holidays or on days of any planned major public events that may generate significant traffic movements in the vicinity of the Site. This also includes major public events remote from the Site that may generate significant traffic movements through or in the vicinity of the Site.

The Contractor shall also maintain access to commercial properties during trading hours, and consider the access requirements of individual owners/occupiers in the programming and execution of the Works.

Traffic Management Plans

The Contractor shall prepare Traffic Management Plans for the management of any impacts the works have on traffic in accordance with the performance requirements included in this specification and relevant legislation.
The Contractor shall be responsible for obtaining all necessary approvals, and the co-ordination, implementation and other arrangements associated with Traffic Management Plans. Each Traffic Management Plan shall be a complete document incorporating the following:

- a statement of purpose including an overview of the Plan, its purpose and justification for the proposed work method including details of any alternative work methods considered;
- computer generated scaled drawings that clearly show the proposed traffic staging together with the measures to adequately control traffic;
- the location, timing and extent of any proposed road or lane closures or other impacts on traffic;
- the timing of any proposed road or lane closures or other event that impacts on traffic;
- any proposed signing and pavement markings, including any changes to the existing signing, pavement markings or existing traffic control devices;
- measures proposed to mitigate the disruption to traffic, including traffic that is disrupted outside of the limits of work;
- the agreement of Lake Macquarie Council;
- a complete list of relevant contacts including Contractor's and Principal's representatives, emergency services, statutory authorities and service providers;
- the findings and actions from a road safety audit of the Traffic Management Plan; and
- a Communication Plan, which, as a minimum includes provision of formal advice of the proposed traffic impacts to all relevant stakeholders, including but not limited to residents, businesses, Lake Macquarie Council, public transport operators, emergency services and responsible authorities not less than seven days prior to the proposed works. It may also incorporate the following as appropriate:
  - provision of variable message signs in advance of and during the works;
  - preparation and submission of newspaper advertisements in relevant local newspapers, following the Principal's agreement to do so;
  - the nomination of a person who is responsible as the community contact for the traffic event; and
  - Process and Responsibilities

The Contractor shall prepare and submit each Traffic Management Plan at not less than the following timeframes:

- a preliminary Traffic Management Plan for the Principal's review at least 4 weeks prior to the commencement of the proposed works impacting traffic; and
- a final Traffic Management Plan, incorporating any comments arising from the review of the preliminary Traffic Management Plan, for the Principal's review at least two weeks prior to the commencement of the proposed works impacting traffic.

The Contractor shall in the preparation of the Traffic Management Plan allow the following times for the Principal's review of each stage of the Traffic Management Plan:

- one week for the preliminary Traffic Management Plan; and
- one week for the final Traffic Management Plan.

E2.2.10 LANDSCAPING SCOPE OF WORK

Provide landscaping services as detailed on the landscaping drawings.

E2.2.11 COORDINATION WITH OTHER SUPPORT WORKS

Coordinate with TINSW's preferred contractors the relocation, removal, reinstatement, and installation of CCTV cameras and other railway services in order to facilitate the demolition and construction works. The Contractor shall provide the Principal's Representative at least one month's notice of any required CCTV/PA/Ticketing/railway service relocation. There is no guarantee that any existing railway services can be relocated to make way for the new works. Where it is not feasible to relocate existing services, other alternative methodology shall be developed and proposed by the Contractor to the Principal's Representative for acceptance.

Coordinate and implement the duties of the Principal Contractor for the following works, which shall be undertaken on site by others:
CCTV relocation, removal, reinstatement and installation works (to be undertaken by TfNSW or contractor nominated by TfNSW). Note: Containment is to be provided by the Contractor under this Contract.

The supply and installation of statin and lift phones and public address system (to be undertaken by TfNSW Communications & Control System Group). Note: Containment is to be provided by the Contractor under this Contract.

The supply and installation of station signage (to be undertaken by contractor nominated and engaged directly by TfNSW).

Power upgrade between Integral Energy's network and the installation side of the Consumer Mains will be undertaken by TfNSW's Renewals Division.

**E2.2.12 RELOCATIONS OF PLATFORM FURNITURE**

Removal and reinstatement later of all existing items of station furniture affected by the works. This will include access ramps, platform seats, light posts and lights, sign posts, signs, station bins, and station Help Points. Provide new footings and fastenings as required for all relocated furniture.

The Contractor shall install/modify/relocate the following items and fixtures:
- All existing station seats, rubbish bins and light poles. They are to be repainted to match TfNSW's Corporate Identity Colour Scheme Manual.

**E2.2.13 DEMOLITION & HAZARDOUS MATERIALS**

**General**

The Contractor shall undertake all demolition and waste disposal works required to achieve the Scope of Work.

The Contractor must perform demolition work including but not limited to the following:
- Partially deconstruct existing ramps to facilitate temporary connection during construction.
- Excavate as required for new lift pits and new stairs and the platform building.
- Decommission, cap-off, seal and remove all redundant external pipework, ducts, cabling, vents stacks and downpipes, and make good.
- Arrange for safe removal of asbestos as identified in the Hazardous Materials Survey (survey attached in Appendix).
- Remove and arrange for relocation/reinstatement of platform furniture and other items, including items which are to remain the property and TfNSW, including light poles and light fittings.
- Removal of existing concrete footpath, kerb and channel and redundant drainage pits, as shown on the Drawings. The Contractor shall make good any damaged surfaces resulting from demolition, clearing and grubbing. The Contractor shall also reinstate such surfaces, where applicable, with native vegetation sufficient to ensure a stable ground surface and prevent any sedimentation or erosion.
- The Contractor must make good ground affected by demolition including filling and compacting substrate materials and finishing with asphalt, concrete paving slabs and/or other finishing materials to match existing surrounding finishes.
- Inspection of existing areas that will undergo alteration/demolition for the presence of asbestos sheets. Perform tests to confirm and arrange for all necessary actions to ensure sheets are removed and disposed in accordance with relevant regulations.
- Inspection of existing surfaces that are required to be painted and/or altered/demolished for the presence of "red lead" paint. Perform tests to confirm and arrange for the appropriate protective measure to be undertaken by Contractor. Remove lead paint with an acceptable 'stick and peel-away' system.
- Excavated spoil is to be tested for presence of hazardous materials before disposal. Contractor shall dispose hazardous materials at designated tip sites and disposal docket shall be submitted to the Principal's Representative.
Scope of Works

Platform
Demolish Ticket Office building including awning and external columns.
Demolish awning at south end of platform, complete with glazed screens.
Remove seats, rubbish bins and other platform furniture and fittings as required to facilitate raising of the platform level.

Existing stairs
Remove existing balustrades.

Footbridge Level
Demolish paving at street entry for construction of new ramps
Remove existing balustrade

Site generally
Demolish existing stairs from Upper Accessway Level to Footbridge
Remove existing stair from Upper Accessway Level to Car Park
Remove paving in various areas as shown on drawings
Remove perimeter fencing as shown on drawings
Remove fencing enclosure to garbage storage area
Remove sections of crib wall near lower car park
Remove existing trees where indicated on drawings
Excavate as required for new works

Services
Remove all redundant services, including main switchboard and transformers.

Miscellaneous demolition
Carry out miscellaneous demolition work as required to enable the contract works to be carried out, even if this is not specifically indicated on the drawings or specification.

E2.3 COORDINATION WITH STATION OPERATION

E2.3.1 EXISTING STATION ACCESS & STATION OPERATION

Works that affect normal station operations (i.e. passenger and staff access to platforms, entrance ways, ticket office, subway and stairs) must be programmed outside station peak hours or during track possession. Proposal that involves alteration to normal station operation shall be accepted by the Principal's Representative and the Station Manager.

The Contractor must maintain safe access for the public via the existing entrances for the entire contract.

The Contractor must provide large and appropriate signs (typically 1000 x 700 mm custom made signs) advising temporary closure or relocation of station entry and exit. They shall be displayed at various strategic locations around the station.

The Contractor must provide a safety hoarding around work areas within the station. Signs advising the passengers of 'Way Out', 'Station Exit' and 'No Standing at this part of Platform' are to be displayed where appropriate.

Where existing lights, lamps or lamp poles are altered due to the works, similar level of illumination must be maintained by provision of temporary lighting.

The booking office and TVMs shall remain open during normal rail opening hours for passengers to purchase tickets.

The contractor must relocate and make good the platform public address speakers that will be affected by the Contractor's activities. The Contractor must install all necessary cabling/conduits to maintain the operation of the public address system.

The Contractor must make good and safe, all affected paving.

E2.3.2 LIMITATIONS FOR CONSTRUCTION WORKS ON THE STATION

The works must be planned in stages to ensure that all station services can be adequately provided to the public.

During morning period (between the hours of 05.30 to 09.30), this includes:
- Ticket sales from the ticket window and all TVMs.
During the evening peak period (between the hours of 16.00 to 19.00), this includes:
- Ticket sales from the ticket window and all TVMs.
Outside of peak periods, this includes:
Ticket sales from the ticket window and one TVM.
At all times the following station elements must be maintained fully operational:
- Public toilets.
- CCTV surveillance of all areas currently covered by cameras.
- Passenger Information Displays Screens (PIDS), either in the current location or in an alternate location on the concourse. If relocation is required, disconnection and reconnection will be carried out by TfNSW staff. All other costs are deemed to be included in the contract price.

Unless otherwise directed by the Principal's Representative, the distance between the platform edge and any hoarding must be a minimum of 2.6 metres.
The following is strictly prohibited:
- Work methods with a high risk of causing interruptions to train services.
- Except between the hours of 21.00 and 05.30 daily, the use in the station concourse of jack hammers or other equipment likely to generate excessive noise.
- Concrete cutting saws must not be used on the concourse between the hours of 05.30 and 21.00 daily.
- In the morning and evening peak periods, transport of materials through the concourse.
- Restrictions to pedestrian access on the footpaths along streets adjoining the station.

**E2.3.3EXISTING SERVICES**
The Contractor must protect and/or redirect existing services to be retained before demolition commences. Reinstate all existing services following completion of works.

**E2.3.4 WORK TO BE UNDERTaken DURING TRACK POSSESSION**
Where construction work cannot be undertaken safely or where safeworking and electrical clearance cannot be achieved e.g. lifting of any prefabricated members/units into position, they are to be completed during a track possession period. The available track possessions are nominated in this RFT.

**E2.3.5 STAGING AND SITE CONSTRAINTS**
With the exception of working during scheduled track possessions, working hours are limited by the Environmental Protection Authority to 0700 to 1800 Monday to Friday and 0800 to 1300 on Saturdays.
No works are permitted on site on Sundays and Public Holidays.
Generally the works shall be staged in such a way as to allow the Station to remain open at all times and to ensure the safety of the public. The contractor shall prepare a Construction Staging Plan and submit details for approval by the principal.

**E2.3.6 SAFETY AND CLEANLINESS OF STATION**
Maintain the site in a safe condition at all times, protecting the public and TfNSW's employees who may require access through the area of the works.
Sweep down public space, which includes platform surfaces, stairs and access/egress areas, which are affected by the works on a daily basis. Do not sweep onto track.
Clean up the site on a daily basis and at the completion of the Work.
Remove all debris and rubbish to leave the area in a clean tidy and safe condition.

**E2.3.7 TRAFFIC AND PEDESTRIAN MANAGEMENT**
Prior to the works commencing on site the Contractor must prepare and submit to Council and other relevant authorities for approval a detailed traffic and pedestrian management plan. A copy of the original submission and the final approved submission must be provided to the Principal's Representative.
The plan must ensure:
- Continued operation of existing shops and commercial premises operating in close proximity to the station.
- Continued operation of any bus or taxi zones, and bicycle facilities.
- Provision of suitable traffic marshalling devices and directional signage detailing revised pedestrian access and traffic routes.
- Safe pedestrian and vehicular movement around construction zones.
- Adequate commuter access into the station.
- Provision of all labour and resources necessary for effective pedestrian and traffic management.
- Safe movement and operation of construction plant, materials deliveries, parking etc.
- Comprehensive planning for the special needs during weekend track possessions.

The Contractor must pay all costs, fees and charges for the provision of traffic and pedestrian management.

E2.3.8 SERVICES EXCAVATION
Excavate for services in platform and public areas. Provide all necessary shoring and cover sheets to open excavations.

E2.4 OTHER REQUIREMENTS

E2.4.1 WORKS BY OTHERS
TfNSW's staff or direct contractors shall be responsible for the following items, which shall not form part of the contract. Contractor is, however, required to manage and coordinate with TfNSW's staff or direct contractors with the installation of these services. This would include acting as Principal Contractor and be held responsible for the safety of these workers.

The provision of the following shall be undertaken directly by TfNSW:
- Provision of temporary Booking Office
- Station Passenger Information with plasma screens.
- Supply and installation of Ticket Vending Machines.

During track possession, other contractors or work groups may be undertaking work at or close to the station. Contractor must allow for coordinating their activities with these work groups.

E2.4.2 HOARDINGS
The provision of temporary hoarding to the relevant TfNSW's standards and balustrades to allow safe public access during the works and to ensure that the public is excluded and protected from the works areas.

Ensure hoarding are free of sharp corners and projections. Maintain hoarding in good condition and remove graffiti immediately. Where hoarding is located less than 2600 mm away from platform edge, diagonal yellow lines are to be painted on the platform surface and signposted to warn passengers of the narrowness of platform.

Signs advising passengers of 'Way Out', 'Station Exit' and 'No Standing at this part of Platform' are to be supplied by the Contractor and displayed on the platform and station hoarding.

Note: Open wire and post temporary fencing with mesh and concrete feet, e.g. ATF, are not to be used on this site.

E2.4.3 SCAFFOLDING, TEMPORARY WORKS AND SUPPORT
Proposal to install metal scaffolding around the proposed lift shafts must be submitted to the Principal's Representative for acceptance before installation. The scaffolding structure shall be assessed and, where necessary, electrically bonded to TfNSW requirements. A continuous rigid barrier shall be installed to the exterior perimeter of the scaffolding tower where the safe working clearance to the 1500v overhead wiring is infringed. In all cases, shade cloth shall be installed around the perimeter of the scaffolding tower.

Any applications for temporary road closure must be submitted well in advance to the local council. A traffic management plan with qualified traffic controllers must be put into place if local traffic conditions are to be altered due to the works. A letter drop to the immediate neighbourhood advising of such traffic alteration is mandatory.
On request by the Principal's Representative, the Contractor shall obtain professional structural assessment if the integrity of any existing structures is likely to be adversely affected because of the work. Any temporary support work is to be designed an certified by a qualified structural engineer at the Contractor's expense.

**E2.4.4 INFRASTRUCTURE CERTIFICATION**

The Contractor shall arrange, at his own cost, a qualified PW52 track inspector to inspect and certify the track infrastructure is suitable for train running after each track possession if the existing tracks have been disturbed in any way e.g. track may have been used as an access for cherry picker and other machinery for construction purposes during a possession.

All remedial works required by the PW52 shall be undertaken and completed before the end of the track possession.

Any excess ballast used for construction of temporary access crossing must be removed at the end of each track possession.

Any electrical or signal infrastructure disturbed or damaged must be reported immediately to the Principal's Representative. The Contractor shall be liable for the cost of rectification. It is therefore advisable for Contractor to take extreme precaution and protect existing signal/electrical infrastructure when work is undertaken in the vicinity of such equipment.

**E2.4.5 SITE COMPOUND AND TEMPORARY SERVICES**

The contractor shall submit his proposal to the Principal's Representative for acceptance before setting up his site compound at the station. A chain wire fencing must be provided to separate the railway corridor from the site compound if the contractor elects to set up his compound adjacent to running lines. Double gates must be installed at appropriate locations to permit continuous after hour access for railway maintenance vehicles.

It is Contractor's responsibility to apply for and obtain his own water, telephone, sewer and electrical services. Where power is to be obtained from external electricity suppliers such as Integral Energy, the supply must be provided via an isolation transformer with specific railway earthing arrangement.

**E2.4.6 UPGRADED POWER SUPPLY**

The upgraded power supply is expected to be made available by TfNSW for the commissioning of the lifts (Note: Contractor shall provide temporary power supply for the installation of the lifts). In the event that delay necessitates suspension of any activity, the Contractor shall progress all other parts of the works in accordance with the contract scope and the approved construction program. If they delay becomes extended such that the Contractor has completed all possible work, the Principal's Representative may direct the Contractor to close the site and return when the updated power supply is available. Where the Principal's Representative issues such direction, the Contractor shall be entitled to claim reasonable re-establishment costs for shall not be entitled to claim delay costs.

**E2.4.7 WORKSITE PROTECTION**

Any construction related work within the railway corridor must be protected in accordance with a Worksite Protection Plan issued by a qualified P04 officer (from penal approved by TfNSW) to be engaged by the Contractor.

The Worksite Protection Plan shall describe the level of protection required for the workers and the Contractor is obliged to provide the protection as necessary.
E3 GENERAL REQUIREMENTS

E3.1 GENERAL

E3.1.1 RESPONSIBILITIES

Performance
Structural: If required, provide structures, installations and components as follows:
- Fixed accessways: To AS 1657.
- Structural design actions: To AS/NZS 1170.0 and the Structural design actions schedule.

Design
Design by contractor: If the contractor provides design, use only appropriately qualified persons and conform to all statutory requirements.
Conflict with the documents: If it is believed that a conflict exists between statutory requirements and the documents, notify the Principal's Representative immediately and provide a recommendation to resolve the conflict.

E3.1.2 PRECEDENCE

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

E3.1.3 CROSS REFERENCES

General
Requirement: Conform to the following:
- Demolition.
- Service trenching.

Common requirements
Requirement: Conform to the following:
- Adhesives, sealants and fasteners.
- Fire-stopping.
- Metals and prefinishes.

Cross referencing styles
Within the text:
- Worksection titles are indicated by italicised text.
- Subsection titles are indicated by BOLD text.
- Clause titles are indicated by Bold text.

E3.1.4 REFERENCED DOCUMENTS

Contractual relationships
General: Responsibilities and duties of the principal, contractor and Principal's Representative are not altered by requirements in the documents referenced in this specification.

Current editions
General: Use referenced documents which are the editions, with amendments, current 3 months before the closing date for tenders, except where other editions or amendments are required by statutory authorities.
E3.1.5 INTERPRETATION

Abbreviations
General: For the purposes of this specification the following abbreviations apply:
- AS: Australian Standard.
- EMC: Electromagnetic compatibility.
- MSDS: Material safety data sheets.
- NZS: New Zealand Standard.
- VOC: Volatile organic compound.

Definitions
General: For the purposes of this specification, the definitions given below apply.
- Approved: 'Approved', 'reviewed', 'directed', 'rejected', 'endorsed' and similar expressions mean 'approved (reviewed, directed, rejected, endorsed) in writing by the Principal's Representative'.
- Attendance: 'Attendance', 'provide attendance' and similar expressions mean 'give assistance for examination and testing'.
- Principal's Representative: 'Principal's Representative' has the same meaning as 'architect' or 'superintendent' and is the person appointed by the 'owner' or 'principal' under the contract.
- Default: Specified value, product or installation method which is to be provided unless otherwise documented.
- Design life: The period of time for which it is assumed, in the design, that an asset will be able to perform its intended purpose with only anticipated maintenance but no major repair or replacement being necessary.
- Documented: 'Documented', 'as documented' and similar terms mean contained in the contract documents.
- Economic life: The period of time from the acquisition of an asset to when the asset, while still physically capable of fulfilling its function and with only anticipated maintenance, ceases to be the lowest cost alternative for satisfying that function.
- Geotechnical site investigation: The process of evaluating the geotechnical characteristics of the site in the context of existing or proposed construction.
- Give notice: 'Give notice', 'submit', 'advise', 'inform' and similar expressions mean 'give notice (submit, advise, inform) in writing to the Principal's Representative'.
- High level interface: Systems transfer information in a digital format using an open system interface.
- Hold point: The activity cannot proceed without the approval of the Principal's Representative.
- Hot-dip galvanized: Zinc coated to AS/NZS 4680 after fabrication with coating thickness and mass to AS/NZS 4680 Table 1.
- IP: 'IP', 'IP code', 'IP rating' and similar expression have the same meaning as 'IP Code' in AS 60529.
- Joints:
  * Construction joint: A joint with continuous reinforcement provided to suit construction sequence.
  * Control joint: An unreinforced joint between or within discrete elements of construction which allows for relative movement of the elements.
  * Contraction joint: An opening control joint with a bond breaking coating separating the joint surfaces to allow independent and controlled contraction of different parts or components, induced by shrinkage, temperature changes or other causes. It may include unbound dowels to assist vertical deflection control.
  * Expansion joint: A closing control joint with the joint surfaces separated by a compressible filler to allow axial movement due to thermal expansion or contraction with changes in temperature or creep. It may include unbound dowels to assist vertical deflection control.
  * Isolation joint: A joint between elements of a structure designed to isolate structural movement while permitting horizontal and/or vertical movement between abutting elements.
- Weakened plane joint: A contraction joint created by forming a groove, extending at least one quarter the depth of the section, either by using a grooving tool, by sawing, or by inserting a premoulded strip.
- Structural control joint: A control joint (contraction, expansion and isolation) in structural elements when used with applied material and finishes.
- Substrate joint: A joint in the substrate which includes construction joints and joints between different materials.
- Sealant joint: A joint filled with a flexible synthetic compound which adheres to surfaces within the joint to prevent the passage of dust, moisture and gases.
- Local government authority: A body established for the purposes of local government by or under a law applying in a state or territory.
- Low level interface: Systems transfer information via terminals and voltage free contacts.
- Metallic-coated: Steel coated with zinc or aluminium-zinc alloy as follows:
  - Metallic-coated steel sheet: To AS 1397. Metal thicknesses specified are base metal thicknesses.
  - Ferrous open sections zinc coated by an in-line process: To AS/NZS 4791.
  - Ferrous hollow sections zinc coated by a continuous or specialised process: To AS/NZS 4792.
- Network Utility Operator: A person who undertakes the piped distribution of drinking water or natural gas for supply or is the operator of a sewerage system or a stormwater system.
- Network Distributor: Body responsible for the distribution and control of electricity.
- Obtain: 'Obtain', 'seek' and similar expressions mean 'obtain (seek) in writing from the Principal's Representative'.
- Practical completion or Defects free completion: The requirements for these stages of completion are defined in the relevant building contract for the project.
- Pipe: Includes pipe and tube.
- Principal: 'Principal' has the same meaning as 'owner', 'client' and 'proprietor' and is the party to whom the contractor is legally bound to construct the works.
- Professional engineer: A person who is listed on the National Professional Engineers Register (NPER) in the relevant discipline at the relevant time.
- Proprietary: 'Proprietary' means identifiable by naming manufacturer, supplier, installer, trade name, brand name, catalogue or reference number.
- Provide: 'Provide' and similar expressions mean 'supply and install' and include development of the design beyond that documented.
- Readily accessible: To AS/NZS 3000.
- Registered testing authority:
  - An organisation registered by the National Association of Testing Authorities (NATA) to test in the relevant field; or
  - An organisation outside Australia registered by an authority recognised by NATA through a mutual recognition agreement; or
  - An organisation recognised as being a Registered Testing Authority under legislation at the time the test was undertaken.
- Required: Means required by the documents, the local council or statutory authorities.
- If required: A conditional specification term for work which may be shown in the documents or is a legislative requirement.
- Samples: includes samples, prototypes and sample panels.
- Statutory authority: A public sector entity created by legislation, that is, a specific law of the Commonwealth.
- Supply: 'Supply', 'furnish' and similar expressions mean 'supply only'.
- Tests:
  - Pre-completion tests: Tests carried out before completion tests.
    - Type tests: Tests carried out on an item identical with a production item, before delivery to the site.
    - Production tests: Tests carried out on a purchased item, before delivery to the site.
General requirements

* Progressive tests: Tests carried out during installation to demonstrate performance in according with this specification.
* Site tests: Tests carried out on site.

- Completion tests: Tests carried out on completed installations or systems and fully resolved before the date for, to demonstrate that the installation or system, including components, controls and equipment, operates correctly, safely and efficiently, and meets performance and other requirements. The Principal’s Representative may direct that completion tests be carried out after the date for practical completion.

- Tolerance: The permitted difference between the upper limit and the lower limit of dimension, value or quantity.
- Verification: Provision of evidence or proof that a performance requirement has been met or a default exists.
- Witness points: Provides an opportunity to attend an activity but does not involve an obligation. The activity can proceed without approval from the Principal’s Representative.

E3.1.6 CONTRACT DOCUMENTS

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

Before commencing work:
- Obtain measurements and other necessary information.
- Coordinate the design and installation in conjunction with all trades.

Levels
General: Spot levels take precedence over contour lines and ground profile lines.

Drawings and manuals for existing services
Warranty: No warranty is given as to the completeness or accuracy of drawings and/or manuals of existing services.

E3.1.7 INSPECTION

Notice
Concealment: If notice of inspection is required in respect of parts of the works that are to be concealed, advise when the inspection can be made before concealment.

Tests: Give notice of the time and place of documented tests.

Minimum notice for inspections to be made and for witnessing of tests: 4 working days.

Light level requirements: to AS/NZS 1680.2.4.

Attendance
General: Provide attendance for documented inspections and tests.

E3.1.8 SUBMISSIONS

General
Submit to: The Principal’s Representative

Default timing: Make submissions at least 5 working days before ordering products for, or starting installation of, the respective portion of the works.

Program: Allow in the construction program for at least the following times for response to submissions:
- Shop drawings: 10 working days.
- Samples and prototypes: 5 working days.
- Manufacturers’ or suppliers’ recommendations: 5 working days.
- Product data: 5 working days.
- Product/design substitution or modification: 5 working days.

Proposed products schedules: If major products are not specified as proprietary items, submit a schedule of those proposed for use within 3 weeks of site possession.
General requirements

Proprietor's requirements
The Contractor must submit all certificates, inspection records, test results/records and verification records to the Principal's Representative for review under clause 9.14 of the General Conditions, no later than ten (10) Business Days following the certification, inspection or test date.

Identification
General: Identify the project, contractor, subcontractor or supplier, manufacturer, applicable product, model number and options, as appropriate and include pertinent contract document references.
Include service connection requirements and product certification.
Non-compliance: Identify proposals for non-compliance with project requirements, and characteristics which may be detrimental to successful performance of the completed work.

Errors
General: If a submission contains errors, make a new or amended submission as appropriate, indicating changes made since the previous submission.

Submissions – electronic copies
File format: dwg and pdf.
Transmission medium: email.

Submissions – hard copy
Quantity: 3 sets.
- Loose documents larger than A3: One transparency on heavyweight plastic film the same size as the standard contract drawings.
- Loose documents up to and including A3: One copy.
Standard contract drawing size: A1

Authorities
Authorities' approvals: Submit documents showing approval by the authorities whose requirements apply to the work.
Correspondence: Submit copies of correspondence and notes of meetings with authorities whose requirements apply to the work.

Building penetrations
General: If it is proposed to penetrate or fix to the following, submit details of the methods proposed to maintain the required structural, fire and other properties:
- Structural building elements including external walls, fire walls, fire doors and access panels, other tested and rated assemblies or elements, floor slabs and beams.
- Membrane elements including damp-proof courses, waterproofing membranes and roof coverings. If penetrating membranes, provide a waterproof seal between the membrane and the penetrating component.

Certification
General: Submit certification that the plant and equipment submitted meets all requirements of the contract documents.

Execution details
General: Before starting the installation of building services, submit the following:
- Embedded services: Proposed method for embedding services in concrete walls or floors or chasing into concrete or masonry walls.
- Fixing of services: Typical details of locations, types and methods of fixing services to the building structure.
- Inaccessible services: If services will be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.

Inspection and testing
General: Submit an inspection and testing plan which is consistent with Clause 8.2 of TfNSW's TSR Q1 Quality Management. Include particulars of test stages and procedures.
Test reports: Submit written reports on nominated tests.

Marking and labelling
General: Before marking and labelling submit:
- Samples of the proposed labels.
- A schedule showing, for each item or type of item:
  - A description of the item or type of item sufficient to identify it.
  - The proposed text of the marking or label
  - The proposed location of the marking or label.

**Materials and components**

Product certification: If products must conform to product certification schemes, submit evidence of conformance.

Product data: For proprietary equipment, submit the manufacturer's product data as follows:
- Technical specifications and drawings.
- Type-test reports.
- Performance and rating tables.
- Recommendations for installation and maintenance.

**Substitutions**

Identified proprietary items: Identification of a proprietary item does not necessarily imply exclusive preference for the item so identified, but indicates the necessary properties of the item.

Alternatives: If alternatives to the documented products, methods or systems are proposed, submit sufficient information to permit evaluation of the proposed alternatives, including the following:
- Evidence that the performance is equal to or greater than that specified.
- Evidence of conformity to a cited standard.
- Samples.
- Essential technical information, in English.
- Reasons for the proposed substitutions.
- Statement of the extent of revisions to the contract documents.
- Statement of the extent of revisions to the construction program.
- Statement of cost implications including costs outside the contract.
- Statement of consequent alterations to other parts of the works.

Availability: If the documented products or systems are unavailable within the time constraints of the construction program, submit evidence.

Criteria: If the substitution is for any reason other than unavailability, submit evidence that the substitution:
- Is of net enhanced value to the principal.
- Is consistent with the contract documents and is as effective as the identified item, detail or method.

**Samples**

Submission: Submit nominated samples.

Incorporation of samples: If it is intended to incorporate samples into the works, submit proposals. Incorporate samples in the works which have been endorsed for inclusion. Do not incorporate other samples.

Retention of samples: Keep endorsed samples in good condition on site, until the date of practical completion.

**Shop drawings**

General: Include dimensioned drawings showing details of the fabrication and installation of structural elements, building components, services and equipment, including relationship to building structure and other services, cable type and size, and marking details.

Diagrammatic layouts: Coordinate work shown diagrammatically in the contract documents, and submit dimensioned set-out drawings.

Services coordination: Coordinate with other building and service elements. Show adjusted positions on the shop and record drawings.

Space requirements: Coordinate with other building and service elements. Show adjusted positions on the shop and record drawings.

Submission medium: Check space requirements of equipment and services indicated diagrammatically in the contract documents.

Drawing size: A1
Checking: Ensure that the drawings have been checked before submission.

Building work drawings for building services: Submit detailed dimensioned drawings showing all:
- Access doors and panels.
- Conduits to be cast in slabs.
- Housing down bolts and other anchorage and/or fixings required complete with loads to be imposed on the structure during installation and operation.
- Openings, penetrations and block-outs.
- Sleeves.
- Plinths, kerbs and bases.
- Required external openings.

E3.2 PRODUCTS

E3.2.1 GENERAL

Manufacturers' or suppliers' recommendations
General: Provide and select, if no selection is given, transport, deliver, store, handle, protect, finish, adjust and prepare for use the manufactured items in accordance with the current written recommendations and instructions of the manufacturer or supplier.

Proprietary items/systems/assemblies: Assemble, install or fix to substrate in accordance with the current written recommendations and instructions of the manufacturer or supplier.

Project modifications: Advise of activities that supplement, or are contrary to, manufacturers' or suppliers' written recommendations and instructions.

Sealed containers
General: If materials or products are supplied by the manufacturer in closed or sealed containers or packages, bring the materials or products to point of use in the original containers or packages.

Prohibited materials
Do not provide the following:
- Materials listed in the Safe Work Australia Hazardous Substances Information System (HSIS).
- Materials that use chlorofluorocarbon (CFC) or hydrochlorofluorocarbon (HCFC) in the manufacturing process.

E3.2.2 TESTS

Attendance
General: Provide attendance on tests.

Testing authorities
General: Except for site tests, have tests carried out by a Registered testing authority and submit test reports.
- Reports: Submit copies of test reports, including certificates for type tests, showing the observations and results of tests and conformance or non-conformance with requirements.
- Site tests: Use instruments calibrated by authorities accredited by a Registered testing authority.

Notice to proprietor
For all tests to be witnessed by the Principal or its representative(s), the Contractor must provide the Principal's Representative with at least five (5) Business Days written notice for any tests to be performed in Australia external to the Asset Lands, and at least 45 days written notice for tests to be performed overseas, or such other time as determined from time-to-time by the Principal's Representative, to enable the Principal to make arrangements for attendance.

E3.2.3 MATERIALS AND COMPONENTS

Consistency
General: For each material or product use the same manufacturer or source and provide consistent type, size, quality and appearance.

Corrosion resistance
General: Conform to the following atmospheric corrosivity category as defined in AS/NZS 2312.
Atmospheric corrosivity category: Low

Situation
The following classification of situation applies to the Corrosion resistance and durability tables.
- Internal: Building fabric protected from salt and moisture by vapour barriers, sarking, sheathing and building wraps.
- External: Includes external leaf and air spaces behind external leaf brickwork or blockwork walls.

Galvanizing
Severe conditions: Galvanize mild steel components (including fasteners) to AS 1214 or AS/NZS 4680 as appropriate, if:
- Exposed to weather.
- Embedded in masonry.
- Exposed to or in air spaces behind the external leaf of masonry walls.
- In contact with chemically treated timber, other than copper chrome arsenate (CCA).

PVC products
Verification: Provide third party verification to demonstrate that PVC products proposed for the project satisfy the criteria required by the GBCA for their Credit in the Materials category of Green star assessment.

E3.3 EXECUTION

E3.3.1 OFF SITE DISPOSAL

Removal of material
General: Dispose of building waste material off site to the requirements of the relevant authorities.

E3.3.2 WALL CHASING

Holes and chases
General: If holes and chases are required in masonry walls, provide proposals to demonstrate that the structural integrity of the wall is maintained. Do not chase walls nominated as fire or acoustic rated. Parallel chases or recesses on opposite faces of a wall: Not closer than 600 mm to each other.

E3.3.3 FIXING

General
Suitability: If equipment is not suitable for fixing to non-structural building elements, fix directly to structure and trim around penetrations in non-structural elements.

Fasteners
General: Use proprietary fasteners capable of transmitting the loads imposed, and sufficient to ensure the rigidity of the assembly.

E3.3.4 SERVICES CONNECTIONS

Connections
General: Connect to network distributor services or service points. Excavate to locate and expose connection points. Reinstate the surfaces and facilities that have been disturbed.

Network distributors' requirements
General: If the network distributor elects to perform or supply part of the works, make the necessary arrangements. Install equipment supplied, but not installed, by the authorities.

E3.3.5 SERVICES INSTALLATION

General
Fixing: If non-structural building elements are not suitable for fixing services to, fix directly to structure and trim around holes or penetrations in non-structural elements.

Installation: Install equipment and services plumb, fix securely and organise reticulated services neatly. Allow for movement in both structure and services.

Concealment: Unless otherwise documented, conceal all cables, ducts, trays and pipes except where installed in plant spaces, ceiling spaces and riser cupboards. If possible, do not locate on external walls.
Lifting: Provide heavy items of equipment with permanent fixtures for lifting as recommended by the manufacturer.

Suspended ground floors: Keep all parts of services under suspended ground floors at least 150 mm clear of the ground surface. Make sure services do not impede access.

Arrangement: Arrange services so that services running together are parallel with each other and with adjacent building elements.

Dissimilar metals: Join dissimilar metals with fittings of electrolytically compatible material.

Temporary capping: During construction protect open ends of pipe with metal or plastic covers or caps.

**Piping**

General: Install piping in straight lines at uniform grades without sags. Arrange to prevent air locks. Provide sufficient unions, flanges and isolating valves to allow removal of piping and fittings for maintenance or replacement of plant.

Spacing: Provide at least 25 mm clear between pipes and between pipes and building elements, additional to insulation.

Changes of direction: Provide long radius elbows or bends and sets where practicable, and swept branch connections. Provide elbows or short radius bends where pipes are led up or along walls and then through to fixtures. Do not provide mitred fittings.

Vibration: Arrange and support piping so that it remains free from vibration whilst permitting necessary movements. Minimise the number of joints.

Embedded pipes: Do not embed pipes that operate under pressure in concrete or surfacing material.

Valve groupings: If possible, locate valves in groups.

Pressure testing precautions: Isolate items not rated for the test pressure. Restrain pipes and equipment to prevent movement during pressure testing.

**Differential movement**

General: If the geotechnical site investigation report predicts differential movements between buildings and the ground in which pipes or conduits are buried, provide control joints in the pipes or conduits, as follows:

- Location: Adjacent to the pipe or conduit supports which are closest to the perimeter of the building.
- Arrangement: Arrange pipes and conduits to minimise the number of control joints.
- Magnitude: Accommodate the predicted movements.

**E3.3.6 BUILDING PENETRATIONS**

**Penetrations**

Fire rated building elements: Seal penetrations with a system conforming to AS 4072.1.

Non-fire rated building elements: Seal penetrations around conduits and sleeves. Seal around cables within sleeves. If the building element is acoustically rated, maintain the rating.

**Sleeves**

General: If piping or conduit penetrates building elements, provide metal or PVC sleeves formed from pipe sections as follows:

- Movement: Arrange to permit normal pipe or conduit movement.
- Diameter (for non fire-rated building elements): Sufficient to provide an annular space around the pipe or pipe insulation of at least 12 mm.
- Prime paint ferrous surfaces.
- Terminations:
  - If cover plates are fitted: Flush with the finished building surface.
  - In fire-rated and acoustic-rated building elements: 50 mm beyond finished building surface.
  - In floors draining to floor wastes: 50 mm above finished floor.
  - Elsewhere: 5 mm beyond finished building surface.
- Termite management: To AS 3660.1.
- Thickness:
  - Metal: ≥ 1 mm.
General requirements

- PVC: ≥ 3 mm.

Sleeves for cables: For penetrations of cables not enclosed in conduit through ground floor slabs, beams and external walls provide sleeves formed from PVC pipe sections.

E3.3.7 SUPPORT AND STRUCTURES

General

Requirement: Provide incidental supports and structures to suit the services.

E3.3.8 PIPE SUPPORTS

Support systems

General: Provide proprietary support systems of metallic-coated steel construction.

Vertical pipes: Provide anchors and guides to maintain long pipes in position, and supports to balance the mass of the pipe and its contents.

Saddles: Do not provide saddle type supports for pipes > DN 25.

Dissimilar metals: If pipe and support materials are dissimilar, provide industrial grade electrically non-conductive material securely bonded to the pipe to separate them. Provide fixings of electrolytically compatible material.

Uninsulated pipes: Clamp piping supports directly to pipes.

Insulated pipes:

- Spacers: Provide spacers at least as thick as the insulation between piping supports and pipes.
  - Extend either side of the support by at least 20 mm.

- Spacer material: Rigid insulation material of sufficient strength to support the piping and suitable for the temperature application.

Support spacing

Cold and heated water pipes: To AS/NZS 3500.1 Table 5.2. Provide additional brackets, clips or hangers to prevent pipe movement caused by water pressure effects.

Sanitary plumbing: To AS/NZS 3500.2 Table 9.1.

Fuel gas: To AS 5601 Table 5.5.

Other pipes: To AS/NZS 3500.1 Table 5.2.

Hangers

Conform to the Hanger size table.

Hanger size table

<table>
<thead>
<tr>
<th>Nominal pipe size (DN)</th>
<th>Minimum hanger diameter (mm) for single hangers</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 50</td>
<td>9.5</td>
</tr>
<tr>
<td>65 to 90</td>
<td>12.7</td>
</tr>
<tr>
<td>100 to 125</td>
<td>15.8</td>
</tr>
<tr>
<td>150 to 200</td>
<td>19.0</td>
</tr>
</tbody>
</table>

E3.3.9 FINISHES TO BUILDING SERVICES

General

General: If exposed to view (including in plant rooms), paint new building services and equipment. Surfaces painted or finished off-site: Conform to the Metals and prefinishes worksection.

Exceptions: Do not paint chromium or nickel plating, anodised aluminium, GRP, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces. Surfaces with finishes applied off-site need not be re-painted on-site provided the corrosion resistance of the finish is not less than that of the respective finish documented.

Standard

General: Conform to the recommendations of AS/NZS 2311 Sections 3, 6 and 7 or AS/NZS 2312 Sections 5, 8 and 10, as applicable.

Powder coating

Standard:
General requirements

Aluminium for architectural applications: To AS 3715.
- Other metals: To AS 4506.

Painting systems
New unpainted interior surfaces: To AS/NZS 2311 Table 5.1.
New unpainted exterior surfaces: To AAS/NZS 2311 Table 5.2.

Paint application
Coats: Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Ensure each coat of paint or clear finish is uniform in colour, gloss, thickness and texture and free of runs, sags, blisters or other discontinuities.

Protection: Do not combine paints from different manufacturers in a paint system.

Underground metal piping
Corrosion protection: Provide corrosion protection for the following:
- Underground ferrous piping.
- Underground non-ferrous metal piping in corrosive environments.

Protection methods:
- Cathodic protection: Sacrificial anodes or impressed current. Incorporate a facility for periodic testing. Conform to the recommendations of AS 2832.1.
- Continuous wrapping using proprietary petroleum taping material.
- Impermeable flexible plastic coating.
- Sealed polyethylene sleeve.

Low VOC emitting paints
Provide the following low odour/low environmental impact paint types with the following VOC limits:
- Primers and undercoats: < 65 g/litre.
- Low gloss white or light coloured latex paints for broadwall areas: < 16 g/litre.
- Coloured low gloss latex paints: < 16 g/litre.
- Gloss latex paints: < 75 g/litre.

E3.3.10 WARRANTIES

General
General: If a warranty is documented or if a manufacturer's standard warranty extends beyond the end of the defects liability period, name the principal as warrantee. Register with manufacturers as necessary. Retain copies delivered with components and equipment.

Commencement: Commence warranty periods at practical completion or at acceptance of installation, if acceptance is not concurrent with practical completion.

Approval of installer: If installation is not by manufacturer, and product warranty is conditional on the manufacturer's approval of the installer, submit the manufacturer's written approval of the installing firm.

E3.3.11 RECORD DRAWINGS

General
General: Submit record drawings. Show the 'as installed' locations of building elements, plant and equipment. Show off-the-grid dimensions where applicable.

Shop drawings: Submit all documented shop drawings, including 'as installed' amendments.

Services: Show dimensions, types and location of the services in relation to permanent site features and other underground services. Show the spatial relationship to building structure and other services. Include all changes made during commissioning and the maintenance period.

Services below ground or concealed: If services and fittings are below ground or concealed, show the depth and dimensioned references that will allow the future location of the service for maintenance or expansion.
Extensions and/or changes to existing: If a drawing shows extensions and/or alterations to existing installations, include sufficient of the existing installation to make the drawing comprehensible without reference to drawings of the original installation.

Accuracy
Progress recording: Keep one set of shop drawings on site at all times expressly for the purpose of marking changes made during the progress of the works.
Documents: Incorporate all modifications made during the progress of the work and testing period. Show any provisions for the future.
Endorsement: Sign and date all record drawings.

Drawing layout
General: Use the same borders and title block as the contract drawings.

Quantity and format
General: Conform to SUBMISSIONS.

Date for submission
General: Not later than 2 weeks after the date of practical completion.

E3.3.12 OPERATION AND MAINTENANCE MANUALS

General
General: Submit operation and maintenance manuals for the whole of the work.
Authors and compilers: Personnel experienced in the maintenance and operation of equipment and systems installed, and with editorial ability.
Referenced documents: If referenced documents or technical worksections require that manuals be submitted, include corresponding material in the operation and maintenance manuals.
Subdivision: By installation or system, depending on project size.

Contents
General: Include the following:
- Table of contents: For each volume. Title to match cover.
- Directory: Names, addresses, and telephone and facsimile numbers of principal consultant, subconsultants, contractor, subcontractors and names of responsible parties.
- Record drawings: Complete set of record drawings, full size.
- Drawings and technical data: As necessary for the efficient operation and maintenance of the installation.
- Installation description: General description of the installation.
- Systems descriptions and performance: Technical description of the systems installed and mode of operation, presented in a clear and concise format readily understandable by the principal's staff. Identify function, normal operating characteristics, and limiting conditions.
- Equipment descriptions:
  - Name, address, email address and telephone and facsimile numbers of the manufacturer and supplier of items of equipment installed, together with catalogue list numbers.
  - Schedules (system by system) of equipment, stating locations, duties, performance figures and dates of manufacture. Provide a unique code number cross-referenced to the record and diagrammatic drawings and schedules, including spare parts schedule, for each item of equipment installed.
  - Manufacturers' technical literature for equipment installed, assembled specifically for the project, excluding irrelevant matter. Mark each product data sheet to clearly identify specific products and component parts used in the installation, and data applicable to the installation.
  - Supplements to product data to illustrate relations of component parts. Include typed text as necessary.
- Certificates:
  - Certificates from authorities.
  - Copies of manufacturers' warranties.
  - Product certification.
  - Test certificates for each service installation and all equipment.
Test reports
- Balancing reports for mechanical installations.
- Control system testing and commissioning results.
- 7 day record of all trends at commissioning.

Operation procedures:
- Manufacturers' technical literature as appropriate.
- Safe starting up, running-in, operating and shutting down procedures for systems installed. Include logical step-by-step sequence of instructions for each procedure.
- Control sequences and flow diagrams for systems installed.
- Legend for colour-codes services.
- Schedules of fixed and variable equipment settings established during commissioning and maintenance.
- Procedures for seasonal changeovers.
- If the installation includes cooling towers, a water efficiency management plan.

Maintenance procedures:
- Detailed recommendations for preventative maintenance and procedures, including schedule of maintenance work including frequency and manufacturers' recommended tests.
- Manufacturer's technical literature as appropriate. Register with manufacturer as necessary. Retain copies delivered with equipment.
- Safe trouble-shooting, disassembly, repair and reassembly, cleaning, alignment and adjustment, balancing and checking procedures. Provide logical step-by-step sequence of instructions for each procedure.
- Schedule of spares recommended to be held on site, being those items subject to wear or deterioration and which may involve the principal in extended deliveries when replacements are required. Include complete nomenclature and model numbers, and local sources of supply.
- Schedule of normal consumable items, local sources of supply, and expected replacement intervals up to a running time of 40,000 hours. Include lubrication schedules for equipment.
- Schedules for recording recommissioning data to enable changes in the system over time can be identified.
- Instructions for use of tools and testing equipment.
- Emergency procedures, including telephone numbers for emergency services, and procedures for fault finding.
- Material safety data sheets (MSDS).

Maintenance records:
- Prototype periodic maintenance and performance report to AS 1851, AS/NZS 3666.2 and AS/NZS 3666.3 as appropriate, prepared to include project specific details.
- Submit, in binders which match the manuals, loose leaf log book pages designed for recording completion activities including operational and maintenance procedures, materials used, test results, comments for future maintenance actions and notes covering the condition of the installation. Include completed log book pages recording the operational and maintenance activities performed up to the time of practical completion.
- Number of pages: The greater of 100 pages or enough pages for the maintenance period and a further 12 months.

Format – electronic copies
Printing: Except for drawings required in the RECORD DRAWINGS clause provide material that can be legibly printed on A4 size paper.
Scope: Provide the same material as documented for hardcopy in electronic format.
Quantity and format: Conform to Submissions – electronic copies.

Format – hard copy
General: A4 size loose leaf, in commercial quality, 4 ring binders with hard covers, each indexed, divided and titled. Include the following features:
- Cover: Identify each binder with typed or printed title 'OPERATION AND MAINTENANCE MANUAL', to spine. Identify title of project, volume number, volume subject matter, and date of issue.
- Dividers: Durable divider for each separate element, with typed description of system and major equipment components. Clearly print short titles under laminated plastic tabs.
- Drawings: Fold drawings to A4 size with title visible, insert in plastic sleeves (one per drawing) and accommodate them in the binders.
- Pagination: Number pages.
- Ring size: 50 mm maximum, with compressor bars.
- Text: Manufacturers' printed data, including associated diagrams, or typewritten, single-sided on bond paper, in clear concise English.

Number of copies: 3.

Date for submission
Date for draft submission: The earlier of the following:
- 2 weeks before the date for practical completion.
- Commencement of training on services equipment.
Date for final submission: Within 2 weeks after practical completion.

E3.3.13 TOOLS AND SPARE PARTS

Spare parts
General: Provide spare parts listed in the appropriate worksections.

Tools and spare parts schedule
General: At least 8 weeks before the date for practical completion, submit a schedule of tools, portable instruments and spare parts necessary for maintenance of the installation. For each item state the recommended quantity and the manufacturer's current price. Include the following in the prices:
- Checking receipt, marking and numbering in accordance with the spare parts schedule.
- Packaging and delivery to site.
- Painting, greasing and packing to prevent deterioration during storage.
- Referencing equipment schedules in the operation and maintenance manuals.
- Suitable means of identifying, storing and securing the tools and instruments. Include instructions for use.

Replacement: Replace spare parts used during the maintenance period.

E3.3.14 COMMISSIONING AND COMPLETION TESTS

Reports
General: Submit reports indicating observations and results of tests and compliance or non-compliance with requirements.

Notice
Inspection: Give sufficient notice for inspection to be made of the commissioning and completion testing of the installation.

Controls
General: Calibrate, set and adjust control instruments, control systems and safety controls.

Samples
General: Remove unincorporated samples on completion.

Circuit protection
General: Confirm that circuit protective devices are sized and adjusted to protect installed circuits.

Completion tests
General: Test the works under the contract to demonstrate compliance with the documented performance requirements of the installation.

Functional checks: Carry out functional and operational checks on energised equipment and circuits and make final adjustments for the correct operation of safety devices and control functions.

Proprietary equipment: Submit type test reports confirming compliance of proprietary equipment.

Sound pressure level measurements: Conform to the following:
General requirements

- Correction for background noise: To AS/NZS 2107 Table B1.
- External: To AS 1055.1.
- Internal: To AS/NZS 2107.
- Measurement positions: If a test position is designated only by reference to a room or space, do not take measurements less than 1 m from the floor, ground or walls.
- Sound pressure level analysis: Measure the sound pressure level and the background sound pressure level over the full range of octave band centre frequencies from 31.5 Hz to 8 kHz at the designated positions.
- Sound pressure levels: Measure the A-weighted sound pressure levels and the A-weighted background sound pressure levels at the designated positions.

Test instruments: Use instruments calibrated by a registered testing authority.

Certification
General: On satisfactory completion of the installation and before the date of practical completion, submit certificates stating that each installation is operating correctly.

E3.3.15 CLEANING

Final cleaning
General: Before practical completion, clean throughout, including all exterior and interior surfaces except those totally and permanently concealed from view.
Labels: Remove all labels not required for maintenance.

E3.3.16 PERIODIC MAINTENANCE OF SERVICES

General
General: During the maintenance period, carry out periodic inspections and maintenance work as recommended by manufacturers of supplied equipment, and promptly rectify faults.
Emergencies: Attend emergency calls promptly.
Annual maintenance: Carry out recommended annual maintenance procedures before the end of the maintenance period.
Maintenance period: The greater of the defects liability period and the period nominated in the Maintenance requirements schedule.

Maintenance program
General: Submit details of maintenance procedures and program, relating to installed plant and equipment, 6 weeks before the date for practical completion. Indicate dates of service visits. State contact telephone numbers of service operators and describe arrangements for emergency calls.

Maintenance records
General: Record in binders provided with operation and maintenance manuals.
Referenced documents: If referenced documents or technical worksections require that log books or records be submitted, include this material in the maintenance records.
Service visits: Record comments on the functioning of the systems, work carried out, items requiring corrective action, adjustments made and name of service operator. Obtain the signature of the principal's designated representative.

Site control
General: Report to the principal's designated representative on arriving at and before leaving the site.

E3.3.17 POST-CONSTRUCTION MANDATORY INSPECTIONS AND MAINTENANCE

General
General: For the duration of the defects liability period, provide inspections and maintenance of safety measures required by the following:
- The Building Code of Australia.
- AS 1851.
- Other statutory requirements applicable to the work.

Records: Provide mandatory records.

Certification: Certify that mandatory inspections and maintenance have been carried out and that the respective items conform to statutory requirements. Submit certification.
Annual inspection: Provide an annual inspection and maintenance immediately prior to the end of the defects liability period.

### E3.4 SELECTIONS

#### E3.4.1 SCHEDULES

**General**

Provide all warranties required by the various Trade Section of this specification. Provide all standard warranties provided by manufacturers for products used throughout the Works.

**Warranty schedule**

Warranties shall include, but not be limited to, those listed in the Warranty Schedule.

<table>
<thead>
<tr>
<th>Warranty schedule</th>
<th>Form</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roofing and roofing installation</td>
<td>Written</td>
<td>25 years</td>
</tr>
<tr>
<td>Waterproofing</td>
<td>Written</td>
<td>25 years</td>
</tr>
<tr>
<td>Lift Manufacturers</td>
<td>Written</td>
<td>As noted in Liftronic specifications</td>
</tr>
<tr>
<td>Lift Installation</td>
<td>Written</td>
<td>As noted in Liftronic specifications</td>
</tr>
<tr>
<td>Air conditioning plant and equipment</td>
<td>Written</td>
<td>As noted in the Mechanical Services specification</td>
</tr>
<tr>
<td>Mechanical Ventilation</td>
<td>Written</td>
<td>As noted in the Mechanical Services specification</td>
</tr>
<tr>
<td>Electrical services and equipment</td>
<td>Written</td>
<td>As noted in the Electrical Services specification</td>
</tr>
<tr>
<td>Hydraulic services and equipment</td>
<td>Written</td>
<td>As noted in the Hydraulic Services specification</td>
</tr>
</tbody>
</table>
Adhesives, sealants and fasteners

E4 ADHESIVES, SEALANTS AND FASTENERS

E4.1 GENERAL

E4.1.1 RESPONSIBILITIES

General
Fitness for purpose: Provide adhesives, sealants and fasteners capable of transmitting imposed loads, sufficient to ensure the rigidity of the assembly, or integrity of the joint.
Finished surface: Provide adhesives and sealants that will not cause discolouration.
Compatibility: Do not use sealants or adhesives that are incompatible with the products to which they are applied.
Sealant replacement: Use sealants that can be safely removed without compromising the application of the replacement sealant for future refurbishment.
Selections: Conform to the Selections.

E4.1.2 PRECEDENCE

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

E4.1.3 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.

E4.1.4 SUBMISSIONS

Sealants
Samples: Submit colour samples of visible joint sealants.
Documents: Submit technical data sheets.

E4.1.5 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of joints and penetrations prepared for the application of sealants to the Installed sealant tests schedule.

E4.1.6 PERFORMANCE

Adhesives and sealants
General: Provide adhesives and sealants capable of transmitting imposed loads, sufficient to ensure the rigidity of the assembly, or integrity of the joint and which will not cause discolouration of finished surfaces.
Compatibility: Do not use sealants or adhesives that are incompatible with the products to which they are applied.
Movement: Where an adhered or sealed joint may be subject to movement, select a system accredited to accommodate the projected movement under the conditions of service.
Refurbishment: Use sealants that can be safely removed and prepared for refurbishment.

Fasteners
Provide fasteners accredited for the particular use, capable of transmitting imposed loads and maintaining the rigidity of the assembly.
E4.2 PRODUCTS

E4.2.1 ADHESIVES

Standards
Mastic adhesive: To AS 2329.
Polymer emulsion adhesive for timber: To AS 2754.2, not inferior to Type 3.

High strength adhesive tape
General description: A foam of cross linked polyethylene or closed cell acrylic coated both sides with a high performance acrylic adhesive system, encased in release liners of paper or polyester.
Product classification: Ensure product suitability for the following substrates:
- Firm high strength foam tapes for high energy surfaces including most bare metals such as stainless steel and aluminium.
- Conformable high strength foam for medium energy surfaces including many plastics and paints, and bare metals.
- Conformable high strength foam for lower energy surfaces including many plastics, most paints and powder coatings, and bare metals.
Thickness: Select the tape to ensure a mismatch between surfaces does not exceed half the tape thickness under the applied lamination pressure.

E4.2.2 SEALANTS

Standards
General: To ISO 11600.

External masonry joints
General: Provide sealant and bond breaking backing materials compatible with each other and the substrate and which are non-staining to masonry. Do not use bituminous materials with absorbent masonry units.
Bond breaking backing:
- Bond breaking materials: Non-adhesive to sealant, or faced with a non-adhering material.
- Foamed materials: Closed-cell or impregnated, not water-absorbing.

Fire rated control joints
General: Provide sealant materials that maintain the nominated fire-resisting rating.
- Fire stopping: To AS 4072.1.

Pointing and bedding
General: Provide sealants for fast moving joints in light weight building elements that are compatible with the contact materials.

Fire rated pointing, bedding and stopping
General: Provide sealant materials that maintain the nominated fire-resisting rating.
- Fire stopping: To AS 4072.1.

Floor control joints
General: Provide trafficable sealants for that are compatible with the contact materials.
Bond breaking backing:
- Bond breaking materials: Non-adhesive to sealant, or faced with a non-adhering material.
- Foamed materials: Closed-cell or impregnated, not water-absorbing.

E4.2.3 FASTENERS

General
Masonry anchors: Proprietary expansion or chemical type.
Plain washers: To AS 1237.1.
- Provide washers to the heads and nuts of bolts, and the nuts of coach bolts.
Plugs: Proprietary purpose-made plastic.
Powder-actuated fasteners: To AS/NZS 1873.4.
Stainless steel fasteners: To ASTM A240/A240M.
Steel nails: To AS 2334.
- Length: At least 2.5 x the thickness of the member being secured, and at least 4 x the thickness if the member is plywood or building board < 10 mm thick.
Unified hexagon bolts, screws and nuts: To AS/NZS 2465.
Fasteners in CCA treated timber: Epoxy coated or stainless steel.

Bolts
Coach bolts: To AS/NZS 1390.
Hexagon bolts Grades A and B: To AS 1110.1.
Hexagon bolts Grade C: To AS 1111.1.

Corrosion resistance
Atmospheric corrosivity category: To the General requirements worksection.
Steel products: Conform to the Corrosion resistance table or provide proprietary products with metallic and/or organic coatings of equivalent corrosion resistance.

Corrosion resistance table – Atmospheric corrosivity categories A and B to AS/NZS 2312

<table>
<thead>
<tr>
<th>Situation</th>
<th>Self drilling screws to AS 3566.2 Class</th>
<th>Threaded fasteners and anchors</th>
<th>Powder actuated fasteners</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Material</td>
<td>Minimum local metallic coating thickness (µm)</td>
</tr>
<tr>
<td>Internal Internal</td>
<td></td>
<td>Electroplated zinc</td>
<td>4</td>
</tr>
<tr>
<td>External External</td>
<td></td>
<td>Electroplated zinc or Hot-dip galvanized</td>
<td>30</td>
</tr>
</tbody>
</table>

Corrosion resistance table – Atmospheric corrosivity category C to AS/NZS 2312

<table>
<thead>
<tr>
<th>Situation</th>
<th>Self drilling screws to AS 3566.2 Class</th>
<th>Threaded fasteners and anchors</th>
<th>Powder actuated fasteners</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Material</td>
<td>Minimum local metallic coating thickness (µm)</td>
</tr>
<tr>
<td>Internal Internal</td>
<td></td>
<td>Electroplated zinc</td>
<td>12</td>
</tr>
<tr>
<td>External External</td>
<td></td>
<td>Hot-dip galvanized</td>
<td>50</td>
</tr>
</tbody>
</table>

Corrosion resistance table – Atmospheric corrosivity categories D and F to AS/NZS 2312

<table>
<thead>
<tr>
<th>Situation</th>
<th>Self drilling screws to AS 3566.2 Class</th>
<th>Threaded fasteners and anchors</th>
<th>Powder actuated fasteners</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Material</td>
<td>Minimum local metallic coating thickness (µm)</td>
</tr>
<tr>
<td>Internal Internal</td>
<td></td>
<td>Electroplated zinc or Hot-dip</td>
<td>30</td>
</tr>
</tbody>
</table>
### Situation

<table>
<thead>
<tr>
<th>Situation</th>
<th>Self drilling screws to AS 3566.2 Class</th>
<th>Threaded fasteners and anchors</th>
<th>Powder actuated fasteners</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Material</td>
<td>Minimum local metallic coating thickness (µm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>galvanized</td>
<td></td>
</tr>
<tr>
<td>External</td>
<td>Stainless steel 316</td>
<td>Stainless steel 316</td>
<td>Stainless steel 316</td>
</tr>
</tbody>
</table>

*Avoid organic coating in Category F zones.*

### Finishes

**Electroplating:**
- Metric thread: To AS 1897.
- Imperial thread: To AS 4397.

**Galvanizing:**
- Threaded fasteners: To AS 1214.
- Other fasteners: To AS/NZS 4680.

**Mild steel fasteners:** Galvanize if:
- Embedded in masonry.
- In external timbers.
- In contact with chemically treated timber, other than CCA treated timber.

**Epoxy coated:**
- CCA Treated timber.

### Nuts

Hexagon chamfered thin nuts Grades A and B: To AS 1112.4.
Hexagon nuts Grade C: To AS 1112.3.
Hexagon nuts Style 1 Grades A and B: To AS 1112.1.
Hexagon nuts Style 2 Grades A and B: To AS 1112.2.

### Screws

Coach screws: To AS/NZS 1393.
Hexagon screws Grades A and B: To AS 1110.2.
Hexagon screws Grade C: To AS 1111.2.
Hexagon socket screws: To AS 1420 and AS/NZS 1421.
Machine screws: To AS/NZS 1427.
Self-drilling screws: To AS 3566.1 and AS 3566.2.
Self-tapping screws:
- Crossed recessed countersunk (flat – common head style): To AS/NZS 4407.
- Crossed recessed pan: To AS/NZS 4406.
- Crossed recessed raised countersunk (oval): To AS/NZS 4408.
- Hexagon: To AS/NZS 4402.
- Hexagon flange: To AS/NZS 4410.
- Hexagon washer: To AS/NZS 4409.
- Slotted countersunk (flat – common head style): To AS/NZS 4404.
- Slotted pan: To AS/NZS 4403.
- Slotted raised countersunk (oval – common head style): To AS/NZS 4405.

### Blind rivets

Description: Expanding end type with snap mandril.
Type: Closed end for external application, open end for internal application.

End material:
- Aluminium base alloy for metallic coated or colourbond coated steel.
- Stainless steel for stainless steel sheet.
- Copper for copper sheet.

Size:
- For sheet metal to sheet metal: 3 mm.
- For sheet metal to supports, brackets and rolled steel angles: 4.8 mm.

Performance
Loads: Provide fasteners capable of transmitting the loads imposed, and sufficient to ensure the rigidity of the assembly.

**E4.3 EXECUTION**

**E4.3.1 ADHESIVES**

Preparation
Substrates: Ensure substrates are:
- Clean and free of any deposit or finish which may impair adhesion.
- If framed or discontinuous, support members are in full lengths without splicing.
- If solid or continuous, excessive projections are removed.
- If previously painted, cracked or flaking paint is removed and the surface lightly sanded.

Contact adhesive
Precautions: Do not use if:
- A substrate is polystyrene foam.
- A PVC substrate may allow plasticiser migration.
- The adhesive solvent can discolor the finished surface.
- Dispersal of the adhesive solvent is impaired.

Two way method: Immediately after application press firmly to transfer adhesive and then pull both surfaces apart. Allow to tack off and then reposition and press firmly together. Tap areas in contact with a hammer and padded block.

One way method: Immediately after application bring substrates together and maintain maximum surface contact for 24 hours by clamps, nails or screws as appropriate. If highly stressed employ permanent mechanical fasteners.

High strength adhesive tape
Preparation:
- Non-porous surfaces: Clean with surface cleaning solvents such as isopropyl alcohol/water, wash down and allow to dry.
- Porous surfaces: Prime the surface with a contact adhesive compatible with the tape adhesive system.

Follow the recommendations of the manufacturer for application to the following: Copper, brass, plasticized vinyl and hydrophilic surfaces such as glass and ceramics in a high humidity environment.

Applied lamination pressure: Ensure the tape experiences 100 kPa.

Application temperature: Generally above 10°C, consult the manufacturer.

Completion: Do not apply loads to the assembly for 72 hours at 21°C.

**E4.3.2 SEALANT JOINTING**

Preparation for jointing
Cleaning: Cut flush joint surface protrusions and make good. Mechanically clean joint surfaces free of any deposit or finish which may impair adhesion of the sealant. Immediately before jointing remove loose particles from the joint, using oil-free compressed air.

Bond breaking: Install bond breaking backing material.
Taping: Protect the surface on each side of the joint using 50 mm wide masking tape or equivalent means. On completion of pointing remove the tape and remove any stains or marks from the surface.

Primer: Apply the recommended primer to the surfaces in contact with sealant materials.

**Sealant joint proportions**

General weatherproofing joints (width:depth):
- 1:1 for joint widths < 12 mm.
- 2:1 for joint widths > 12 mm.

**Sealant application**

General: Apply the sealant to dry joint surfaces using a pneumatic applicator gun. Ensure the sealant completely fills the joint to the required depth, that it is in good contact with the full depth of the sides and that there is no air trapped in the joint. Do not apply the sealant outside the recommended working time for the material or the primer.

**Weather conditions**

Two pack polyurethanes: Do not apply the sealant if ambient conditions are outside the following:
- Temperature: < 5°C or > 40°C.
- Humidity: To the manufacturer’s recommendations.

**Joint finish**

General: Force the sealant into the joint and finish with a smooth, slightly concave surface using a tool designed for the purpose.

**Protection**

General: Protect the joint from inclement weather during the setting or curing period of the material.
E5 FIRE-STOPPING

E5.1 GENERAL

E5.1.1 CROSS REFERENCES

General
General: Conform to the General requirements worksection.

E5.1.2 PRECEDENCE

General
Worksections and referenced documents:
- The requirements of other worksections of the specification override conflicting requirements of this worksection.
- The requirements of this worksection overrides conflicting requirements of its referenced documents.
- The requirements of the referenced documents are minimum requirements.

E5.1.3 STANDARDS

General
Service penetration fire-stopping systems: To BCA C3.15.
Control joint fire-stopping systems: To AS 4072.1.

E5.1.4 INSPECTION

Notice
Inspection: Give sufficient notice so that inspection may be made of the following:
- Service penetrations completed and ready for fire-stopping.
- Finished fire-stopping, before being concealed.

E5.2 PRODUCTS

E5.2.1 MATERIALS

General
Shelf life: Ensure materials used have not exceeded their shelf life.
Toxic materials: Free of asbestos and lead and free of, nor requiring the use of, toxic solvents.
Toxicity in fire: Non-toxic.

Fire-stop mortars
Type: Re-enterable cement-based compound, mixed with water. Non-shrinking, moisture resistant. Insoluble in water after setting.

Formulated compound of incombustible fibres
Material: Formulated compound mixed with mineral fibres, non-shrinking, moisture resistant. Insoluble in water after setting.

Fibre stuffing
Material: Mineral fibre stuffing insulation, dry and free of other contaminants.
Standard: AS/NZS 4859.1 Section 8.

Fire-stop sealants
Material: Elastomeric sealant. Soft, permanently flexible, non-sag, non-shrinking, moisture resistant. Capable of providing a smoke-tight, gas-tight and waterproo f seal when properly installed. Insoluble in water after setting.

Fire-stop foams
Material: Single component compound of reactive foam ingredients, non-shrinking, moisture resistant. Insoluble in water after setting.
Fire-stop putty
Material: Single component, mouldable, permanently flexible, non-shrinking, moisture resistant, intumescent compound which expands on exposure to surface heat gain, forming a high-volume thermally insulating char that closes gaps and voids, resists the turbulence of a severe fire. Capable of being placed by hand to form an immediate fire seal. Insoluble in water after setting.

Product certification
Certifier: Certifire or other approved certifier.

E5.2.2 COMPONENTS

Fire-stop collars
Material: Mechanical device with incombustible intumescent fillers covered with sheet steel jacket. Airtight and watertight.

Fire-stop pillows
Material: Formed self-contained compressible flexible mineral fibre in cloth bags, rated to permit frequent changes in service.

Accessories
Primer: As recommended by manufacturer for substrates
Permanent dam material: Non-combustible.
- Type: Mineral fibreboard or other approved material as required.
Metal lath: Provide where required to keep fire-stop pillows in place and to prevent unauthorised or accidental removal of fire-stopping.
Installation accessories: Provide clips, collars, fasteners, temporary stops and dams, and other devices required to position, support and contain fire-stopping and accessories.

Product certification
Certifier: Certifire or other approved certifier.

E5.3 EXECUTION

E5.3.1 EXECUTION GENERALLY

General
Extent: Fire-stop and smoke-stop interruptions to fire-rated assemblies, materials and components, including penetrations through fire-rated elements, breaks within fire-rated elements (e.g. expansion joints), and junctions between fire-rated elements. The Fire-stopping systems schedule is not necessarily comprehensive.
Sequence: Fire-stop after services have been installed through penetrations and properly spaced and supported, after sleeving where appropriate, and after removal of temporary lines, but before restricting access to the penetrations, including before dry lining.
Installer qualifications: Minimum 5 years in the installation of fire-stopping that is similar in material, design and extent to that being installed.
Density: Apply fire-stopping material to uniform density.
Fire-stopping exposed to view: Finish surfaces to a uniform and level condition.
Cable separation: Maintain.
Protection: Protect adjacent surfaces from damage arising through installation of fire-stopping. Protect completed fire-stopping from damage arising from other work.
Loose or damaged fire-stopping material: Remove and replace.
Penetrations by pipes and ducts: Allow for thermal movement of the pipes and ducts.
Preventing displacement: Reinforce or support fire-stopping materials with non-combustible materials when:
- The unsupported span of the fire-stopping materials > 100 mm.
- The fire-stopping materials are non-rigid (unless shown to be satisfactory by test).
Large openings: Provide fire-stopping capable of supporting the same loads as the surrounding element or provide similar structural support around the opening.
Fire-stopping

Installation certification
Certifier: Certifire or other approved certifier

Preparation
Cleaning: Clean substrates of dirt, dust, grease, oil, loose material, and other matter which may affect bond of fire-stop material.
Primer: Clean and dry substrates for primers and sealants.
Restraint: Install backing and/or damming materials to arrest liquid material leakage. Remove temporary dams after material has cured.

E5.3.2 SYSTEMS

Fire-stop mortars
Ambient conditions: Do not install below 5°C.

Formulated compound of incombustible fibres
Installation: In accordance with the manufacturer’s requirements, adapted as required to completely close openings.

Fibre stuffing
Installation: Compress to 40% of its uncompressed volume.

Fire-stop composite sheets
Installation: In accordance with the manufacturer’s requirements, adapted as required to completely close openings.
Adapt manufacturer’s instructions to project requirements to completely close openings.

Fire-stop sealants
Ambient conditions: Do not store above 32°C. Do not install outside the temperature range recommended by the sealant manufacturer. Do not install when humidity exceeds that recommended by the sealant manufacturer for safe installation.

Fire-stop foams
Ambient conditions: Do not store above 32°C. Do not install below 15°C or above 32°C. Do not apply when temperature of substrate and air is below 15°C. Maintain this minimum temperature before, during and for 3 days after installation.
Installation: Test substrates for adhesion and prime if necessary. Place in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

Fire-stop putty
Ambient conditions: Do not install below 5°C. Do not allow the material to freeze.
Installation: In accordance with the manufacturer’s requirements, adapted as required to completely close openings.

Fire-stop collars
Installation: In accordance with the manufacturer’s requirements, adapted as required to completely close openings.

Fire-stop pillows
Ambient conditions: Do not install in conditions outside of the manufacturer’s recommendations.

Fire-stopping systems schedule
Provide fire stopping systems as required to fire resistant construction for new Communications Room and storage cupboards below existing stairs.

Labelling
Label each fire-stopping installation with a permanently fixed tag or sticker containing the following information:
- Manufacturer’s name.
- Name and address of installer.
- Date of installation.
E5.3.3 COMPLETION SUBMISSIONS

Certification
General: Submit evidence of compliance, in accordance with the recommendations of AS 4072.1 Appendix B.
Certification: Submit a completed certification document for installed fire-stopped penetrations and control joints.
- Form: To Figure B2 of AS 4072.1.
Schedule: Submit a schedule of installed fire-stopped penetrations and control joints.
- Form: To Figure B1 of AS 4072.1.

User manual
For fire-stopping systems which are intended to be modified in service, submit user manual.

E5.3.4 MAINTENANCE

Cleaning
Remove spilled and excess fire-stopping materials without damaging other work.
E6 METALS AND PREFINISHES

E6.1 GENERAL

E6.1.1 PRECEDENCE

General
Worksections and referenced documents:
- The requirements of other worksections of the specification override conflicting requirements of this worksection.
- The requirements of this worksection overrides conflicting requirements of its referenced documents.
- The requirements of the referenced documents are minimum requirements.

E6.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Windows
- Fabricated Metalwork

E6.2 PRODUCTS

E6.2.1 METALS

Metals
Performance: Provide metals in sections of strength and stiffness suited to their required function, finish and method of fabrication.
Aluminium and aluminium alloys
Drawn pipe: To AS/NZS 1867.
Drawn rod, bar and strip: To AS/NZS 1865.
Extrusions: To AS/NZS 1866.
Plate and sheets: To AS/NZS 1734.
Coated steel
Electrogalvanizing ferrous hollow and open sections: To AS 4750.
Hot-dip galvanizing (zinc):
- Ferrous open sections by an in-line process: To AS/NZS 4791.
- Ferrous hollow sections by a continuous or specialised process: To AS/NZS 4792.
Metallic-coated steel:
- Ferrous open sections zinc coated by an in-line process: To AS/NZS 4791.
- Ferrous hollow sections zinc coated by a continuous or specialised process: To AS/NZS 4792.
Metallic-coated steel sheet: To AS 1397. Metal thicknesses specified are base metal thicknesses.
Steel wire: To AS/NZS 4534.
Copper and copper alloys
Casting: To AS 1565.
Plate, sheet and strip: To AS 1566.
Rods, bars and sections: To AS/NZS 1567.
Composition and designations: To AS 2738.
Stainless steel
Bars: To ASTM A276.
Plate, sheet and strip: To ASTM A240/A240M.
Welded pipe (round): To AS 1769.
Welded pipe (square): To ASTM A554.

**Steel**

Sheet: To AS/NZS 1595.
Structural bars and sections: To AS/NZS 3679.1.
Structural hollow section: AS/NZS 1163.

**Steel for prefinishes**

Cold rolled bar: To AS 1443 – Bright.
Cold rolled sheet: To AS/NZS 1595.
- Designation: CA2S-E.

Electric resistance welded tube: To AS 1450.

---

## E6.3 EXECUTION

### E6.3.1 GENERAL

**Metal separation**

Incompatible sheet metals: Provide separation by one of the following:
- Apply an anti-corrosion low moisture transmission coating such as alkyd zinc phosphate primer or aluminium pigmented bituminous paint to contact surfaces.
- Insert a concealed separation layer such as polyethylene film, adhesive tape, or bituminous felt.

Incompatible fixings: Do not use.

Incompatible service pipes: Install lagging or grommets. Do not use absorbent, fibrous or paper products.

**Brazing**

General: Make sure brazed joints have sufficient lap to provide a mechanically sound joint.

Butt joints: Do not use butt jointing for joints subject to load. If butt joints are used, do not rely on the filler metal fillet only.

Filler metal: To AS/NZS 1167.1.

**Finishing**

Visible joints: Finish visible joints made by welding, brazing or soldering using methods appropriate to the class of work (including grinding or buffing) before further treatment such as painting, galvanizing or electroplating. Make sure self-finished metals are without surface colour variations after jointing.

**Preparation**

General: Before applying decorative or protective prefinishes to metal components, complete welding, cutting, drilling and other fabrication, and prepare the surface using a suitable method.

Standard: To AS 1627.

Priming steel surfaces: If site painting is documented to otherwise uncoated mild steel or similar surfaces, prime as follows:
- After fabrication and before delivery to the works.
- After installation, repair damaged priming and complete the coverage to unprimed surfaces.

**Welding**

Aluminium: To AS 1665.

Stainless steel: To AS/NZS 1554.6.

Steel: To AS/NZS 1554.1.

---

## E6.3.2 NON-FERROUS FINISHING

**Mechanical finishes**

Bright finished copper alloy surfaces: For indoor applications, apply a clear lacquer protecting coating.

## E6.3.3 ELECTROPLATING

**Electroplated coatings**

Chromium on metals: To AS 1192.
- Service condition number: At least 2.

Nickel on metals: To AS 1192.
- Service condition number: At least 2.
Zinc on iron or steel: To AS 1789.

**E6.3.4 ANODISING**

**Sample**
General: Provide a finish to match the sample in terms of colour and finishing options.

**Anodising**
Standard: To AS 1231.
Thickness grade: To AS 1231 Table H1.
Application:
- Indoor applications: At least AA15
- Outdoor Applications: At least AA20
Colour: Refer to the Finishes Schedule.
Warranty: As offered by the aluminium finisher.

**E6.3.5 METAL SPRAYING**

**Metal spray**
Standard: To ISO 2063.
Minimum thicknesses:
- Indoor applications: 125 μm.
- Outdoor applications: 175 μm.
Process: Electric arc.
Seal coat: Cover the metal spray finish with two coats of vinyl seal to a total dry film thickness of 80 μm.

**E6.3.6 POWDER COATING**

**General**
General: Provide powder coating systems to substrates as follows:
- Consistent in colour, gloss level, texture and dry film thickness.
- Fully bonded.
- Resistant to environmental degradation within the manufacturer's stated life span for the product type.

**Substrates**
Application to aluminium and aluminium alloy substrates for architectural applications: To AS 3715.
Application to substrates other than aluminium for architectural applications: To AS 4506.

**Definitions**
General: For the purposes of this worksection the following definitions apply:
- HSS: Heat sensitive substrate; e.g. medium density fibreboard (MDF)
- Substrate: The surface to which a material or product is applied.
  - Thermoset powder coat: A mixture of finely ground particles of pigment and resin sprayed on to the surface to be coated. The charged powder particles adhere to the electrically grounded surfaces until heated and fused into a smooth coating in a curing oven.
  - Thermoset polyester powder coating utilises an enhanced polyester resin.
  - Thermoset fluoropolymer coating, for factory applied spray coatings on aluminium products, includes PVF₂ and PTFE coatings (poly tetra fluoro ethylene).

**Powder coated samples**
General: Submit, on representative substrates, samples of each coating system showing surface preparation, colour, gloss level, texture, and physical properties.

**Manufacturer's documents**
General: Submit the selected manufacturer's details at least 3 weeks before the material is required for fabrication, as follows:
- Recommended coating system for the nominated service condition.
- Brand name.
- Storage and handling recommendations.
- Maintenance recommendations.

Specialist applicators
General: Submit name and contact details of proposed specialist applicators as registered by the coating manufacturer.

Accreditation: To the Australasian Institute of Surface Finishing.

Warranties
General: Submit the coating manufacturer's warranties.

Cleaning
Completed assembly: Clean to AS 3715 Appendix C.

E6.3.7 PREPAINTING

Air-drying enamel
Application: Spray or brush.
Finish: Full gloss.

General use:
- Primer: Two-pack epoxy primer to AS/NZS 3750.13.
- Top coats: 2 coats to AS 3730.6.

Oil resistant use:
- Primer: Two-pack epoxy primer to AS/NZS 3750.13.
- Top coats: 2 coats to AS/NZS 3750.22.

Equipment paint system
Description: Brush or spray application using paint as follows:
- Full gloss enamel finish coats, oil and petrol resistant: To AS/NZS 3750.22, two coats.
- Prime coat to metal surfaces generally: To AS/NZS 3750.19 or AS/NZS 3750.20.
- Prime coat to zinc-coated steel: To AS 3730.15.
- Undercoat: To AS/NZS 3750.21.

Prepainted metal products
Standard: To AS/NZS 2728.
Product type as noted in AS/NZS 2728: Not lower than the type appropriate to the field of application.

Stoving enamel
Application: Spray or dip.

Two-pack liquid coating
Application: Spray.
Finish: Full gloss.

Primer: Two pack epoxy primer to AS/NZS 3750.13.
Topcoat:
- Internal use: Proprietary polyurethane or epoxy acrylic system.
- External use: Proprietary polyurethane system.

E6.3.8 COMPLETION

Damage
General: If prefinishes are damaged, including damage caused by unauthorised site cutting or drilling, remove and replace the damaged item.

Repair
General: If a repair is required to metallic coated sheet or electrogalvanizing on inline galvanized steel products, clean the affected area and apply a two-pack organic primer to AS/NZS 3750.9.
E7 SUNDRY ITEMS

E7.1 GENERAL

E7.1.1 RESPONSIBILITIES

General
General: Provide sundry items that are:
- Undamaged and free of surface defects or distortions.
- Correctly located and aligned, plumb, level and straight.
- Connected to the nominated service(s), if required.
Selections: Conform to the Selections.

E7.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.

E7.1.3 INTERPRETATIONS

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

E7.1.4 INSPECTIONS

Notice
Inspection: Give notice so inspection can be made of the following:
- Set out of item locations before fixing.
- Completion of installation.

E7.1.5 SUBMISSIONS

Shop drawings
General: Submit shop drawings showing the following information:
- Details of fabrication and components.
- Details of fabrication involving other trades or components.
- Information necessary for site assembly.
- Proposals for the break-up of large items as required for delivery to the site.
- Proposed method of joining the modules of large items.
- Fixing locations and types.

Samples
General: Submit samples of the following:
- Each type of joint.
- Each type of finish.
- Sections for use in fabricated work.
Labelling: Label each sample, giving the brand and product name, manufacturer’s code reference, date of manufacture and intended building location.

Sealant compatibility
Compatibility statements: Submit statements from all parties to the installation that certify the compatibility of sealants with items.
**E7.2**

**E7.3  +SELECTIONS**

**E7.3.1 GENERAL**

Supply and install miscellaneous fittings as shown on drawings and detailed below. Co-ordinate with wall framing subcontractor to ensure that adequate provisions are made in the wall framing to provide suitable fixing points for all fittings, particularly grab rails.

**E7.3.2 TOILET AREA FITTINGS**

**Location**

Staff Toilet, Family Accessible Toilet in new Platform Building.

**Grab Rails**

Manufacturer: Bradley Australia  
Standard: AS 1428.1  
Item identification code: Each toilet to be fitted with Item 001 and Item 005 or 006 as appropriate to suit right or left hand installation.  
Material: Stainless steel  
Finish: Satin finish  
Fixing: Concealed

**Hand dryers**

Proprietary item: Dyson Airblades  
Item identification code: A01  
Finish: Silver

**Soap dispensers**

Manufacturer: Kimberley Clark  
Item identification code: Code 6340  
Colour: White

**Coat hooks**

Proprietary item: JDMcDonald  
Item identification code: 7340  
Material: Stainless steel

**Toilet paper holders**

(a) Family Accessible Toilet  
Manufacturer: Kimberley Clark  
Item identification code: Jumbo – Code 4972  
Material: Stainless steel

(b) Staff Toilet  
Manufacturer: Bradley Australia  
Item identification code: Single roll 5084  
Material: Stainless steel

**Shelves**

Manufacturer: Bradley Australia  
Item identification code: Model 755  
Size: 300mm long x 125mm deep  
Material: Stainless steel

**Baby Change Unit**

Manufacturer: Koala Care  
Item identification code: Countertop recessed, model KB112-01RE  
Installation: Install in countertop as specified in Joinery.
E7.3.3 CLEANERS ROOM

Location
Cleaners Room

Mop and broom holder rack
Manufacturer: JDMcDonald
Item identification code: 8215-3
Material: Stainless steel

Storage cupboard
Refer to Joinery section

Lockers
Re-install the existing lockers in the new building.

E7.3.4 PLATFORMS

Seating
Install seating in the locations shown on drawings. Seating to include:
- Existing seating re-installed in new locations
- New floor mounted seating supplied by TfNSW to match existing seating.
- New wall mounted seating supplied by TfNSW

Bins
Supply and install new platform bins to match existing.

E7.3.5 ITEMS CONNECTED TO HYDRAULIC SERVICES

General
Provide and install sanitaryware and tapware as detailed in the Finishes Schedule, including
- WC suites
- Hand basins
- Cleaner's sink
- Kitchen sink
- All associated tapware.

Kitchen sink
Manufacturer: Clark
Type: single bowl and draining board
Length: 930mm
Item identification code: 1003.1 (1th LHB)
Material: Stainless steel

Tap to kitchen sink
Manufacturer: Enware
Type: Single lever sink mixer with extended lever
Item identification code: SLM607D
Finish: Chrome
Other: 5 Star WELS rating model

Accessible WC
Manufacturer: Caroma
Type: Caroma Care 800 Wall Faced Invisi Series II Suite with buttons and panels
Item identification code: 718100W
Colour: White

Accessible Basin
Manufacturer: Caroma
Type: Caroma Care Integra 500 with one tap hole
Item identification code: 648210W
Colour: White
**Sundry items**

**Taps to Accessible basins**  
Manufacturer: Caroma  
Type: Caroma Nordic Care basin mixer  
Item identification code: 90965C5A  
Finish: Chrome  
Other: 5 Star WELS rating model

**Cleaners sink**  
Manufacturer: Caroma  
Type: Cleaners sink with 1521 wall mounted bracket  
Item identification code: 811592W  
Colour: White

**Taps to cleaners sink**  
Manufacturer: Caroma  
Type: G Series Standard wall sink set 150mm  
Item identification code: G91842C4A  
Finish: Chrome
E8 ROOF ACCESS SAFETY SYSTEMS

E8.1 GENERAL

E8.1.1 RESPONSIBILITIES

General
General: Provide the fall protection system in conformance with Selections.
Outcomes: Maintain the waterproofing integrity of roofing and cladding without damage or distortion. Maintain the structural integrity of the supporting elements.

Supply
Design: The design, supply, installation, testing, certification, user manuals and training.
Delivery: Deliver the fall protection assembly ready for installation as follows:
- Clearly labelled to show the intended location.
- In a separate dust and moisture proof package.
- Including the necessary templates, fixings and fixing instructions.

E8.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.

E8.1.3 DESIGN BY CONTRACTOR

General
Designer: The roof safety access system shall be designed by the contractor/subcontractor.

Requirements
Responsibility: The contractor shall be responsible for coordination with other trades, including Light Steel Framing, Structural Steel and Roofing.
Performance requirements: To AS/NZS 1891.2 Section 4 System acceptance criteria.
Authority requirements: The installation shall comply with the requirements of the relevant WorkCover authority.
Access: Make provision for three workers to access the system at any one time, and provide access as follows:
- Full extent of gutters.
- Roof mounted plant and equipment.
- Roof areas within 2.5 m of fall hazards not otherwise protected by parapets or guard rails.
Means of access: Nominate permanent means of access as appropriate.

Documentation
Submit drawings showing location of fixing points and manufacturers and suppliers documents related to this worksection.

Certification
The complete system shall be designed and certified by a structural engineer and copies of the certification shall be provided to the Principal’s Representative.

E8.1.4 STANDARDS

General
Standard: To AS/NZS 1891.

E8.1.5 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Shop fabricated or assembled items ready for delivery to the site.
- Commencement of shop or site welding.
- All equipment attachments with concealed fixings, before they are covered.
- Site erected assemblies on completion of erection, before applying finishes.
- Steel surfaces prepared for, and immediately before, site applied finishes.

Installation inspector: Registered Height Safety Inspector.

### E8.1.6 SUBMISSIONS

**Design**

Documentation: Submit design documentation.

**Product data sheets**

Installation: Submit the manufacture’s Installation Data Sheets/Specification Manual.

### E8.2 PRODUCTS

#### E8.2.1 FALL PROTECTION SYSTEMS

**Fall restraint systems**

Description: Cable based systems positioned so that the user cannot reach a fall hazard when continuously connected to the system using a standard 2 m shock absorbing lanyard. Adjustment of the Personnel Protective Equipment (PPE) is not required whilst connected to the system.

Demonstrators: Use only manufacturer’s representatives competent in connecting the appropriate travelling device to and from the cable.

**Fall arrest systems**

Description: Either cable based where the user is continuously attached to the system, rope based series of anchor points or a single anchor point from which the users can attach themselves when working at height. Whilst attached to these systems they are at risk of falling. The system relies on a rescue plan being in place.

**Ladder access**

Product: Vertical systems comprising top, intermediate and bottom anchor sets and 8 mm 1 x 19 grade 316 stainless steel cables.

**Personal protective equipment (PPE)**

Harness: Supply two full body harnesses with shock absorbing lanyards to AS/NZS 1891.1.

Cable attachment:

Storage: PPE storage holdall supplied by the manufacture.

### E8.3 EXECUTION

#### E8.3.1 INSTALLATION

**Standard**

Installation: To AS/NZS 1891.2.

**Contractor**

Installer: Registered Installer approved by the manufacture.

### E8.3.2 MAINTENANCE

**General**

Preventative and mandatory system maintenance: By competent or Accredited Height Safety Inspector/Certifier, in conformance with AS/NZS 1891.4 Section 9 and manufacturer’s maintenance/recertification recommendations.

Check list for all inspections: To AS/NZS 1891.2 Table 8.

The installer/competent person: To AS/NZS 1891.2 clause 1.3.1.

**Routine inspections**

Standard: To AS/NZS 1891.2 clause 9.2.

Completion certificate:
- Provide inspection, testing and certification by an Accredited Installer and/or Accredited Height Safety Inspector:
  - Upon completion of the installation
  - Upon the expiry of the defects liability period or 12 months after completion of the installation whichever is the lesser, and valid for a further 12 months period.
- Note the date of the next system inspection and period of validity and display the certificate at the access points of the work area or on the individual system components where provision is made.

**Inspection after a fall or other event**
Standard: To AS/NZS 1891.2 clause 9.3.

**Proof testing of drilled-in anchorages**
Standard: To AS/NZS 1891.2 clause 9.4.

**On-going maintenance**
Certificate: Submit the completion certificates and notify the proprietor of the requirement for continued interval testing.

**E8.4 SELECTIONS**

**E8.4.1 ROOF ACCESS AND FALL PROTECTION**

**Roof safety access system**
Provide a safety access system to the roof of the new Platform Building to allow for future maintenance to the roof. The system shall incorporate ladder brackets and roof anchor points, and shall include a safe system of access from the ladder fixing point to the first anchor point.

The system shall be supplied by Sala Group Pty Ltd or approved equivalent.

Ladder fixing points are to be located to minimise visual impact. The location shall also be compatible with TINSW maintenance and operational requirements. Submit the proposed location to the Principal’s Representative for approval prior to installation.

**Extent**
- Roof of new Platform building
- Roofs over existing canopies
- Roofs of lift shafts
E9 DEMOLITION

E9.1 GENERAL

E9.1.1 RESPONSIBILITIES

General
General: Carry out demolition, as documented.

E9.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Site Management

E9.1.3 STANDARD

General
Demolition: To AS 2601.

E9.1.4 INTERPRETATION

Definitions
For the purposes of this worksection, the following definitions apply:
- Demolition: The complete or partial dismantling of a building or structure, by pre-planned and controlled methods or procedures.
- Dilapidation record: The photographic or video and written record made before commencement of demolition work of the condition of the portion of the existing building being retained, adjacent buildings, and other relevant structures or facilities.
- Dismantle: The reduction of an item to its components in a manner to allow re-assembly.
- Recover: The disconnection and removal of an item in a manner to allow re-installation.

E9.1.5 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Adjacent structures before commencement of demolition.
- Services before disconnection or diversion.
- Trees as documented to be retained, before commencement of demolition.
- Contents of building before commencement of demolition.
- Structure after stripping and removal of roof coverings and external cladding.
- Underground structures after demolition above them.
- Excavations remaining after removal of underground work.
- Site after removal of demolished materials.
- Services after reconnection or diversion.

E9.1.6 SUBMISSIONS

Authorities
Evidence of compliance: Before commencing demolition, submit evidence of the following:
- Requirements of authorities relating to the work under the contract have been ascertained.
- A permit to demolish has been obtained from the appropriate authority.
- A scaffold permit has been obtained from the appropriate authority (if scaffolding is proposed to be used).
- Certification that each person having access to the construction site has completed an OHS induction training procedure which is site-specific.
- Precautions necessary for protection of persons and property have been taken and suitable protective and safety devices have been provided to the approval of the relevant authority.

- Treatment for rodent infestation has been carried out and a certificate has been obtained from the appropriate authority.

- Fees and other costs have been paid.

### Investigation and work plan

Work plan: Submit the work plan before demolition or stripping work. Include the check list items appropriate to the project from AS 2601 Appendix A, and the following information:

- The method of protection and support for adjacent property.

- Locations and details of necessary service deviations and terminations.

- Confirmation of the sequence of work.

- Requirements of AS 2601 Section 2 Planning and execution.

- If the demolition program results in components temporarily cantilevered, provide a certificate from a professional engineer.

- Proposals for the safe use of mobile plant on suspended structural members including provisions for the protection of lower floors in the event of structural failure.

- If implosion methods are proposed, provide a separate report of methods and safeguards.

- Wheel loads of tipping or loading vehicles.

### Hazardous materials

Audit: Prepare a Hazardous substances management plan to AS 2601 clause 1.6. Include the following:

- Asbestos or material containing asbestos.

- Flammable or explosive liquids or gases.

- Toxic, infective or contaminated materials.

- Radiation or radioactive materials.

- Noxious or explosive chemicals.

- Tanks or other containers which have been used for storage of explosive, toxic, infective or contaminated substances.

### Records

Dilapidation record: Submit a copy of the dilapidation record for inspection. Submit to each owner of each adjacent property a copy of the part of the record relating to that property and obtain their written agreement to the contents of the record, before commencement of demolition.

Stockpiles

Location: Submit the locations for on-site stockpiles for demolished materials for recycling in the works. Coordinate with the locations of storage for other waste streams and prevent mixing or pollution.

Off site disposal

Disposal location: Submit the locations and evidence of compliance with the relevant authorities for the disposal of material required to be removed from the site.

Recycling

Delivery location: Submit the name and address of the proposed recycling facility.

Certification: Provide evidence of delivery to the nominated recycling facility.

### E9.2 PRODUCTS

#### E9.2.1 DEMOLISHED MATERIALS

Demolished materials classes

Ownership and implementation: Comply with the Demolished materials classes table.

Demolished materials classes table

<table>
<thead>
<tr>
<th>Class</th>
<th>Requirement</th>
<th>Ownership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovered items for re-use in the works</td>
<td>Recover without damage items identified in the Recovered</td>
<td>Principal/proprietor</td>
</tr>
</tbody>
</table>
### Demolition

<table>
<thead>
<tr>
<th>Class</th>
<th>Requirement</th>
<th>Ownership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovered items for delivery to the principal</td>
<td>Recover without damage items identified in the Recovered items for delivery to the principal schedule</td>
<td>Principal/proprietor</td>
</tr>
<tr>
<td>Demolished material for recycling off site</td>
<td>Demolish and deliver for recycling material identified in the Demolished material for recycling off-site schedule</td>
<td>Contractor</td>
</tr>
<tr>
<td>Demolished for removal</td>
<td>Remove from the site demolished materials identified in the Demolish for removal schedule. Do not burn or bury on site Transit: Prevent spillage of demolished materials in transit</td>
<td>Contractor</td>
</tr>
</tbody>
</table>

### E9.3 EXECUTION

#### E9.3.1 SUPPORT

**Temporary support**

General: If temporary support is required, certification for its design and installation is required from a professional engineer engaged by the contractor.

Existing buildings: Until permanent support is provided, provide temporary support for sections of existing buildings which are to be altered and which normally rely for support on work to be demolished.

Ground support: Support excavations for demolition of underground structures.

Adjacent structures: Provide supports to adjacent structures where necessary, sufficient to prevent damage resulting from the works.

- Lateral supports: Provide lateral support equal to that given by the structure to be demolished.
- Vertical supports: Provide vertical support equal to that given by the structure to be demolished.

**Permanent supports**

General: If permanent supports for adjacent structures are necessary and are not documented, give notice and obtain instructions.

#### E9.3.2 PROTECTION

**Encroachment**

General: Prevent the encroachment of demolished materials onto adjoining property, including public places.

**Weather protection**

General: If walls or roofs are opened for alterations and additions or the surfaces of adjoining buildings are exposed, provide temporary covers to prevent water penetration. Provide covers to protect existing plant, equipment and materials intended for re-use.

**Dust protection**

General: Provide dust-proof screens, bulkheads and covers to protect existing finishes and the immediate environment from dust and debris.

**Security**

General: If a wall or roof is opened for alterations and additions, provide security against unauthorised entry to the building.

**Temporary screens**

General: Fill the whole of designated temporary openings or other spaces using dustproof and weatherproof temporary screens, fixed securely to the existing structure, and install to ensure appropriate shedding of water to avoid damage to retained existing elements or adjacent structures and contents.
Demolition

Type: Timber framed screens sheeted with 12 mm plywood and painted. Seal the junctions between the screens and the openings.

Temporary access
General: If required, provide a substantial temporary doorset fitted with a rim deadlock, and remove on completion of demolition.

Exposed surfaces
General: Where necessary, protect and weatherproof the surfaces of adjacent structures exposed by demolition.

Existing services
Location: Before commencing demolition, locate and mark existing underground services in the areas which will be affected by the demolition operations.

Utility services: Contact DIAL BEFORE YOU DIG to identify location of underground utility services pipes and cables.

Excavation: Do not excavate by machine within 1 m of existing underground services.

Concrete slabs
General: Using a diamond saw, neatly cut back or trim to new alignment with a clean true face existing concrete slabs to be partially demolished or penetrated.

Recycling: If concrete crushing is proposed on site, submit details of plant and environmental controls.

Material below grade
Extent: Demolish the following:
- Demolish any materials as required to complete the building works.

Remaining voids: Stabilise and provide barriers.

Explosives
General: Do not use explosives.

E9.3.3 DEMOLITION – BUILDING WORKS

Dilapidation record
Purpose: Use the dilapidation record to assess the damage and making good arising out of demolition work.

Availability: Keep the records of the investigations on site and available for inspection until the date of practical completion of the contract.

Encroachment
General: If encroachments from adjacent structures are encountered and are not documented, give notice and obtain instructions.

Sequence
Sequence of demolition: All demolition is to be staged to conform to the Project staging as described in Section E2 – Scope of Work

Concrete slabs
General: Using a diamond saw, neatly cut back or trim to new alignment with a clean true face existing concrete slabs to be partially demolished or penetrated.

Recycling: If concrete crushing is proposed on site, submit details of plant and environmental controls.

E9.3.4 DEMOLITION – BUILDING SERVICES

General
General: Decommission, isolate, demolish and remove from the site all existing redundant equipment including associated components that become redundant as a result of the demolition.

Breaking down: Disassemble or cut up equipment where necessary to allow removal.

Recovered materials: Recover all components associated with the listed items. Minimise damage during removal and deliver to the locations scheduled.

Refrigeration systems
General: Undertake demolition work on refrigeration systems in conformance with:
- AS/NZS 1677.2 Appendix F.
Demolition

- The recommendations of SAA HB 40.1 and SAA HB 40.2.

Re-used components
General: Clean re-used components and test for compliance with current Australian Standards before returning to service. Provide results of compliance tests.

E9.3.5 HAZARDOUS MATERIALS
Register: Hazardous materials have been identified as present on site and a Hazardous materials register has been prepared.
Availability: [complete/delete]
Hazardous materials removal
Standard: To AS 2601 clause 1.6.2.

E9.3.6 COMPLETION
Notice of completion
General: Give at least 7 working days notice of completion of demolition so that adjacent structures may be inspected following completion of demolition.
Making good: Make good any damage arising out of demolition work. Obtain written acceptance from the owner of each adjoining property of completeness and standard of making good.
Temporary support
General: Clear away at completion of demolition.

E9.4 SELECTIONS

E9.4.1 DEMOLITION
General
Demolish all materials as noted on the drawings, in Section 2 Scope of Work and as may be required to complete the contract works.

Recovered items for re-use in the works schedule

<table>
<thead>
<tr>
<th>Item</th>
<th>Location for re-use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platform seats generally</td>
<td>Re-install in same location or as advised by TfNSW</td>
</tr>
<tr>
<td>Platform seats under awning that is being demolished</td>
<td>As advised by TfNSW</td>
</tr>
<tr>
<td>Platform garbage bins</td>
<td>Re-install in similar position after platform level has been raised.</td>
</tr>
</tbody>
</table>

Demolished material for recycling off-site schedule

<table>
<thead>
<tr>
<th>Material</th>
</tr>
</thead>
</table>
| Platform awning:
  • Steel structure
  • Roof cladding
  • Frames to glazing
  • Glazing
| Ticket Office Building:
  • External columns
  • Steel framing to walls and roof
  • Roof sheeting
  • Partition and ceiling linings
  • Services
  • Joinery
  • Sanitary items
  • Any other materials suitable for recycling
| Store under Stair to platform:
  • Steel framing to walls

Contract No
Cardiff Railway Station Easy Access Upgrade
Tender issue
February 2012
### Demolition

<table>
<thead>
<tr>
<th>Material</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• All linings</td>
<td></td>
</tr>
<tr>
<td>• Any other materials suitable for recycling</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stair to footbridge</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Concrete</td>
<td></td>
</tr>
<tr>
<td>• Metal balustrade</td>
<td></td>
</tr>
<tr>
<td>• Any other materials suitable for recycling</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Footbridge</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Balustrade</td>
<td></td>
</tr>
<tr>
<td>• Lights</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Platform</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Tactile tiles</td>
<td></td>
</tr>
<tr>
<td>• Bricks from planter at south end</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site generally</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Stair to Lower Car Park</td>
<td></td>
</tr>
<tr>
<td>• Paving and kerbs as indicated and as required to complete the works</td>
<td></td>
</tr>
<tr>
<td>• Fencing</td>
<td></td>
</tr>
<tr>
<td>• Trees</td>
<td></td>
</tr>
</tbody>
</table>

### Demolish for removal schedule

<table>
<thead>
<tr>
<th>Item</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Generally</td>
<td></td>
</tr>
<tr>
<td>• Any materials not suitable for recycling</td>
<td></td>
</tr>
</tbody>
</table>
E10 SITE MANAGEMENT

E10.1 GENERAL

E10.1.1 RESPONSIBILITIES

General
Designated areas for protection: Refer to TfNSW Part E, Technical Requirements
Outline of the works: Refer to TfNSW Part E, Technical Requirements

Incidental works
Generally: Undertake the following:
- Reinstatement: Reinstall undeveloped ground surfaces to the condition existing at the commencement of the contract.
- Minor trimming: As required to complete the works as documented.

E10.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Demolition
- Earthwork

E10.1.3 INTERPRETATION

Definitions
General: For the purposes of this work section the following definitions apply:
- Clearance authority: Any authority covering statutory requirements relating to the project and requiring clearances for work in that particular area.
- Clearances: A formal certificate, approval or condition issued by a statutory authority to allow work to be carried out in a particular area.
- Contamination of land: The presence of a substance on or under the land which is a designated hazardous material and/or at a concentration above that which is normally found in that locality, such that there presents a risk of harm to human health or to the environment.
- Green and organic waste: Includes all food wastes, vegetative wastes from land clearing and pruning operations, biosolids produced from the treatment of liquid wastes, garden wastes and forestry waste (bark and saw dust) and paper and cardboard products.
- Environment: The physical factors of the surroundings of human beings including the land, waters, atmosphere, climate, sound, odours, tastes, the biological factors of animals and plants and the social factor of aesthetics.
- Environmental audits: A review of environment management practices, in particular the evaluation of a site for environmental liability.
- Environmental impact assessment: A method for predicting environmental impacts of a proposed development including minimising identified impacts.
- Environmental management plan (EMP): A plan describing the management of the environmental issues and considerations for the activity being undertaken. This applies to the design, construction and operation of the buildings and infrastructure.
- Pollution incident: An incident or set of circumstances during or as a consequence of which there is, or is likely to be a leak, spill or other escape of a substance as a result of which pollution has occurred, is occurring or is likely to occur.
- Weed: An invasive plant that degrades our natural areas, reduces the sustainability or affects the health of people and animals.
**E10.1.4 MANAGEMENT AND CONTROL**

**Plans submitted by the contractor**
Implementation: Approved management plans documented in Submissions.

**Management and control measures**
Implementation: Management and control measures documented in Execution.

**E10.1.5 SUBMISSIONS**

Submissions program
Time for submissions: Before work is commenced on site.

Training program: Submit a program to familiarise staff regarding the site environmental management plan, environmentally sensitive areas and responsibilities.

**Environmental management plan (EMP)**

EMP: Submit an environmental management plan and include the following details:
- Assignment of responsibility for environmental controls.
- Conditions of approvals, licences and permits to meet statutory requirements.
- Details of potential environmental impacts and operational control measures for implementation including:
  - Heritage.
  - Preservation of visual values.
  - Protection of endangered species.
  - Preservation of habitat.
- Details of environmental protection for each activity.
- Locations of environmental controls and environmentally sensitive areas.
- Communication procedures.
- Emergency response procedures including response time.
- Environmental training plan and procedures.
- Environmental auditing program.
- Other items necessary to protect the surrounding environment.

Address the phases of activity, as appropriate:
- Before construction and site establishment.
- During construction.
- After construction, including rehabilitation activities and maintenance of erosion and sedimentation controls.

Preliminary environmental management plan: Submit with the tender documentation.
Completed environmental management plan: Submit before work commences on site.

**Soil erosion and sediment control plan**

Plan: Submit a soil erosion and sediment control plan and include the following details:
- Staging of operations and sequence of works.
- Diversion of upstream water around the site.
- Provision of temporary drains and catch drains.
- Application of diversion, dispersal and/or retention measures to concentrate flows to control and dissipate stormwater through the site without damage.
- Spreader banks or other structures to disperse concentrated runoff.
- Temporary grassing or other treatments such as contour ploughing or bunding to disturbed areas and long-term stockpiles.
- Restoration of disturbed areas in progress with the works.
- Use of mulch materials to protect disturbed or exposed areas where suitable.

Areas: Include all site areas and access and haulage tracks, borrow pits, stockpile and storage areas and compound areas.
Waste management plan
Plan: Submit a waste management plan and identify major waste streams that will be generated during the contract including:
- Green waste and organic waste.
- Construction waste, including:
  - Spoil.
  - Demolition waste.
  - Asphalt or bitumen.
  - Concrete
  - Metal.
  - Paint materials and empty containers.
  - Office waste.
  - Kitchen waste.
  - Sewage effluent.
- For each waste stream indicate:
  - How and where the waste is to be re-used, recycled, stockpiled or disposed off.
  - Indicate how the waste will be transported between the site and point of re-use, recycling, stockpiling, treating or disposal and who will be responsible.

Plan: Submit details of location, labelling and protection of separate skips for the identified waste stream.

Ground contamination control plan
Plan: Submit a ground contamination plan and include the following details:
- If the land is identified as contaminated, or the presence of acid sulphate soils is found, prepare a Remediation Action Plan (RAP) in accordance with the Environmental Protection Authority (EPA) guidelines.

Weed management plan
Plan: Submit a weed management plan and include the following details:
- Identify weeds and infestation zones within the work site/investigation period.
- Method of cleaning vehicles and machinery and cleaning date.
- Cleaning bay location and treatment date.
- Contaminated fill stockpile, treatment type and treatment date.

Site preparation
Mulching: Submit details of provisions for mulching cleared vegetation.

Internal monitoring
Documents: Provide documented procedures describing:
- How environmental monitoring is to be planned, implemented and recorded.
- Non-conformance control and corrective action procedures for all of the control measures that are to be implemented.
Records: Maintain records of the results of environmental monitoring, including the effectiveness of any remedial action taken.

Internal monitoring personnel: Provide staff member’s names and contact details.

Machinery and equipment: Provide details of proposed plant.

Emergency response
Emergency response personnel: Provide staff member’s names and contact details.

Weed management personnel
Requirement: Submit details of the following:
- Subcontractors who will treat weed infestations.
- Chemical handlers, qualifications, date, and spray type.
E10.1.6 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Enclosures to trees to be retained.
- Trees to be removed.

E10.2 EXECUTION

E10.2.1 GENERAL

Community liaison
General: Notify residents about new or changed construction activities which will affect access to, or disrupt the use of, their properties.
Notice: 5 working days unless the work is of an urgent nature with safety implications.
Notification content:
- The nature of the work.
- The reason for it being undertaken.
- The expected duration.
- Changes to traffic arrangements and property access.
- The 24-hour contact number of the responsible representative.

Legislative requirements
Comply with the requirement of the Review of Environmental Factors.

Complaints
Report: Within 1 working day of receiving a complaint about any environmental issue, including pollution, submit a written report detailing the complaint and action taken.
Register: Keep a register of all environmental complaints and action taken.

Cultural heritage
Training: Ensure that all personnel working on site have received training relating to their responsibilities regarding cultural heritage and are made aware of any sites/areas, which must be avoided. Mark-up such sites/areas on a site map and make available to all relevant personnel during the works.
Notice: Give notice if any item is encountered which is suspected to be an artefact of heritage value or any relic or material suspected of being of Aboriginal or early settlement origin.
Action: Stop construction work that might affect the item and protect the item from damage or disturbance.

Aboriginal sacred sites protection
Refer to the Review of Environmental Factors.

No Indigenous heritage items have been recorded within the footprint of the proposal.
If previously unidentified Indigenous heritage items are uncovered during the work, all work in the vicinity of the find is to cease and appropriate advice be sought from DECCW in order to mitigate potential impacts

Clearances
If required obtain clearances from the relevant authorities.

E10.2.2 CONTROL AND PROTECTION

Air quality control
General: Protect adjoining owners, residents and the public against dust, dirt and water nuisance and injury. Use dust screens and watering to reduce the dust nuisance.

Lighting of fires
Prohibition: Do not light fires.

Noise control and vibration
Maximum noise level at the site boundary: Refer to REF
Noise control measures: Refer to REF
Monitoring: Measure vibration levels of the peak particle velocity to AS 2187.2.
Limits: Do not exceed the vibration or airblast overpressure recommended in AS 2187.2 Appendix J.

Dust control
Dust control measures: Refer to REF

Vegetation and fauna
Wild life protected: All native.
Trees to be removed: Inspect to establish if nesting native fauna are present. If present give notice.
Pruning: To AS 4373.

Water quality
Wash out: Ensure that wash out does not enter waterways or stormwater drains.
Cross connection: Ensure that there are no cross connections between the stormwater and the public sewerage system.

Dewatering
General: Keep earthworks free of water. Provide and maintain slopes, crowns and drains on excavations and embankments to ensure free drainage. Place construction, including fill, masonry, concrete and services, on ground from which free water has been removed. Prevent water flow over freshly laid work.

Disposal: Dispose of water off-site.

E10.2.3 MANAGEMENT AND CONTROL MEASURES

Environmental management plan (EMP)
Assignment of responsibility for environmental controls: The Contractor shall undertake works under the Contract in such a manner that impacts on the environment are mitigated. The Contractor shall ensure that the environmental objectives and attainment measures outlined in the relevant State Environmental Protection Policies and all other relevant State and Commonwealth legislation are complied with at all times. Where different objectives are nominated, the more stringent requirement shall be adopted.


The Contractor shall prepare an Environmental Management Strategy and associated Plans for the management of environmental impacts of works under the Contract, including but not limited to those listed below. Environmental Management Plans shall be prepared, implemented, managed and monitored by an environmental specialist meeting the following requirements:

(a) Development, Implementation and Maintenance of the Environmental Management Strategy

The Contractor shall engage an individual/s to develop, implement and maintain the Environmental Management Strategy and the relevant Plans identified in this section of the Specification. Such persons shall:

(i) have demonstrated competence and suitable experience in environmental management in a construction environment;
(ii) be employed by an ISO 14000 certified company; and
(iii) be a member of the Environment Institute of Australia, Institute of Engineers (Australia), Environment Business Australia, or other appropriate affiliation.

(b) Design, Implementation and Monitoring of Environmental Management

The Contractor shall engage competent individuals or companies to work on the Contract to design, implement and monitor all environmental issues and environmental management treatments
implemented on Site during construction. The individual shall have a minimum of five years experience in environmental management.

The Environmental Management Strategy shall be a single document for the Whole of the Works and shall include as a minimum:

- the Contractor’s methodology for ensuring compliance with the EMS Guidelines, and the purpose and objectives of the Environmental Management Strategy;
- a listing of the environmental aspects and impacts associated with the works under the Contract including an outline of proposed mitigation treatments and proposed timeframes;
- processes and responsibilities for:
  - reviewing and updating the Environmental Management Strategy, and site specific plans;
  - the development, implementation, onsite review and maintenance of the Environmental Management Strategy and associated plans/controls;
  - independent verification and auditing of Environmental Management Strategy;
  - reporting and investigation of environmental incidents or complaints relating to any environmental issue under the Contract;
  - an adaptive approach for the review and update of the Plans as works progress and/or following non-conformances, complaints, or previously unidentified issues; and
  - after hours response including arrangements for containing environmental damage and attendance on site in the event of an emergency; and
- requirements of all relevant statutory authorities including necessary approvals and permits;
- arrangements for site induction and training to ensure that all relevant personnel are aware of the requirements of the Environmental Management Plan; and
- arrangements to ensure that all subcontractors comply with the requirements of the Plans.

In preparing the Environmental Management Strategy, the Contractor shall consult with the Environment Protection Authority (EPA) and other relevant authorities, where relevant, and the Plan shall be developed with reference to the specific requirements of the EPA and other relevant authorities.

The Contractor shall develop and implement the following Plans, which detail the Contractor’s proposals for the management of individual stages of work (defined by work activity and/or location) that impact on the environment. Site specific environmental management plans shall be prepared to mitigate all impacts on the environment. They shall address the impacts of activities on elements of the environment and shall include, but not be limited to:

- Construction Environmental Management Plan, which includes;
  - Soil erosion and sediment control plan, which covers:
    - Staging of operations and sequence of works
    - Diversion of upstream water around the site:
    - Provision of temporary drains and catch drains;
  - Stormwater control:
    - Diversion.
    - Dispersal
    - Retention
    - Contour ploughing or bunding to disturbed areas and long-term stockpiles
    - Restoration of disturbed areas in progress with the works:
    - Use of mulch materials to protect disturbed or exposed areas where suitable:
    - Areas: Include all site areas and access and haulage tracks, borrow pits, stockpile and storage areas and compound areas.
Site management

- Waste management plan
  Establish major waste streams that will be generated during the contract including:
  - Green waste and organic waste.
  - Construction waste, including spoil, demolition waste, asphalt or bitumen, concrete, metal, paint materials and empty containers, office waste, kitchen waste, sewage effluent and hazardous materials.

- Weed management plan
  - Construction Compounds and Ancillary Facilities Management Plan;
  - Construction Noise and Vibration Management Plan;
  - Earthworks and Water Quality Management Plan;
  - Waste Management Plan;
  - Flora and Fauna Management Plan;
  - Community Communication Strategy;

The Contractor shall submit to the Superintendent for review the above Plans for each stage of the work, e.g. by geographical area or by construction activity not less than fourteen days prior to the commencement of that stage of the work and not less than 7 business days prior to any proposed change to the Plan unless otherwise specified. Work relevant to that stage shall not commence until the Superintendent is satisfied that the Plan meets the requirements of this specification.

Where, in the opinion of the Superintendent, the Plan does not comply, operate or function in accordance with the performance requirements specified, the Contractor shall cease all activities associated with the Plan until a suitable Plan is developed. Should there be no cessation of activities, the Superintendent reserves the right to take action to provide environmental protection and make good the site. The costs incurred by the Superintendent in undertaking such action will be deducted from progress payments due to the Contractor.

Training program: Submit a program to familiarise staff regarding the site Environmental Management Plan, environmentally sensitive areas and responsibilities.

E10.2.4 TRUCK CONTAMINATION

Truck contamination precautions
Covers: Use tarpaulins to prevent the dropping of materials on public roads.
Washing: Wash the underside of all vehicles leaving the site as follows:
- Mud: Do not carry mud on to adjacent paved streets or other areas.
- Noxious plants: If noxious plants, as designated by the local authority, are present on the site, ensure seeds are not carried on to adjacent paved streets or other areas.

Wheel wash/shaker bay
Facilities: Provide the following:
- Surface: Crushed concrete or rock of between 100 mm and 200 mm rough diameter.
- Services: High pressure hose water supply.
- Location: Site the shaker bay and provide berms as required to drain to grassed areas of the site and allow infiltration to the subsurface.

E10.2.5 MANAGEMENT AND CONTROL PLAN IMPLEMENTATION

Reporting
General: Compile the environment management plan (EMP) reports regularly to report the progress in relation to:
- Performance against statutory requirements.
- Performance against the EMP and the EMP policy, ecologically sustainable development outcomes and targets.
- Summary of monitoring, inspection and audits.
- Summary of reports required to meet the statutory requirements.
- Summary of environmental emergencies, incidents, non-compliance and complaints.

**E10.2.6 TEMPORARY LANDSCAPE FENCING**

**Fence dimensions**
Height: 1200 mm.
Maximum post spacing: 5000 mm.

**Components sizes**
Corner and gate posts: Hardwood or preservative-treated softwood, 250 mm diameter.
Intermediate posts: Star picket.
Gate: Provide a suitable hinged gate with a gate latch.
Wire: Top, intermediate and bottom rows of 3.2 mm plain galvanized steel wire. Thread the top wire through pieces of plastic tube and through corner posts.

**Removal**
Completion: Remove the fence at the end of the planting establishment period.

**E10.2.7 TREE PROTECTION**

**Standard**
General: Comply with the recommendations of those parts of AS 4970 which are referenced in this works section.

**General**
Warning sign: Display a sign in a prominent position at each entrance to the site, warning that trees and plantings are to be protected during the contract. Remove on completion.
Lettering: Road sign type sans serif letters, 100 mm high to AS 4970 Appendix C.
Protection measures program: Before commencement of earthworks.

**Trees to be retained**
Extent: All trees NOT marked for removal.

**Tree protection**
Tree protection zone: To AS 4970 Section 3.
Tree protective measures: To AS 4970 Section 4.
Monitoring and certification: To AS 4970 Section 5.

**Work near trees**
Harmful materials: Keep the area within the dripline free of sheds and paths, construction material and debris. Do not place bulk materials and harmful materials under or near trees. Do not place spoil from excavations against tree trunks. Prevent wind-blown materials such as cement from harming trees and plants.
Damage: Prevent damage to tree bark. Do not attach stays, guys and the like to trees.
Work under trees: Do not remove topsoil from, or add topsoil to, the area within the dripline of the trees.

Excavation: If excavation is required near trees to be retained, give notice and obtain instructions. Open up excavations under tree canopies for as short a period as possible.

Hand methods: Use hand methods to locate, expose and cleanly remove the roots on the line of excavation. If it is necessary to excavate within the drip line, use hand methods such that root systems are preserved intact and undamaged.

Roots: Do not cut tree roots exceeding 50 mm diameter. Where it is necessary to cut tree roots, use means such that the cutting does not unduly disturb the remaining root system. Immediately after cutting, water the tree and apply a liquid rooting hormone to stimulate the growth of new roots.

Backfilling: Backfill to excavations around tree roots with a mixture consisting of three parts by volume of topsoil and one part of well rotted compost with a neutral pH value, free from weed growth and harmful materials. Place the backfill layers, each of 300 mm maximum depth, compacted to a dry density similar to that of the original or surrounding soil. Do not backfill around tree trunks to a height greater than 200 mm above the original ground surface. Immediately after backfilling, thoroughly water the root zone surrounding the tree.
Compacted ground: Do not compact the ground or use skid-steel vehicles under the tree dripline. If compaction occurs, give notice and obtain instructions.

Compaction protection: Protect areas adjacent the tree dripline. Submit proposals for an elevated platform to suit the proposed earthworks machinery.

Watering: Water trees as necessary, including where roots are exposed at ambient temperature > 35°C.

Mulching: Spread 100 mm thick organic mulch to the whole of the area covered by the drip line of all protected trees.

**E10.2.8 EXISTING SERVICES**

**Location**
Requirement: Before commencing earthworks, locate and mark existing underground services in the areas which will be affected by the earthworks operations including clearing, excavating and trenching.

Utility services: Contact DIAL BEFORE YOU DIG to identify location of underground utility services pipes and cables.

**Excavation**
General: Do not excavate by machine within 1 m of existing underground services.

**E10.2.9 TREES TO BE REMOVED**

**Designation**
Extent: As agreed with the Superintendent.

Marking: Mark trees and shrubs to be removed as follows:
- Tags: Surveyor’s ribbon
- Location: 1000 mm above ground level.

**E10.2.10 SITE CLEARING**

**Extent**
General: Clear only the following site areas:
- Areas to be occupied by works such as structures, paving, excavation, regrading and landscaping.
- Other areas designated to be cleared.

Contractor’s site areas: If not included within the areas documented above, clear generally only to the extent necessary for the performance of the works.

**Clearing and grubbing**
Clearing: Remove everything on or above the site surface, including rubbish, scrap, grass, vegetable matter and organic debris, scrub, trees, timber, stumps, boulders and rubble.
Grubbing: Grub out stumps and roots over 75 mm diameter to a minimum depth of 500 mm below subgrade under buildings, embankments or paving, or 300 mm below finished surface in unpaved areas. Backfill holes remaining after grubbing with sand material to prevent ponding of water. Compact the material to the relative density of the existing adjacent ground material.

Old works: Remove old works, including slabs, foundations, pavings, drains and access chambers covers found on the surface.

**E10.2.11 TREE MAINTENANCE**

**General**
Notice: Give notice before commencing tree maintenance.

Work on trees: If it is necessary to perform any work on trees to be retained, give notice.

Pruning requirements: Carry out all pruning in conformance with AS 4373 and Occupational Health and Safety Act 1983 and the relevant industry code of practice by a fully qualified and experienced arborist. Carry out all required works in a safe and progressive manner.

**Execution**
Repair: Undertake tree surgery and make good damage to existing trees noted to be retained.

Operations: Remove dead and decayed wood or limbs that have been broken. Make all cuts at branch collars. If trees show signs of deterioration after the work has been done, carry out a program of soil
Site management

amelioration such as soil aeration, irrigation or incorporation of organic material. Continue this program until the end of the plant establishment period.

Root pruning: Do not unduly disturb the remaining root system. Cut off damaged roots cleanly inside the exposed or damaged area. Cover exposed root area with soil immediately. Do not leave roots exposed.

Wetting and new root stimulation: Form a water collecting basin and apply a rooting hormone and wetting agent to the rootball.

Precautions: Avoid damage to trees being treated or to nearby trees and surroundings. Do not use trees as anchors for winching operations or bracing. Provide bracing as necessary before cutting to prevent uncontrolled breakages and damage to surroundings.

Failure: If repair work is impracticable, or is attempted and is rejected, remove the tree and root system and make good.

E10.2.12 SEDIMENT FILTERS

General

Inspection: Inspect for displacement, undercutting, over-topping and soil build-up, after each rain event. Effect repairs immediately.

Removal: When the upslope areas have been permanently stabilised.

Straw bale filters

Description: Temporary structures made of straw bales (cereal straw) laid end to end across direction of stormwater flow in order to filter sediment.

Location: to be determined by the Contractor’s environmental specialist.

Slopes: If filter is at toe of a slope, place bales 1500 – 2000 mm away from slope, to provide access for maintenance and to allow coarse sediment to drop out of suspension before reaching sediment filter.

Binding: Wire-bound or with string-tied bindings wrapped around the bale sides.

Installation:

- Trench: 100 mm deep trench the width of a bale and the length of the proposed sediment filter.
- Placement: Lengthwise in the trench with ends tightly abutting and corners lapped.
- Fixing: Drive two 50 x 50 mm wooden stakes or metal star pickets through each bale. Ensure bales are packed closely and staked securely. Eliminate gaps with loose straw wedged between tight.

Backfilling: Compacted excavated soil to ground level on downhill side of barrier, and 100 mm above ground level on the uphill side of the bales.

Silt fence

Description: A temporary barrier of geotextile, supported on wire or mesh fencing in order to filter sediment from stormwater flow.

Location: to be determined by the Contractor’s environmental specialist.

Slopes: If filter is at toe of a slope, locate fence 1500 – 2000 mm away from slope, to provide access for maintenance and to allow coarse sediment to drop out of suspension before reaching sediment filter.

Contours: Locate fence line and posts along contours curving upstream at the sides to direct flow toward middle of the fence.

Installation:

- Trench: 100 mm wide x 200 mm deep along line of posts and upslope from barrier.
- Posts: 1200 mm long pre drilled steel star picket posts at 3000 mm centres, driven 600 mm and fitted with plastic safety caps.
- Wire mesh: ≥ 14 gauge x ≤ 150 mm mesh spacing. Fasten wire mesh to upslope side of posts with 25 mm long heavy-duty wire staples and tie wire. Extend wire mesh 150 mm into trench.
- Filter: Geotextile selected to suit local soil conditions cut from a continuous roll to minimise joints.
- Fixing: Wire ties to the uphill side of fence posts, and extended 200 mm into the trench. Do not staple onto trees.
- Joints: 150 mm overlap at a support post, with both ends fastened to the post.
Performance: Retain soil found on site but with openings large enough to permit drainage and prevent clogging.  
Fence height: 600 mm average.  
Backfilling: Backfill trench over toe of geotextile and compact soil.  

**Straw bale – geotextile filters**  
Description: Sediment filter comprising straw bales and geotextile.  
Location: to be determined by the Contractor’s environmental specialist.  
Slopes: If filter is at toe of a slope, place bales 1500 – 2000 mm away from slope, to provide access for maintenance and to allow coarse sediment to drop out of suspension before reaching sediment filter.  
Binding: Wire-bound or with string-tied bindings wrapped around the bale sides.  
Bale installation:  
- Trench: 100 mm deep trench the width of a bale and the length of the proposed sediment filter.  
- Placing: Lengthwise in the trench with ends tightly abutting and corners lapped.  
- Fixing: Drive two 50 x 50 mm wooden stakes or metal star pickets through each bale. Ensure bales are packed closely and staked securely. Eliminate gaps with loose straw wedged between tight.  
Geotextile installation:  
- Geotextile selected to suit local soil conditions cut from a continuous roll to minimise joints.  
- Fixing: Staple geotextile to top of straw bale and extend down the uphill face of the bale into the trench. Stretch the geotextile and peg securely into the subgrade.  
- Joints: 150 mm overlap at a support post, with both ends fastened to the post.  
Performance: Retain soil found on site but with openings large enough to permit drainage and prevent clogging.  
Backfilling: Compacted excavated soil to ground level on downhill side of barrier, and 100 mm above ground level on the uphill side of the bales against and over toe of the fabric.

**E10.2.13 DISPOSAL OF MATERIALS**  

**Disposal**  
Spoil: Remove cleared and grubbed material from the site and dispose of legally.  
Surplus material: Remove all surplus material from site.  
Burial: Bury concrete and other inorganic fragments as follows:  
- Location: Beyond built or paved areas.  
- Depth: > 600 mm from finished ground level to the top of the object.  
- Compaction: Eliminate voids.  

**Mulch**  
Seed free aerial vegetative matter: Put through a chipper. Reduce to pieces not larger than 75 x 50 x 15 mm and stockpile for re-use as mulch.  
Material not permitted: Leaf matter and tree loppings from privet, camphor laurel, coral tree, poplar, willow and noxious weeds.

**E10.2.14 COMPLETION**  

**Temporary works**  
Remove at completion: Remove all temporary works on completion.  

**Joining up**  
Abutments: Join new and existing work including cutting if required, in the manner appropriate to the materials and make good to existing work.  

**Clean up**  
Progressive cleaning: Keep the work under the contract clean and tidy as it proceeds and regularly remove from the site rubbish and surplus material arising from the execution of the work including any work performed during the defects liability period or the plant establishment period.  
Removal of plant: Within fourteen days of the date of practical completion, remove temporary works, construction plant, buildings, workshops and equipment not forming part of the works, except what is
Site management

required for work during the defects liability period or the plant establishment period. Remove these on completion.

E10.2.15 VERMIN

Vermin management

Requirement: Employ an approved firm of pest exterminators and provide a certificate from the firm stating that the completed building is free of vermin.
E11 EARTHWORK

E11.1 GENERAL

E11.1.1 RESPONSIBILITIES

General
Requirement: Provide earthworks to the dimensions and tolerances, as documented.

Design
Geotechnical and environmental reports are not available.

E11.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Site management.
- Civil works.
- Landscaping.
- Structural.
- Electrical.
- Architectural

E11.1.3 STANDARDS

General
Earthworks: To AS 3798.

General: Comply with the recommendations of those parts of AS 3798 which are referenced in this worksection.

E11.1.4 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
- GITa: Geotechnical inspection and testing authority.
- GTA: Geotechnical testing authority.

Definitions
General: For the purposes of this worksection the definitions given in AS 1348, AS 3798 and the following apply:
- Description and classification of soils: To AS 1726.
- Site classification: To BCA 3.2.4.
- Bad ground: Ground unsuitable for the purposes of the works, including fill liable to subsidence, ground containing cavities, faults or fissures, ground contaminated by harmful substances and ground which is or becomes soft, wet or unstable.
- Base: One or more layers of material usually constituting the uppermost structural element of a pavement and on which the surfacing may be placed, which may be composed of fine crushed rock, natural gravel, broken stone, stabilised material, asphalt or Portland cement concrete.
- Discrepancy: A difference between contract information about the site and conditions encountered on the site, including but not limited to discrepancies concerning the following:
  - The nature or quantity of the material to be excavated or placed.
  - Existing site levels.
  - Services or other obstructions beneath the site surface.
- Rock: Monolithic material with volume greater than 0.5 m³ which cannot be removed until broken up either by explosives or by rippers or percussion tools.
- Site topsoil: Soil excavated from the site which contains organic matter, supports plant life, conforms generally to the fine to medium texture classification to AS 4419 (loam, silt, clay loam) and is free from:
  - Stones > 25 mm diameter.
  - Clay lumps > 75 mm diameter.
  - Weeds and tree roots.
  - Sticks and rubbish.
  - Material toxic to plants.
- Subbase: The material laid on the subgrade below the base either for the purpose of making up additional pavement thickness required, to prevent intrusion of the subgrade into the base, or to provide a working platform.
- Subgrade: The trimmed or prepared portion of the formation on which the pavement or slab is constructed. Generally taken to relate to the upper line of the formation.
- Zone of influence: A foundation zone bounded by planes extending downward and outward from the bottom edge of a footing, slab or pavement and defining the extent of foundation material having influence on the stability or support of the footings, slab or pavement.

**E11.1.5 INSPECTION**

**Notice**
Inspection: Give notice so that inspection may be made of the following:
- Items to be measured as listed in Records of measurement.
- Areas to be cleared and/or stripped of topsoil.
- Areas stripped of topsoil.
- Excavation completed to contract levels or founding material.
- Proof roll subgrade before placing fill.
- Filling completed to contract levels.
- Stockpiled topsoil before spreading.

**E11.1.6 TOLERANCES**

**General**
Finish: Finish the surface to the required level, grade and shape within the following tolerances:
- Under building slabs and load bearing elements: +0, -25 mm.
- Pavement subgrades: +0, -40 mm.
- Batters: No steeper than the slope shown on the drawings. Ensure flatter slopes do not impact on boundaries or required clearances to buildings, pavements or landscaping.
- Other ground surfaces: ±50 mm, provided the area remains free draining and matches adjacent construction where required. Provide smoothness as normally produced by a scraper blade.

**E11.1.7 SUBMISSIONS**

**Design**
Calculations: Submit calculations by a professional engineer to show that proposed excavations and temporary supports, including where applicable supports for adjacent structures, will be stable and safe.

**Tests**
Compaction: Submit certification and/or test results in conformance with the specified level of responsibility to AS 3798.

**Materials**
Imported fill: Submit certification or test results by a GTA registered laboratory which establish the compliance of imported fill with the contract including the source.

**Execution details**
Report: Submit a time based schedule noting the methods and equipment proposed for the groundworks, including the following:
- Dewatering and groundwater control and disposal of surface water.
- Excavation methods, stages, clearances, batters and temporary supports.
- Stockpiles and borrow pits.
- Placing and compaction methods and stages.

Geotechnical site investigations: Provide a geotechnical report supporting the procedures proposed for excavation.

Disposal location: Submit the locations and evidence of compliance with the relevant authorities for the disposal of material required to be removed from site.

Explosives: Submit proposal for any explosives required. Include name of specialist subcontractor, type of explosives, protection and safety measures to AS 2187.1 and AS 2187.2.

Temporary shoring: Provide a proposal for any temporary shoring or underpinning required including the progressive removal.

Proof rolling: Submit method and equipment for proof rolling.

Certified records of measurement: Submit a certified copy of the agreed records of measurement.

Construction records: Submit the following to AS 3798 clause 3.4 and Appendix B:
- Geotechnical site visit record; and
- Earthworks summary report or daily geotechnical reports.

### E11.2 PRODUCTS

#### E11.2.1 FILL MATERIALS

**General**

Suitable material: To AS 3798 clause 4.4 including inorganic, non-perishable material suitably graded and capable of compaction to the documented density.

Unsuitable materials: Do not use unsuitable material for fill in conformance with AS 3798 clause 4.3.

Sulphur content: Do not provide filling with sulphur content exceeding 0.5 % within 500 mm of cement bound elements (for example concrete structures or masonry) unless such elements are protected by impermeable membranes or equivalent means.

Re-use of excavated material: Only re-use suitable material in conformance with AS 3798 clause 4.4.

Stockpiles: Segregate the earth and rock material and stockpile, for reuse in backfilling operations.

Locations: Do not stockpile excavated material against tree trunks, buildings, fences or obstruct the free flow of water along gutters where stockpiling is permitted along the line of the trench excavation.

Disposal: If stockpiling is not permitted under the contract, dispose of excavated material off-site to AS 3798 clause 6.1.8.

#### E11.2.2 BORROW OR IMPORTED FILL

Borrow or imported material: Only when no suitable excavated material is available.

- Suitable material: To AS 3798 clause 4.4.

Borrow pits:
- Location: > 3 m from any fence line, boundary, edge of excavation or embankment.
- Strip and stockpile topsoil.
- Provide erosion protection during winning operations of material and ensure drainage is maintained.
- On completion of winning operations grade abrupt changes of slope, respread topsoil and apply and maintain hydroseeded grassing.

### E11.3 EXECUTION

#### E11.3.1 SITE PREPARATION

**Erosion and sedimentation control**

Drainage, erosion and sedimentation control: To the Site management worksection.
E11.3.2 GEOTECHNICAL

As found site conditions
General: If the following are encountered, give notice immediately and obtain instructions before carrying out any further work in the affected area:
- Bad ground.
- Discrepancies.
- Rock.
- Springs, seepages.
- Topsoil > 100 mm deep.

Inspection and testing
Inspection and testing: Conform to the following:
- Level 1 GITA required to AS 3798 clause 8.2.
- Level 2 GTA required to AS 3798 clause 8.3.

E11.3.3 RECORDS OF MEASUREMENT

Excavation and backfilling
Agreed quantities: If a schedule of rates applies, provisional quantities are specified, or there are variations to the contract levels or dimensions of excavations, do not commence backfilling or place permanent works in the excavation until the following have been agreed and recorded:
- Depths of excavations related to the datum.
- Final plan dimensions of excavations.
- Quantities of excavations in rock.

Method of measurement: By registered surveyor unless otherwise agreed.

Rock
Level and class: If rock is measured for payment purposes, whether as extra over excavation of material other than rock or for adjustment of provisional measurements, do not remove the rock until the commencing levels and the classes of rock have been determined.

E11.3.4 REMOVAL OF TOPSOIL

General
Extent: Areas of cut or fill and areas occupied by structures, pavements and embankments.
Maximum depth: 200 mm.

Topsoil stockpiles
General: Stockpile site topsoil intended for re-use and imported topsoil where necessary.
Stockpile heights: Establish stockpiles to maximum height of 1.5 m.
Mark: Identify stockpiles of different soil types.
Vegetation: Do not burn off or remove plant growth which may occur during storage.
Protection: Provide the following:
- Drainage and erosion protection.
- Do not allow traffic on stockpiles.
- If a stockpile is to remain for more than four weeks, sow with temporary grass.
- Protect the topsoil stockpiles from contamination by other excavated material, weeds and building debris.
Remove: Remove topsoil that is unsuitable for re-use from the site to AS 3798 clause 6.1.8.

E11.3.5 EXCAVATION

Extent
Site surface: Excavate over the site to give correct levels and profiles as the basis for structures, pavements, filling and landscaping. Make allowance for compaction, settlement or heaving.
Footings: Excavate for footings, pits, wells and shafts, to the required sizes and depths. Confirm that the foundation conditions meet the design bearing capacity.
Rock
General: Do not use explosives.

Existing footings
Requirement: If excavation is required within the zone of influence of an existing footing, use methods including (temporary) shoring or underpinning which maintain the support of the footing and ensure that the structure and finishes supported by the footing are not damaged.

Existing services
Location: Before commencing earthworks, locate and mark existing underground services in the areas which will be affected by the earthworks operations including clearing, excavating and trenching.
Utility services: Contact DIAL BEFORE YOU DIG to identify location of underground utility services pipes and cables. See www.1100.com.au.
Excavation: Identify existing underground services and give notice. Do not excavate by machine within 1 m of existing underground services.

Proof rolling
Extent: Proof roll excavations for pavements, filling and non-spanning slabs on ground to determine the presence of any bad ground.
Proof rolling method and equipment: To AS 3798 clause 5.5.
Outcome: If excessive settlement, rebound or heaving is encountered, provide test pits or trenching to determine the extent of bad ground.

Disposal of excess excavated material
General: Remove excess excavated material from site not required or unsuitable for fill.
- Standard: To AS 3798 clause 6.1.8.

E11.3.6 Subgrades affected by moisture
General
General: If the subgrade is unable to support construction equipment, or it is not possible to compact the overlying pavement only because of a high moisture content, perform one or more of the following:
- Allow the subgrade to dry until it will support equipment and allow compaction.
- Scarify the subgrade to a depth of 150 mm, work as necessary to accelerate drying, and recompact when the moisture content is satisfactory.
- Excavate the wet material and remove to spoil, and backfill excavated areas.

E11.3.7 Bearing surfaces
General
General: Provide even plane bearing surfaces for loadbearing elements including footings. Step to accommodate level changes. Make the steps to the appropriate courses if supporting masonry.

Deterioration
General: If the bearing surface deteriorates because of water or other cause, excavate further to a sound surface before placing the loadbearing element.

E11.3.8 Reinstatement of excavation
General
Requirement: If the excavation exceeds the required depth, or deteriorates, reinstate to the correct depth, level and bearing value.
Fill adjacent structures and trenches: To AS 3798 clause 6.2.6.
Zone of influence: Within the zone of influence of footings, beams, or other structural elements, use concrete of strength equal to the structural element, minimum 15 Mpa. Ensure that remedial concrete does not create differential bearing conditions.
Below slabs or pavements: Provide selected fill compacted to the specified density.
Cut subgrades: Where the over excavation is less than 100 mm, do not backfill. Make good by increasing the thickness of the layer above.
Rock depressions and subsoil drains: Backfill rock depressions and over excavation of subsoil drains using coarse subsoil filter.
E11.3.9 SUPPORTING EXCAVATIONS

Removal of supports
General: Remove temporary supports progressively as backfilling proceeds.

Voids
General: Guard against the formation of voids outside sheeting or sheet piling if used. Fill and compact voids to a dry density similar to that of the surrounding material.

E11.3.10 ADJACENT STRUCTURES

Temporary supports
General: Provide supports to adjacent structures where necessary, sufficient to prevent damage arising from the works.
Lateral supports: Provide lateral support using shoring.
Vertical supports: Provide vertical support where necessary using piling or underpinning or both.

Permanent supports
General: If permanent supports for adjacent structures are necessary and are not described, give notice and obtain instructions.

Encroachments
General: If encroachments from adjacent structures are encountered and are not shown on the drawings, give notice and obtain instructions.

E11.3.11 ROCK BOLTING

General
General: Provide proprietary high strength steel bars or tubes anchored into holes drilled in the rock and tensioned against plates bearing on the rock face to provide temporary or permanent support for the rock face. Schedule the installation to conform to systematic bolting or calculated relief, as documented.
Standard: To AS 4678.

Protection
General: Protect permanent rock bolts by grouting the drilled hole with cement grout after tensioning the rock bolt. Protect the bearing plate and the exposed portion of rock bolt and anchorage with a protective coating or by embedment in concrete.

E11.3.12 PREPARATION FOR FILLING

Preparation
Stripping: Prepare the ground surface before placing fill (including topsoil fill), ground slabs or load bearing elements to AS 3798 clause 6.1.5. Remove materials which will inhibit or prevent satisfactory placement of fill layers, loose material, debris and organic matter.
Foundation preparation: To AS 3798 clause 6.1.7.
Compaction: Compact the ground exposed after stripping or excavation to the minimum relative compaction in AS 3798 Section 5 and the Compaction table.
Scarify method: Loosen exposed excavation by scarifying to a minimum or 150 mm, moisture condition and compact to AS 3798 Section 5 and the Compaction table.
Impact roller compaction: Use an approved impact roller or impact completion.
Slope preparation: If fill is placed on a surface which slopes steeper than 4 H:1 V, bench the surface to form a key for the fill. As each layer of fill is placed, cut the existing ground surface progressively to form a series of horizontal steps > 1 m in width and > 100 mm deep. Recompact the excavated material as part of the filling. Shape to provide free drainage.

Under earth mounds
General: Cultivate the ground to a depth of 200 mm before mound formation.

Under slabs, paving and embankments
General: Compact the ground to achieve the densities specified in the Compaction schedule. If necessary loosen the ground to a depth of > 200 mm and adjust the moisture content before compaction to a density consistent with subsequent filling.
Rock ledges
General: Remove overhanging rock ledges.

E11.3.13 GEOTEXTILE

General
Geotextile: N/A
Material: UV stabilised polymeric fabric formed from a plastic yarn composed of at least 85% by weight.
Identification and marking: To AS 3705.
Product: N/A
Properties: N/A
Preparation: Trim the ground to a smooth surface free from cavities and projecting rocks.
Placing: Lay the fabric flat, but not stretched tight, and secure it with anchor pins. Overlap joints 300 mm minimum.

E11.3.14 PLACING FILL

General
Layers: Place fill in near-horizontal layers of uniform thickness, deposited systematically across the fill area.
Extent: Place and compact fill to the designated dimensions, levels, grades, and cross sections so that the surface is always self draining.
Edges: At junctions of fill and existing surfaces, do not feather the edges.
Mix: Place fill in a uniform mixture.
Previous fill: Before placing subsequent fill layers, ensure that previously accepted layers still conform to requirements, including moisture content.
Protection: Protect the works from damage due to compaction operations. Where necessary, limit the size of compaction equipment or compact by hand. Commence compacting each layer at the structure and proceed away from it.
Protective covering: Do not disturb or damage the protective covering of membranes during backfilling.

Placing at structures
General: Place and compact fill in layers simultaneously on both sides of structures, culverts and pipelines to avoid differential loading. Carefully place first layers of fill over the top of structures.
Concrete: Do not place fill against concrete retaining walls until the concrete has been in place for 28 days unless the structure is supported by struts.

E11.3.15 PLACING TOPSOIL

Stockpiled topsoil
Cultivation: Rip to a depth of 100 mm or to the depth of rippable subgrade if less. Cultivate around services and tree roots by hand. Trim to allow for the required topsoil depth.
Herbicide: Apply before placing topsoil.
Placing: Spread and grade evenly.

Disposal of excess topsoil
On site: Dispose of surplus topsoil remaining on site by spreading evenly over the areas already placed.
Off site: Remove excess topsoil from the site and dispose of legally.
Compaction: Lightly compact topsoil so that the finished surface is smooth, free from lumps of soil, at the required level, ready for cultivation and planting.
Edges: Finish topsoil flush with abutting kerbs, mowing strips and paved surfaces. Feather edges into adjoining undisturbed ground.
E11.3.16 FILL MOISTURE CONTROL

General
Moisture content: Adjust the moisture content of fill during compaction within the range of 85 – 115% of the optimum moisture content determined by AS 1289.5.1.1 or AS 1289.5.2.1 as appropriate, in order to achieve the required density.

E11.3.17 COMPACTION REQUIREMENTS FOR FILL AND SUBGRADE

Density
General: Other than rolled fill to AS 2870 clause 6.4.2(b). Compact the subgrade and each layer of fill to the required depth and density, as a systematic construction operation and to conform to the Compaction table. Shape surfaces to provide drainage and prevent ponding.

Compaction table

<table>
<thead>
<tr>
<th>Location</th>
<th>Cohesive soils. Minimum dry density ratio (standard compaction) to AS 1289.5.4.1</th>
<th>Cohesionless soils. Minimum density index to AS 1289.5.6.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential: Lot fill, house sites.</td>
<td>95</td>
<td>70</td>
</tr>
<tr>
<td>Commercial: Fills to support minor loadings incl. floor loadings &lt; 20 kPa and isolated pad or strip footings &lt; 100 kPa.</td>
<td>98</td>
<td>75</td>
</tr>
<tr>
<td>Pavements: Fill to support pavements</td>
<td>95</td>
<td>70</td>
</tr>
<tr>
<td>Subgrade to 300 mm deep</td>
<td>98</td>
<td>75</td>
</tr>
</tbody>
</table>

Excavated and stripped ground surface: After excavation and/or stripping, compact these surfaces in conformance with the Compaction table to a minimum depth of 150 mm.

Maximum rock and lump size in layer after compaction: 2/3 compacted layer thickness.

Fill batter faces: Either compact separately, or overfill and cut back. Form roughened surfaces to the faces.

Compaction control tests
Compaction control tests: To AS 1289 5.4.1 or AS 1289.5.7.1.

Compaction control test frequency
Standard: To AS 3798 Table 8.1.
Confined operations: 1 test per 2 layers per 50 m².

E11.3.18 COMPLETION

Grading
External areas: Grade to give falls away from buildings, minimum 1:100.
Subfloor areas: Grade the ground surface under suspended floors to drain ground or surface water away from buildings without ponding.

Temporary works
Tree enclosures: Remove temporary tree enclosures at completion.
Tree marking: Remove temporary marks and tags at completion.
Temporary supports: Remove temporary supports to adjacent structures at completion.

Site restoration
Requirement: Where variation of existing ground surfaces is not required as part of the works, restore surfaces to the condition existing at the commencement of the contract.
E12 STORMWATER – SITE

E12.1 GENERAL

E12.1.1 RESPONSIBILITIES
General
General: Provide stormwater drainage as documented.
Selections: As documented.

E12.1.2 CROSS REFERENCES
General
Requirement: Conform to the following:
- General requirements.
- Earthwork.

E12.1.3 INTERPRETATION
Definitions
General: For the purposes of this worksection the following definition applies:
- Pipe surround: Includes pipe overlay, pipe side support, side zone and haunch zone.

E12.1.4 STANDARDS
Stormwater drainage
Standard: To AS/NZS 3500.3.

E12.1.5 INSPECTION
Notice
Inspection: Give notice so that inspection may be made of the following:
- Excavated surfaces before placing pipe bedding material.
- Formwork and reinforcement before placing cast in situ concrete.
- Pipe joints before covering.
- Placing of cast in situ concrete.
- Upon completion.

E12.1.6 SUBMISSIONS
Samples
General: Submit samples of the following:
- Each type of imported pipe bedding material.
- Each type of filter material.

Products – documentation
Conformance: Produce documentary evidence that the pipes conform to the requirements of this worksection.

E12.2 PRODUCTS

E12.2.1 MATERIALS
Concrete and mortar
Concrete: To AS 1379 and the following:
- Grade: N20.
- Cement: To AS 3972.
- Type: GP or GB.
Steel reinforcement:
- Bars and machine welded mesh: To AS/NZS 4671.

**Joints**
Solvent cement and priming fluid: To AS/NZS 3879.

**Pipe and fittings**
Fibre reinforced cement (FRC): To AS 4139 and the following:
- ≤ 450 mm diameter: Rubber ring joints to AS 4139.
- > 450 mm diameter: With a purpose machined internal spigot and socket system within the pipe wall.

Glass-reinforced polyester (GRP): To AS 3571.1.
Cast iron access chamber covers and frames: To AS 1830 and AS 1831, as appropriate.
Polyvinyl chloride (PVC): To AS/NZS 1254, AS/NZS 1260, AS 1273, as appropriate.
Polyethylene (PE): To AS/NZS 4129, AS/NZS 4130, ISO 8770, or AS/NZS 2033.
Precast concrete: To AS/NZS 4058.
Rubber ring joints/elastomeric seals: To AS 1646.
Subsoil: To AS 2439.1.
Vitrified clay or ceramic: To AS 1741.

**Bedding material**
Bed and haunch zones: Provide granular material graded to AS 1141.
Conformance: Conform to the **Bedding material grading table**.

<table>
<thead>
<tr>
<th>Sieve size (mm)</th>
<th>Weight passing %</th>
<th>Bed and haunch</th>
<th>Side zones</th>
</tr>
</thead>
<tbody>
<tr>
<td>75.0</td>
<td>-</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19.0</td>
<td>100</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>9.5</td>
<td>-</td>
<td>50-100</td>
<td></td>
</tr>
<tr>
<td>2.36</td>
<td>50-100</td>
<td>30-100</td>
<td></td>
</tr>
<tr>
<td>0.60</td>
<td>20-90</td>
<td>15-50</td>
<td></td>
</tr>
<tr>
<td>0.30</td>
<td>10-60</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>0.15</td>
<td>0-25</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>0.075</td>
<td>0-10</td>
<td>0-25</td>
<td></td>
</tr>
</tbody>
</table>

**E12.3 EXECUTION**

**E12.3.1 TOLERANCES**

**General**
General: Conform to the **Pipeline tolerances table**. These tolerances are conditional on falls to outlets being maintained and no part of a pipeline being at less than the designated gradient.

**Pipeline tolerances table**

<table>
<thead>
<tr>
<th></th>
<th>Permissible angular deviation from alignment</th>
<th>Permissible displacement from alignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal</td>
<td>1 in 300</td>
<td>15 mm</td>
</tr>
<tr>
<td>Vertical</td>
<td>1 in 500</td>
<td>5 mm</td>
</tr>
</tbody>
</table>

**E12.3.2 STORMWATER DRAINS**

**Location**
General: Provide stormwater drains to connect downpipes, surface drains, subsoil drains and drainage pits to the outlet point or point of connection. Make sure that location of piping will not interfere with
other services and building elements not yet installed or built. Subject to the preceding and documented layouts, follow the most direct route with the least number of changes in direction.

Downpipe connections: Turn up branch pipelines with bends to meet the downpipe, finishing 50 mm (nominal) above finished ground or pavement level. Seal joints between downpipes and drains.

Laying
General: Lay in straight lines between changes in direction or grade with socket end placed upstream. If other pipes are adjacent, set each pipe true to line and complete each joint before laying the next pipe. If work is not continuous cap open ends to prevent entry of foreign matter.

Bedding
General: Grade the underlay evenly to the gradient of the pipeline.
Standard: To AS/NZS 3725 and AS/NZS 3725 Supp 1.
Layers: Compact all material in layers not exceeding 150 mm compacted thickness.

Lifting holes
General: Seal lifting holes in all pipes with plastic preformed plugs or 3:1 sand:cement mortar, before the commencement of backfilling.

Trench backfill
General: Backfill the remainder of the trench to the underside of the subgrade with fill material in conformance with the Earthwork worksection.

Anchor blocks
General: If necessary to restrain lateral and axial movement of the stormwater pipes, provide anchor blocks at junctions and changes of grade or direction.

Encasement
General: Conform to the Stormwater pipeline schedule.
Location: Encase the pipeline in concrete at least 150 mm above and below the pipe, and 150 mm each side or the width of the trench, whichever is the greater.

E12.3.3 SUBSOIL DRAINS

General
General: Provide subsoil drains to intercept groundwater seepage and prevent water build-up behind walls and under floors and pavements. Connect subsoil drains to surface drains or to the stormwater drainage system as applicable. Conform to the Subsoil pipeline schedule.

Trench width: ≥ 450 mm.

Pipe depth: Provide the following minimum clear depths, measured to the crown of the pipe, where the pipe passes below the following elements:
- 100 mm below subgrade level of the pavement, kerb or channel.
- 100 mm below the average gradient of the bottom of footings.
- 450 mm below the finished surface of unpaved ground.

Jointing
General: At junctions of subsoil pipes, provide tees, couplings or adaptors to AS 2439.1.

Pipe underlay
General: Grade the trench floor evenly to the gradient of the pipeline. If the trench floor is rock, correct any irregularities with compacted bedding material. Bed piping on a continuous underlay of bedding material, at least 75 mm thick after compaction. Lay the pipe with one line of perforations at the bottom.

Chases: If necessary, form chases to prevent projections such as sockets and flanges from bearing on the trench bottom or underlay.

Pipe surrounds
General: Place the material in the pipe surround in layers ≤ 200 mm loose thickness, and compact without damaging or displacing the piping.

Depth of overlay:
- To the underside of the bases of overlying structures such as pavements, slabs and channels.
- To within 150 mm of the finished surface of unpaved or landscaped areas.
Geotextile
General: Provide polymeric fabric formed from plastic yarn composed of at least 85% by weight propylene, ethylene, amide or vinylidenechloride, and containing stabilisers or inhibitors which provide resistance to deterioration due to ultraviolet light.
Marking: To AS 3705.
Protection: Provide heavy duty protective covering. Store clear of the ground and out of direct sunlight. During installation do not expose the filter fabric to sunlight for more than 14 days.

Filter socks
General: Provide polyester permeable socks capable of retaining particles of 0.25 mm size. Securely fit or join the sock at each joint.

E12.3.4 PITS
Finish to exposed surfaces
General: Provide a smooth, seamless finish, using steel trowelled render or concrete cast in steel forms.
Corners: Cove or splay internal corners.

Metal access covers and grates
Standard: To AS 3996.
Cover levels: Top of cover or grate, including frame:
- In paved areas: Flush with the paving surface.
- In landscaped areas: 25 mm above finished surface.
- Gratings taking surface water runoff: Locate to receive runoff without ponding.

E12.3.5 TESTING
Pre-completion tests
General: Before backfilling or concealing, carry out the following tests:
- Site stormwater drains and main internal drains: Air or water pressure test to AS/NZS 3500.3 Section 10.
Leaks: If leaks are found, rectify and re-test.

E12.3.6 COMPLETION
Cleaning
General: Clean and flush the whole installation.

E12.4 SELECTIONS

E12.4.1 STORMWATER
Stormwater pipeline schedule – Refer to Drawings for drainage pit location

<table>
<thead>
<tr>
<th>Properties</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe material and nominal size</td>
<td></td>
</tr>
<tr>
<td>Depth</td>
<td></td>
</tr>
<tr>
<td>Joistng</td>
<td></td>
</tr>
<tr>
<td>Electrode</td>
<td></td>
</tr>
<tr>
<td>Pipe support</td>
<td></td>
</tr>
<tr>
<td>Concrete encasement</td>
<td></td>
</tr>
</tbody>
</table>

Pipe bedding schedule Refer to Drawings

<table>
<thead>
<tr>
<th>Properties</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedding application</td>
<td></td>
</tr>
</tbody>
</table>
### Stormwater – site

<table>
<thead>
<tr>
<th>Properties</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Bedding zone</td>
<td></td>
</tr>
<tr>
<td>Material and grading</td>
<td></td>
</tr>
<tr>
<td>Required density</td>
<td></td>
</tr>
</tbody>
</table>

#### Lined surface drain schedule

<table>
<thead>
<tr>
<th>Properties</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Lining material</td>
<td></td>
</tr>
</tbody>
</table>

#### Subsoil pipeline schedule

<table>
<thead>
<tr>
<th>Properties</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Trench depth (mm)</td>
<td></td>
</tr>
<tr>
<td>Pipe size (nominal)</td>
<td></td>
</tr>
<tr>
<td>Pipe class</td>
<td></td>
</tr>
<tr>
<td>Other requirements</td>
<td></td>
</tr>
</tbody>
</table>

#### Pit schedule Refer to Drawings

<table>
<thead>
<tr>
<th>Properties</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Remarks</td>
<td></td>
</tr>
</tbody>
</table>
**E13 PAVEMENT BASE AND SUBBASE**

**E13.1 GENERAL**

**E13.1.1 RESPONSIBILITIES**

*General*

General: Provide base and subbase courses that are as follows:
- In conformance with the level tolerances, as documented.
- Tested by a geotechnical testing authority.
- In conformance with the compaction requirements documented.

The existing pavement for the Upper Accessway shall be removed by cold milling in accordance with the requirements of RTA Specification R101 Cold Milling of Asphalt, Base Course and Cement Concrete, and in accordance with the Contract Drawings.

The new pavement shall be constructed to comprise the following pavement composition:
- Tack Coat and 30 mm Asphalt Wearing Course to RTA Specification R116,
- Prime Coat to RTA Specification R106,
- 150 mm DGB20 to RTA Specification 3051 and R71 compacted to 102% Standard Compaction,
- 200 mm DGS40 to RTA Specification 3051 and R71 compacted to 102% Standard Compaction,
- Select Fill to RTA Spec 3071 and R44 (minimum soaked CBR of 15%) placed onto subgrade in 150 mm layers to provide a platform to construct the subbase, and
- 150 mm Rip and Recompress In-situ at Optimum Moisture Content (OMC -3% + 1%) to 100% Standard Compaction.

**E13.1.2 CROSS REFERENCES**

*General*

Requirement: Conform to the following:
- General requirements.
- Site management.
- Earthwork.
- Stormwater - site.
- Pavement ancillaries.

**E13.1.3 INTERPRETATION**

*Abbreviations*

General: For the purposes of this worksection the following abbreviations apply:
- CBR: California bearing ratio.
- DGB: Densely graded base.
- DGS: Densely graded subbase.
- ESA: Equivalent standard axle.
- GMB: Graded macadam base.
- GMS: Graded macadam subbase.
- NGB: Natural gravel base.
- NGS: Natural gravel subbase.

*Definitions*

General: For the purposes of this worksection the definitions given in AS 1348 and the following apply:
- Absolute level tolerance: Maximum deviation from design levels.
- Base: One or more layers of material usually constituting the uppermost structural element of a pavement and on which the surfacing may be placed, which may be composed of fine crushed rock, natural gravel, broken stone, stabilised material, asphalt or Portland cement concrete.
- Flexible pavement: Consists of a base and a subbase constructed of unbound materials.
- Relative level tolerance: Maximum deviation from a 3 m straight edge laid on the surface.
- Subbase: The material laid on the subgrade below the base either for the purpose of making up additional pavement thickness required, to prevent intrusion of the subgrade into the base, or to provide a working platform.

E13.1.4 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Prepared subgrade.
- Proof rolling of subbase before spreading of base.
- Proof rolling of base before sealing.

E13.1.5 TESTS

Compaction control tests
Standard: To AS 1289.5.4.1 and AS 1289.5.4.2.

E13.1.6 SUBMISSIONS

Frequency of compaction control tests
General: Not less than the following (whichever requires the most tests):
- 1 test per layer per 25 lineal metres for 2-lane roads.
- 1 test per layer per 1000 m² for carparks.
- 3 tests per layer.
- 3 tests per visit.

Materials
Source of material: Submit the supplier name, nature of material (crushed rock, natural gravel, recycled concrete aggregate) and source quarry or recycling site.

Compliance of material: Provide certification and test results from a NATA registered laboratory confirming that the material conforms to the requirements of the specification.

Execution
General: Submit details of the methods and equipment proposed for each pathway and roadworks operation, including the following:
- Staging of the work, access and traffic control methods.
- Disposal of surface water, control of erosion, contamination and sedimentation of the site, surrounding areas and drainage systems.
- Sources of materials.
- Material stockpiles.

Compaction: If it is proposed that a layer is to exceed 150 mm in thickness, submit evidence demonstrating that the proposed compaction equipment can achieve the required density throughout the layer.

E13.2 PRODUCTS

E13.2.1 TRAFFIC CATEGORY

E13.2.2 BASE AND SUBBASE MATERIAL

General
Compliance: To the Base and subbase compliance table.

Base and subbase compliance table

<table>
<thead>
<tr>
<th>Course</th>
<th>Source</th>
<th>Compliance requirement</th>
</tr>
</thead>
</table>

Contract No
Cardiff Railway Station Easy Access Upgrade

Tender Issue
February 2012
Pavement base and subbase

<table>
<thead>
<tr>
<th>Course</th>
<th>Source</th>
<th>Compliance requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>Crushed rock or natural gravel</td>
<td>To the Pavement material traffic categories table, Acceptable pavement material types table, and Unbound base material properties table</td>
</tr>
<tr>
<td></td>
<td>Recycled concrete aggregate</td>
<td>To SAA HB 155 Table 19</td>
</tr>
<tr>
<td>Subbase</td>
<td>Crushed rock or natural gravel</td>
<td>To the Pavement material traffic categories table, Acceptable pavement material types table, and Unbound subbase material properties table</td>
</tr>
<tr>
<td></td>
<td>Recycled concrete aggregate</td>
<td>To SAA HB 155 Table 19</td>
</tr>
</tbody>
</table>

Granular material
Requirement: Provide unbound materials, including blends of two or more different materials, consisting of granular material which does not develop significant structural stiffness when compacted, and is uniform in grading and physical characteristics.

Crushed rock
General: Provide unbound crushed rock materials designated as follows:
- DGB20: 20 mm nominal sized densely graded base.
- DGS20: 20 mm nominal sized densely graded subbase.
- DGS40: 40 mm nominal sized densely graded subbase.
- GMB20: 2 mm nominal sized graded macadam base.
- GMS40: 40 mm nominal sized graded macadam subbase.

Natural gravel
General: Provide unbound natural gravel materials designated as follows:
- NGB20-2c: 20 mm nominal sized natural gravel base for Traffic Category 2c.
- NGB20-2d: 20 mm nominal sized natural gravel base for Traffic Category 2d.
- NGS20: 20 mm nominal sized natural gravel subbase.
- NGS40: 40 mm nominal sized natural gravel subbase.

E13.3 EXECUTION

E13.3.1 SUBGRADE PREPARATION
General
Requirement: Prepare the subgrade in conformance with the Earthwork worksection.

E13.3.2 TOLERANCES
Surface level
General: Provide a finished surface which is free draining and evenly graded between level points.
Edges abutting gutters: Within ± 5 mm of the level of the actual gutter edge.
Tolerances: The tolerances in the Surface level tolerances table apply to the finished level of each layer, unless overridden by the requirements (including tolerances) for the finished level and thickness of the wearing course.

Surface level tolerances table

<table>
<thead>
<tr>
<th>Item</th>
<th>Level tolerance</th>
<th>Absolute</th>
<th>Relative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subbase surface</td>
<td>± 10 mm</td>
<td>10 mm</td>
<td></td>
</tr>
<tr>
<td>Base surface</td>
<td>± 10 mm</td>
<td>10 mm</td>
<td></td>
</tr>
</tbody>
</table>
**E13.3.3 SUBBASE AND BASE COMPACTION**

**General**
General: Compact each layer of fill to the required depth and density, as a systematic construction operation and to conform to the **Minimum relative compaction table**.

**Minimum relative compaction table**

<table>
<thead>
<tr>
<th>Item description</th>
<th>Minimum dry density ratio (modified compaction) to AS 1289.5.2.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subbase</td>
<td>95</td>
</tr>
<tr>
<td>Base</td>
<td>98</td>
</tr>
</tbody>
</table>

Unstable areas: Remove any unstable areas which develop during rolling or identified by proof rolling for the full depth of the layer and dispose of and replace with fresh material.

**Compaction requirements**
General: Apply uniform and sufficient compactive effort over the whole area to be compacted. Use rollers appropriate to the materials and compaction requirements.

**Moisture content**
General: During spreading and compaction, maintain materials at the optimum moisture content (modified compaction) within the range of -2% to +1% from the optimum moisture content.
Spraying: Maintain moisture content. Use water spraying equipment capable of distributing water uniformly in controlled quantities over uniform lane widths.

**Rectification**
General: If a section of pavement material fails to meet the required density or moisture content after compaction, remove the non-complying material, dispose of off-site or condition for re-use, and replace with fresh material, and recompact.

**Level corrections**
General: Rectify incorrect levels as follows:
- High areas: Grade off.
- Low areas: Remove layers to a minimum depth of 75 mm, replace with new material and recompact.

**E13.3.4 PLACING BASE AND SUBBASE**

**General**
Weak surfaces: Do not place material on a surface which has been so weakened by moisture that it will not support, without damage, the constructional plant required to perform the work.

**Spreading**
Spread material in uniform layers without segregation.

**Moisture content**
Maintain wet mixed materials at the required moisture content before and during spreading. Add water to dry mixed materials through fine sprays to the entire surface of the layer after spreading, to bring the material to the required moisture content.

Layer thickness: 150 mm maximum and 75 mm minimum (after compaction). Provide equal layers in multilayer courses.

**Joints**
General: Plan spreading and delivery to minimise the number of joints. Offset joints in successive layers by at least 300 mm.

**Final trimming**
General: Trim and grade the base course to produce a tight even surface without loose stones or a slurry of fines.
E14 ASPHALTIC CONCRETE

E14.1 GENERAL

E14.1.1 RESPONSIBILITIES

General
General: Provide a finished asphaltic concrete surface which is as follows:
- Free draining and evenly graded between level points.
- Even and smooth riding.
Selections: As documented.

Performance
Requirements:
Tack Coat and 30 mm Asphalt Wearing Course to RTA Specification R116
Prior to tack coating and placement of the wearing course, the Contractor shall place a Prime Coat to the prepared pavement in accordance with RTA Specification R106.

The Contractor shall undertake the removal of pavement materials from the Upper Accessway road pavement by cold milling in accordance with the requirements of RTA Specification R101 Cold Milling of Asphalt, Base Course and Cement Concrete, and in accordance with the Contract Drawings.

Selections: As documented.

E14.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Site management.
- Earthwork.
- Stormwater – site.
- Pavement base and subbase.
- Pavement ancillaries.

E14.1.3 STANDARDS

Hot mix asphalt: To AS 2150.

E14.1.4 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions given below apply:
- Levelness: Absolute level tolerance – maximum deviation from design levels.
- Lot: A lot consists of any part of the works which has been constructed/manufactured under a continuous operation of uniform conditions and is essentially homogeneous with respect to material and general appearance. The whole of the work included in a lot is of a uniform quality without obvious changes in attribute values.
- Flatness: Relative level tolerance – maximum deviation from a 3 m straightedge laid on the surface.
- Relative compaction: The ratio between the field bulk density and the bulk density of the job mix when compacted in the laboratory.

E14.1.5 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Surface prepared for priming, sealing or asphalt surfacing.
- Commencement of asphalt surfacing.
- Completion of asphalt surfacing.

**E14.1.6 TOLERANCES**

General: Conform to the Tolerances table which applies to the finished level of each layer, unless overridden by the requirements (including tolerances) for the finished level and thickness of the surface course.

<table>
<thead>
<tr>
<th>Item</th>
<th>Level tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level (Longitudinal)</td>
<td>± 10 mm Absolute 5 mm Relative</td>
</tr>
<tr>
<td>Level (Transverse)</td>
<td>± 10 mm Absolute 10 mm Relative</td>
</tr>
<tr>
<td>Compacted layer thickness (Any one sample)</td>
<td>+ 10 mm, - 5 mm.</td>
</tr>
<tr>
<td>Edges abutting gutters</td>
<td>Within ± 5 mm of the level of the actual gutter edge.</td>
</tr>
<tr>
<td>Shape</td>
<td>Conform to AS 2150 Table 15.</td>
</tr>
<tr>
<td>Roughness</td>
<td>Conform to AS 2150 Table 16.</td>
</tr>
</tbody>
</table>

**E14.1.7 SUBMISSIONS**

Execution details

General: Submit proposals for work methods and equipment including the following:
- Survey control.
- Staging of the work, access and traffic control methods.
- Disposal of surface water, control of erosion, contamination and sedimentation of the site, surrounding areas and drainage systems.
- Methods and equipment for each operation.
- Material stockpiles.

Trial: Submit trial paving using the proposed job mix and all equipment as proposed. Trial may be incorporated into the final works, if satisfactory.

**Products**

Certificate of compliance: As an alternative to testing a product, submit the manufacturer's certificate together with the results of recent tests undertaken by the manufacturer, showing conformance with test criteria.

Proposals: Submit the following details before commencing production:
- Combined aggregate particle size distribution.
- Binder content expressed as a percentage of the total mix.
- The filler content expressed as a percentage by mass of the combined aggregates.
- The asphalt mix properties.
- The proposed mixing temperature.
- Sources of materials.
- Reclaimed asphalt pavement stockpile and proportion.

**Samples**

Samples: Submit samples to AS 1141.3.1 at least one month before use:
- Granular materials: Submit samples of each proposed type and size of asphalt and cover aggregate.

Identification: Attach a tag to each sample showing relevant information including description, source and nominal size of material.
E14.2 PRODUCTS

E14.2.1 AGGREGATE

Properties
Description: Clean, sound, hard, angular, of uniform quality, free from deleterious matter in conformance with the Aggregate properties table.
Standard: To AS 2758.5.
Mineral filler: To AS 2150 clause 4.2.
Combined aggregate grading: To AS 2150 clause 5.2.
Crushed slag: Air-cooled blast furnace slag of uniform quality, generally free from vesicular, glassy or other brittle pieces.
Fine aggregate: Clean, sound, hard, durable particles of natural sand or particles derived from crushed stone, gravel or slag, free from injurious coating or particles of clay, silt, loam or other deleterious matter.

Aggregate properties table

<table>
<thead>
<tr>
<th>Property</th>
<th>Test method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle shape</td>
<td>AS 1141.14</td>
<td>≤ 25 for wearing course</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤ 30 for binder course</td>
</tr>
<tr>
<td>Wet strength</td>
<td>AS 1141.22</td>
<td>≥ 100 kN</td>
</tr>
<tr>
<td>Wet/dry strength variation</td>
<td>-</td>
<td>≤ 35%</td>
</tr>
</tbody>
</table>

E14.2.2 TACK COATING

Properties
Bitumen emulsion: Rapid setting to AS 1160.
Tack coat mix: In accordance with RTA Specification R116.

E14.2.3 ASPHALT

General
Hot mix asphalt: To AS 2150.
Medium cut back bitumen: To AS 2157.
Bitumen emulsion: To AS 1160.
Bitumen binder: Class 170.

Mix design
Design: To AS 2891.5 and AS 2150 and the Marshall method:
- Marshall stability: > 4.5 kN.
- Marshall flow: 2 – 4 mm.
- Voids in total mix (maximum theoretical density based on apparent specific gravity of aggregates):
  - Wearing courses: 3% – 5%.
  - Binder courses and 7 mm mixes: 4% – 6%.
- Voids in aggregate filled with bitumen:
  - Wearing courses: 75% – 85%.
  - Binder courses and 7 mm mixes: 70% – 80%.

Reclaimed asphalt pavement: To AS 2150 clause 4.6.

Product tests
General: Take samples from trucks at the mixing plant and test for mix properties using one of the following methods as applicable:
Standard: To AS 2150 Table 9 and AS 2891.5.
- Marshall stability of compacted mix:
  - Compactive effort:
Asphaltic concrete

* 35 blows for light traffic,
* 50 blows for general conditions
* 75 blows for heavy traffic or deep lifts.

Variations in mix properties
General: Ensure that the maximum variation between the mix property of each sample and the job mix value conforms to the Mix property table.

Mix property table

<table>
<thead>
<tr>
<th>Mix property</th>
<th>Maximum variation from job mix value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate passing 4.75 mm sieve or larger</td>
<td>± 7% by mass</td>
</tr>
<tr>
<td>Aggregate passing 2.36 mm to 300 μm sieves</td>
<td>± 5% by mass</td>
</tr>
<tr>
<td>Aggregate passing 150 μm sieve</td>
<td>± 2.5% by mass</td>
</tr>
<tr>
<td>Aggregate passing 75 μm sieve</td>
<td>± 1.5% by mass</td>
</tr>
<tr>
<td>Bitumen content</td>
<td>± 0.3% by mass</td>
</tr>
<tr>
<td>Added filler content</td>
<td>± 0.3% by mass</td>
</tr>
<tr>
<td>Mixing temperature</td>
<td>± 10°C</td>
</tr>
</tbody>
</table>

E14.2.4 OTHER MATERIALS

Tactile ground surface indicators
Standard: To AS/NZS 1428.4.1.

E14.3 EXECUTION

E14.3.1 PREPARATION

Cleaning
Remove: Immediately before priming or tack coating remove loose stones, dust and foreign material from the base surface using a power broom or blower. Keep traffic off the cleaned surface.

Priming
Protection: Prime the base surface as soon as possible after compaction and finishing.

Potholes
Patching: Trim to a regular shape and a uniform depth of at least 75 mm, tack coat the edges and patch with asphaltic concrete.

Level anomalies
Final levels: Flush kerbing, gutter or other concrete or metal components may require level modification to achieve safe foot surfaces or drainage. Prepare adjacent asphaltic areas as for potholes to achieve uniform or tapered depth to match final levels.

Pre-treatment: Regulate to AS 2150 clause 14.3.2.

Protection
Adjacent surfaces: Protect adjacent surfaces during spraying. Protect freshly sprayed surfaces from contamination.

Tack coating
Application rate: Apply tack coat 30 – 120 minutes before asphalt surfacing is placed. Cover the surface uniformly at an application rate of 0.20 – 0.40 L/m² of residual bitumen.

E14.3.2 SURFACING

Spreading
Conditions: Place asphalt surfacing in dry weather on a dry pavement surface at a pavement temperature of at least 10°C.

Operations: Spread the mix in layers covering the full width of the pavement, or, in the case of carriageways and wide pavements, in lanes of minimum width 3 m. Place layers in adjoining lanes to the same compacted thickness.

Method: Spreading by self propelled paving machine to AS 2150 clause 12.2.

Hand spreading: To AS 2150 clause 12.3.

Thickness tolerance:
- Thickness ≤ 50 mm tolerance is either an average or a minimum.
- Thickness > 50 mm tolerance ± 10% of total thickness up to ± 15 mm.
  Frequently check thickness: Measure uncompacted and compacted layer to conform with AS 2150.

**Abutting structures**

Level: Place asphalt surfacing to match the level of abutting surfaces such as kerbs, gutters, edge strips, access chamber covers, or adjoining pavement in the same manner as for longitudinal and transverse joints. Fill: Fill spaces left unfilled between the spreader run and abutting edges with sufficient material to the proper height before compaction.

Assess: On site level anomalies to determine the need to raise the surface level of a structure where the use of infill or tapered asphalt would create a local pedestrian trip hazard or effect the durability.

**Matched junctions**

Smooth joints: If asphalt surfacing is to match an existing pavement, bridge deck, rail or other fixture, place the material to provide a smooth riding surface across the junction.

As required: Remove existing pavement or taper the thickness of layers.

Junction: Terminate layers at a 20 mm deep and 400 mm wide chase cut into the existing pavement.

Remove: Coarse particles from a layer of tapering thickness using hand raking.

Tack coat: Where the thickness of the layer tapers to less than twice the nominal size of the mix, tack coat the area upon which material of such thickness is to be placed uniformly at an application rate 0.50 – 0.75 L/m².

**Joints**


Minimise the number of joints: Make joints that are well bonded and sealed and provide a smooth riding surface across the joint.

Transverse joints: Construct a transverse joint if the operation is stopped for more than 20 minutes or the pavement temperature falls below 90°C. Construct to a straight vertical face for the full depth of the layer, and offset in adjoining spreader runs and layer to layer by at least 1 m.

Longitudinal joints: Offset joints from layer to layer by at least 150 mm. Position longitudinal joints in the wearing course to coincide with the lane line.

Edges: Form exposed edges of each spreader run while hot to a straight line with a dense face inclined between vertical and 45°.

Cold joints: Tack coat the surface of cold longitudinal and transverse joint before placing the adjoining asphalt.

**Compaction**

Trimming: Before commencing compaction, correct any irregularities in line or level. Trim lane edges to a straight line.

Rolling: Compact asphalt surfacing uniformly as soon as it will support rollers without undue displacement, and complete rolling while the mix temperature is above 90°C.

Density tests: Perform a field bulk density test for each test site from either of the following:
- On a core sample taken from the asphalt surfacing layer.
- If the nominal layer thickness is ≥ 50 mm, measured in situ using a nuclear gauge.

Sample preparation: To AS 2891.2.1 and AS 2891.2.2, as applicable.

Number of tests per lot: To AS 2150, generally 6 tests per lot for simple/small works.

Nuclear gauge tests: To AS/NZS 2891.14.2.

Density criteria: In accordance with RTA Specification R118.

**E14.3.3 COMPLETION**

**Rejection**

Extent: Remove areas of rejected asphalt surfacing, including defective joints and finish, to the full depth of the layer, and replace with complying pavement.

Joints: Treat edges of remedial work as specified for cold joints.

**Reinstating adjacent surfaces**

General: Reinstate surfaces next to new pavements and associated elements. Where an existing flexible road pavement has been disturbed, trim it back to a straight and undisturbed edge 250 –
Asphaltic concrete

300 mm from and parallel to the new concrete for the full depth of the slab. Backfill with asphalt rammed solid, using suitable rammers.

Removal: Disposal of any residual or rejected material to a location off site.

Traffic on pavement
General: Give notice before opening the pavement to traffic before the work is completed. Provide protection.

Junctions with existing pavements
Trimming: Where the pavement is to be joined to an existing pavement remove a strip of the existing pavement at least 300 mm wide for its full depth and trim the edge to an angle of approximately 45 in steps of maximum height 150 mm before placing new pavement material.

Existing sealed pavement: Trim the seal to a neat edge.

Finished pavement properties
Tolerances: Check finished pavement levels, thickness and shape with the Tolerances table.
Reject surfaces: Where tolerances are exceeded reject surface.

E14.3.4 TESTING
General
- Project lot: In accordance with RTA Specification R116.
Tests: Perform tests of the type and frequency necessary to control the materials and processes used in the construction of the works and in conformance with the Tests schedule.

Process control tests
Records: Show the results of process control tests on control charts or graphs displayed on site in a readily accessible location and updated daily.

Methods: Use wet preparation methods where applicable.

Sampling: Timing and location to AS 2891.1.1.

Compliance assessment tests
Timing: Obtain materials samples at the time of delivery to the site.
Location: Sample from selected sample sites within designated uniform test lots, consisting of an area placed, or compacted or both in one day. Test lots must be uniform in terms of material properties and density.
E15 SPRAYED BITUMINOUS SURFACING

E15.1 GENERAL

E15.1.1 RESPONSIBILITIES

General

General: Provide a sprayed bituminous surfacing as follows:
- Free draining and uniformly graded.
- Even and smooth riding.

E15.1.2 CROSS REFERENCES

General

Requirement: Conform to the following:
- General requirements.
- The application of a prime to the prepared pavement prior to the application of a tack coat and asphalt wearing course shall be in accordance with RTA Specification R106.

E15.1.3 INTERPRETATION

Definitions

General: For the purposes of this worksection the glossary of terms in AS 1348 and the definitions given below apply:
- Absolute level tolerance: Maximum deviation from design levels.
- Relative level tolerance: Maximum deviation from a 3 m straightedge laid on the surface.

E15.1.4 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of the following:
- Surfaces prepared for priming, sealing or surfacing.
- Commencement of bituminous spraying.

E15.1.5 SUBMISSIONS

Execution

General: Submit proposals for the methods and equipment used, including the following:
- Staging of the work, access and internal traffic control methods.
- Disposal of surface water, control of erosion, removal of contaminated material and sedimentation control on the site, surrounding areas and drainage systems.
- Methods and equipment for each operation.
- Sources of materials.
- Material stockpiles.
Spraying equipment: Submit a current certificate and calibration chart issued by the State Road Authority.
Hand sprayer: If intended, submit proposals.
Spraying operations: Submit proposals for start, finish and width of each spray run.
Bituminous surfacing records: Submit certified records of the works completed in accordance with RTA Specification R106
Records of measurement: Submit certified records of work performed.

Materials

General: Submit information including the following:
- Cutback bitumen field mix/proprietary mix.
- Binder proposal.
- Adhesion agent: Proof of previous conformance with test criteria.
- Aggregates: Source.

**Tests**

Compliance assessment: Compliance assessment tests are to be carried out by an independent testing authority. Submit 3 copies of each test result.

Certificate of compliance: A certificate of compliance is acceptable as an alternative to testing a manufactured material. Submit the manufacturer's certificate together with the results of recent tests undertaken by the manufacturer, showing compliance with test criteria.

**E15.1.6 TOLERANCES**

Finished levels
General: Provide a finished surface which is free draining and evenly graded between level points.

Edges abutting gutters: Within ± 5 mm of the level of the actual gutter edge.

**E15.2 PRODUCTS**

**E15.2.1 BITUMINOUS MATERIALS**

Material grades
- Bitumen: To AS 2008 Class 170.
- Bitumen emulsion: To AS 1160.
- Cut back bitumen classification and grading: To AS 2157 and the Selections.
- Proprietary grades of cutback bitumen: To the manufacturer's specification.
- Cutter oil and flux oil: To AS 3568.

**Aggregate precoating materials**

Precoating agent: Provide precoating agents capable of satisfying plate stripping tests.

Allowable percentage of stripping: Less than 10% in accordance with AS 1141.50.

**Measuring bitumen and cutter**

General: Measure by volume at 15°C.

Volume correction factors: Conform to the following for converting volume of bituminous binders
- From 15°C to elevated temperature to AAPA National sprayed sealing specification Table D8, or
- From elevated temperature back to 15°C to AAPA National sprayed sealing specification Table D9.

**E15.2.2 AGGREGATE**

Standard: To AS 2758.2.

Class of aggregate: N/A

Resistence to polishing: N/A

Method of determination of aggregate shape: N/A

Combination of hardness and durability: N/A

**E15.2.3 OTHER MATERIALS**

**Protective paper**

Start, finish and taper operations: Apply heavy duty protective paper of minimum weight 120g/m², and wide enough to prevent over spray.

**Geotextile**

Type: Non woven, needle punched fabric with minimum melting point 165°C and minimum mass 130g/m².

Application: To AUSTROADS AP-T37.

**Tactile ground surface indicators**

Standard: To AS/NZS 1428.4.1.
E15.3 EXECUTION

E15.3.1 APPLICATION

Precoating
Supply: Precoat aggregates immediately before the aggregate is loaded into the spreader trucks. 7 mm cover aggregate: Precoat at least 48 hours in advance of spreading.
Target application: Apply precoating agent thinly and evenly using a fine pressure spray to a moving stream of aggregate, or by other approved means, so that particles are fully coated but without excess material.
Wet aggregate: If the aggregate is too wet to precoat, or contains enough moisture to cause uneven distribution of the precoating agent, dry the aggregate by turning the stockpile over. Do not precoat aggregate until the moisture has evaporated sufficiently for the precoating agent to adhere evenly.
Target application rate: In the range 4 – 14 L/m³ of aggregate.

Cutting bitumen
Temperature: Heat sufficient bitumen for immediate needs only. Do not keep the material at spraying temperature for longer than 10 hours. Do not reheat.
Mixing and heating (on site): Heat the bitumen at a rate not exceeding 40°C/h, and circulate cutback bitumen for 20 minutes to ensure thorough mixing.
Heating devices: Use devices capable of uniform heating without damaging bituminous materials.

Spraying equipment
Areas not accessible to the mechanical sprayer: Spray using hand spray equipment attached to the mechanical sprayer.

E15.3.2 PREPARATION FOR SPRAYING

Cleaning
General: Immediately before spraying, remove loose and foreign material on the finished base surface, including dust, debris and sand spread on primed surfaces, until a mosaic of well embedded aggregate shows on the surface. Keep traffic off the cleaned surface.
Method: Use suitable power blowers or power brooms (or using hand methods where inaccessible to the power equipment).
Preconditions: Prime and seal in dry and reasonably calm weather, on a dry pavement surface at a temperature of at least 10°C in accordance with Table D1 AAPA.

Potholes
General: Trim to a regular shape and a uniform depth of at least 75 mm. Tack coat the sides, and patch with bituminous premix, sanded after completion. Allow sufficient time for the premix to cure before spraying the surface, in accordance with Table DB1 AAPA.

E15.3.3 SPRAYING OPERATIONS

Protection
General: Protect adjacent surfaces during spraying. Place drip trays under spray bars when the sprayer is stationary. Clean bituminous materials from adjacent surfaces or, if this is not possible, replace and make good the surface. Protect freshly sprayed surfaces from contamination.
Primed surface: Keep traffic off the primed surface for at least 3 days after spraying. If required commence sanding 4 – 24 hours after spraying.

Priming
General: Prime the granular pavement to achieve and maintain a strong bond between granular surface and pavement treatment seal.

Edges: At underbed edges, extend the primer 150 mm beyond the edge of the seal.

Junctions with existing pavements
Pavement base: Protect using a suitable temporary seal or primersal.

Spraying
General: Completely and uniformly cover the surface to be treated. Prevent the spray overlapping previously treated areas, except that where part-width spraying is used, lap the longitudinal joint between adjacent runs by at least 50 mm.
Sprayed bituminous surfacing

**Primersealing and sealing**
Process: Allow at least 3 days between priming and sealing and between first and second binder application in double seals. Incorporate the first course of aggregate thoroughly into the binder before a second course is applied.

Spraying temperature ranges:
- Bitumen without cutter: 160°C – 190°C.
- Priming Grade AMC1: 60 °C – 80°C.
- Primerbinder Grade AMC3: 95°C – 115°C.
- Bitumen emulsion binder: Ambient temperature.

**Application rates**
General: To the Bituminous materials schedule.
Grade or class: To AS 2157 and AS 1160.

**E15.3.4 PLACING COVER AGGREGATE**

**Placing cover aggregate**
Spreading: Immediately after the binder or primerbinder has been sprayed, cover with a uniform layer of dry aggregate.

Rolling: Immediately after spreading roll and drag broom the area until it is uniformly covered with aggregate thoroughly embedded in the binder. Roll uniformly over the whole area. Complete rolling as soon as possible but not later than 3 days after spraying.

**Steel rolling**
General: Roll using a maximum of two coverages of a steel-wheeled roller of maximum axle load 5 tonne. Discontinue steel rolling if aggregate shows signs of breaking down.

**Pneumatic tyred rolling**
Roller: After steel rolling, roll the area using a pneumatic-tyred roller of minimum mass 10 t and with tyre pressures adjustable in the range 550 – 700 kPa.

Rolling:
- Minimum rate: 4 roller hours per 4500 L of binder or primerbinder sprayed.
- Timing: At least one roller pass within 2 minutes of covering, over the whole of the area. After an initial slow pass increase the speed of rolling to the maximum practicable for the area being sealed. Complete at least 25% of the rolling within 2 hours of covering, and 50% within 24 hours of covering.

**Loose aggregate**
General: When the aggregate has been evenly spread and embedded, remove loose particles remaining on the pavement by sweeping lightly, without disturbing embedded aggregate. Apply additional aggregate to achieve the required surface finish.

**Surface finish**
General: Provide an even, smooth riding and free draining surface to the grades and levels, as documented.

**E15.3.5 DEFECTIVE SURFACING**

**Primer**
Actual rate of application < 90% of that ordered: Make up the deficiency with a second spray run.
Actual rate of application > 110% of that ordered: Cover the surface with sand which is chemically inert and free of salts.

**Binder and primerbinder**
Actual rate of application < 90% or > 110% of that ordered: Reseal the surface.

**Minimum criteria for retention**
Actual rate of application: Between 95 and 105% of the target application rate.

**E15.3.6 COMPLETION**

**Traffic on pavement**
Removal: Dispose of any residual or rejected material off-site.
Sprayed bituminous surfacing

Notice: Give notice before opening the pavement to traffic before the work is completed. Provide protection.
E16 CONCRETE PAVEMENT

E16.1 GENERAL

E16.1.1 RESPONSIBILITIES

General
General: Provide finished surfaces that are:
- Free draining and evenly graded between level points.
- Even and smooth riding.

Performance
Conformance: Comply with the local authority in respect of the levels, grades and the minimum details of thickness, reinforcement and concrete strength for pavements within the kerb-and-gutter property boundaries.
Selections: As documented.

Design
Coordination: Determine the local authority requirements initially as they may affect grades, transition, zones for the works. Considerations include:
- Drainage.
- Tree's (due to settlement).
- Adjacent structures.

E16.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Site management.
- Earthwork.
- Stormwater – site.
- Pavement base and subbase.
- Pavement ancillaries.
- Concrete finishes.

E16.1.3 STANDARDS

Concrete
Specification and supply: To AS 1379.
Materials and construction: To AS 3600.

E16.1.4 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions given in AS 1348 and the following apply.
- Levelness: Absolute level tolerance – maximum deviation from design levels.
- Ambient temperature: The air temperature at the time of mixing and placing of concrete, and the predicted or likely air temperature at any time during the 48 hours following concrete placement.
- Concrete class:
  - Normal: Concrete which is specified primarily by a standard compressive strength grade and otherwise in accordance with AS 1379 clause 1.5.3.
  - Special: Concrete which is specified to have certain properties or characteristics different from, or additional to, those of normal-class concrete and otherwise in accordance with AS 1379 clause 1.5.4.
- Early age: A mean compressive strength at 7 days exceeding the values shown in AS 1379 Table 1.2.
Concrete pavement

- Green concrete: Concrete which has set but not appreciably hardened.
- Flatness: Relative level tolerance – maximum deviation from a 3 m straightedge laid on the surface.
- Weather:
  - Cold: Ambient shade temperature < 10°C.
  - Hot: Ambient shade temperature > 32°C.

E16.1.5 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Base or subgrade before covering.
- Membrane or film underlay installed on the base or subgrade.
- Concrete formwork, reinforcement and dowels in position.
- Commencement of concrete placing.
- Completion of concrete placing.
- Evaluation of surface finish.

E16.1.6 TOLERANCES

General
Edges abutting gutters: Within ± 5 mm of the level of the actual gutter edge.
Rigid pavement surface:
- Absolute tolerance: ± 10 mm, ± 0 mm.
- Relative tolerance: ± 5 mm.
Joint locations in plan (rigid pavement): ± 15 mm.

E16.1.7 SUBMISSIONS

Products
Compliance certificate: As an alternative to testing a product, submit the manufacturer's certificate together with the results of recent tests undertaken by the manufacturer, showing compliance with test criteria.
Aggregates: Nominate the source for all aggregates proposed.
Reinforcement: Submit the manufacturer's certificate of compliance with AS/NZS 4671, or submit test certificates from an independent testing authority.
Liquid curing compounds: Submit certified test results, including the application rate and the efficiency index to AS 3799 Appendix B.
Curing by covering: Submit details of the proposed covering material.
Repair materials: Submit proposals for epoxy resin/grout and elastomeric sealant.
Concrete: Submit the concrete supply delivery dockets.
Subcontractors: Submit names and contact details of proposed pre-mixed concrete suppliers, and alternative source of supply in the event of breakdown of pre-mixed or site mixed supply.
Trial mix design report: Six weeks before commencing production, submit a report for each mix design containing the information required in AS 1012.2, the individual and combined aggregate particle size distribution, and the records and reports for the tests.

Execution
Work method statements: Submit proposals for the methods and equipment to be used for the pavement works, including the following:
- Staging of the work, access and traffic control methods.
- Disposal of surface water, control of erosion, contamination and sedimentation of the site, surrounding areas and drainage systems.
- Methods and equipment for each operation.
- Sources of materials.
- Material stockpiles.
- Methods of concrete manufacture.
Concrete pavement

- Temperature control, curing and protection methods for concrete.
Mix design variation: If a variation is proposed, submit a further mix design report.
Concrete: Submit proposals for mixing, placing, finishing and curing concrete including the following:
- Addition of water at the site.
- Changes to the plastic concrete mix.
- Curing and protection methods.
- Cutting or displacing reinforcement, or cutting hardened concrete.
- Handling, placing, compaction and finishing methods and equipment, including pumping.
- Sequence and times for concrete pours, and construction joint locations and relocations.
Cores, fixings and embedded items: If required, submit shop drawings showing the proposed locations, clearances and cover, and indicate any proposed repositioning of reinforcement.
Cutting or coring: If cutting or coring of hardened concrete is proposed, provide details.
Sawn joints: Submit proposed methods, timing and sequence of sawing joints.
Damaged galvanizing: If repair is required, submit proposals to AS/NZS 4680 Section 8.
Splicing: If splicing not documented is proposed, submit details.
Welding: If welding of reinforcement is proposed, provide details and give notice before welding reinforcement.
Joint sealants: Submit proposals for installation methods and sealant performance.
Concrete placing: Submit proposals for size of the area to be placed and the spacing of planned construction joints before placement commences.
Crack assessment: If unplanned cracks occur in the finished pavement, submit proposals for investigation.
Surface repair method: If required, submit details of the proposed method before commencing repairs.
Trial section: Submit trial pavement.

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

E16.2 PRODUCTS

E16.2.1 REINFORCEMENT
General
- Steel reinforcement: Steel bars or mesh to AS/NZS 4671.
- Ductility class: L or N.
Identification: Supply reinforcement which is readily identifiable as to grade and origin.
Reinforcement and joint requirements: in accordance with the Drawings.
Surface condition: Free of loose mill scale, rust, oil, grease, mud or other material which would reduce the bond between the reinforcement and concrete.

Protective coatings
Protective coating: Coatings to reinforcement must not reduce the performance of the reinforcement.
Do not galvanize reinforcement steel. For pavements containing protective coated reinforcement, provide the same coating type to all reinforcement and embedded ferrous metal items, including tie wires, stools, spacers, stirrups, plates and ferrules.
Epoxy coating: Provide high build, high solids chemically resistant coating.
- Thickness: 200 μm minimum.

Steel fibres
Fibre reinforcement: Reference CIA CPN35.
Steel fibre content: 75 kg/m³.

Accessories
Bar chairs: Use plastic tipped wire bar chairs.
Tie wire: Galvanized annealed steel 1.25 mm diameter (minimum).
**Concrete pavement**

**Dowels**
General: Provide each dowel in one piece, straight, cut accurately to length with ends square and free from burrs.
Standard: To AS/NZS 4671.
Grade: 250R steel bars 450 mm long.
Diameter: in accordance with the Drawings
End tolerances: Ensure that deformation of an end from its true circular shape does not exceed 1 mm nor extend more than 1 mm from the end.

**Tie bars**
Type: Deformed bar, 12 mm diameter, grade 500N, 1 m long.

**E16.2.2 AGGREGATE**

**Characteristics**
Standards: AS 2758.1.
Quality: Provide at least 40% by mass of the total aggregates in the concrete mix of quartz sand aggregate having a nominal size of < 5 mm and containing at least 70% quartz by mass.
Durability: All constituent, fraction of constituent or aggregates to conform to AS 1141.22 and the following:
- Wet strength not less than 80 kN.
- 10% Fines Wet/Dry Variation not to exceed 35%.
Recycled concrete aggregate (RCA): Use coarse aggregates from demolition concrete or RCA.
Blending: If blending coarse RCA with natural aggregates ensure substitution rates are below 30%.
Slipform grading requirements: For concrete mixes proposed for slipforming, conform to the Combined aggregate grading table for the combined total aggregates proportion by mass passing the Australian Standard sieves.

**Combined aggregate grading table**

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

**E16.2.3 CEMENT**

Standard
GP Portland cement: To AS 3972.
Transport: Cement in watertight packaging and protect from moisture until used. Do not use caked or lumpy cement.
- Age: Less than 6 months old.
- Storage: Store cement bags under cover and above ground.

**E16.2.4 FLY ASH**

General
Standard: Fine grade fly ash to AS 3582.1.
Fly ash quantity: Nil to 70 kg/m³.
Minimum binder content (fly ash plus cement): 300 to 330 kg/m³.
E16.2.5 WATER

General
Standard: Chloride ion to AS 3583.13 and sulphate ion to AS 1289.4.2.1.
Quality: Water used in the production of concrete to be potable, free from materials harmful to concrete or reinforcement, and be neither salty nor brackish.
Limits: Not containing more than:
- 600 parts per million of chloride ion, as determined to AS 3583.13.
- 400 parts per million of sulphate ion, as determined to AS 1289.4.2.1.

E16.2.6 ADMIXTURES

General
Standard: Chemical admixtures to AS 1478.1.
Quality: Provide admixtures free from calcium chloride, calcium formate, or triethanolamine or any other accelerator. Do not use admixtures or combinations of admixtures without prior written approval.
Dosage: Vary the dosage of chemical admixture to account for air temperature and setting time in accordance with the manufacturer's recommendations.

Types of admixtures
Air entraining agent: Adjust mix for workability allowing up to 5% air entainment.
Warm season retarder: During the warm season, (October to March inclusive), use a lignin or lignin-based ('ligpol') set-retarding admixture (Type Re or Type WRRe) as approved to control slump within the limits stated in Concrete mix, properties.
Cool season retarder: During the cool season, (April to September inclusive), use only a lignin or lignin based set-retarding admixture containing not more than 6% reducing sugars (Type WRRe complying with AS 1478.1).

E16.2.7 CURING COMPOUNDS

General
Curing compounds: To AS 3799 and AS 1160, Type 2, white pigmented or containing aluminium reflective pigments.
Covering with sheet materials: To ASTM C171, white opaque or clear polyethylene film, or white burlap-polyethylene sheet, or equivalent material.

E16.2.8 OTHER MATERIALS

Tactile ground surface indicators
Standard: To AS 1428.4.

E16.3 EXECUTION

E16.3.1 SUBGRADE

Preparation
Conformance: Prepare subgrade in accordance with the Earthwork worksection.
Extent: Prepare a uniform subgrade for the full pavement formation, extending at least to the back of kerbs.
Reinstatement: Ensure uniformity for backfilling of any utility trenches.

E16.3.2 SUBBASE

Thickness
Subbase thickness: in accordance with the Drawings.
Width
Subbase width: Extend the subbase at its full depth to at least the back of kerbs or other edge stops before their installation.
No integral kerbs: Extend granular unbound subbase at least 300 mm beyond each side of the carriageway.
Unbound subbase materials and installation: Conform to Pavement base and subbase worksection.
Concrete pavement

Bound subbase materials and installation: Conform to the Pavement base and subbase worksection.

**Tolerance and friction reduction**
Tolerance: Subbase finished surface level + 0 mm to −10 mm to ensure full base layer is cast.
Friction reduction: Provide 0.2 mm thick polyethylene sheeting with 200 mm taped minimum laps and/or a 20 mm thick layer of sand (silt and clay material < 5%) directly beneath the concrete pavement.

**E16.3.3 TRIAL PAVEMENT**
Trial pavement: Demonstrate by placing a test section that the proposed method of placement will produce a conforming pavement. Remove test sections which do not comply with requirements and dispose of as directed.
Minimum area of test section: N/A
Location: N/A

**E16.3.4 CONCRETE MIX**

**Standard**
Concrete mix and supply: To AS 3600 Section 17 and AS 1379.

**Properties**
Concrete pavement thickness: in accordance with the Drawings
Concrete pavement strength: in accordance with the Drawings
Workability: Slump values to conform with the following:
- Fixed form paving with manual operated vibration: 50 – 60 mm.
- For slip form with no side forms: 30 – 50 mm.
- Drying shrinkage: Maximum 450 με after 21 days of air drying.

**Special class concrete additional properties**
Colour: N/A
Aggregates: N/A
Cement colour: N/A

**Elapsed delivery time**
General: Ensure that the elapsed time between the wetting of the mix and the discharge of the mix at the site is in conformance with the Elapsed delivery time table. Do not discharge at ambient temperature below 10°C or above 30°C.

**Elapsed delivery time table**

<table>
<thead>
<tr>
<th>Concrete temperature at time of discharge (°C)</th>
<th>Maximum elapsed time (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 – 24</td>
<td>2.00</td>
</tr>
<tr>
<td>24 – 27</td>
<td>1.50</td>
</tr>
<tr>
<td>27 – 30</td>
<td>1.00</td>
</tr>
<tr>
<td>30 – 32</td>
<td>0.75</td>
</tr>
</tbody>
</table>

**Site mixed supply**
Emergencies: If mixing by hand is carried out, provide details.
Plant: Mix concrete in a plant located on the construction site.

**Pre-mixed supply**
Addition of water: Do not add water.
Transport: Make sure that the mode of transport prevents segregation, loss of material and contamination of the environment, and does not adversely affect placing or compaction.
Concrete delivery docket: For each batch, submit a docket listing the information required by AS 1379 clause 1.7.3, and the following information:
- Any binders or additives.
- Method of placement and climate conditions during pour.
- Name of concrete delivery supervisor.
Concrete pavement

- The concrete element or part of the works for which the concrete was ordered, and where it was placed.

E16.3.5 TESTING

Standards
Sampling, identification, testing and recording: To AS 1012.
Specimens: Sample the concrete on site, at the point of discharge from the agitator.
Type and frequency: Conform to AS 1379.
Sampling frequency: To the Project assessment sampling table.
Test authority: Concrete supplier or NATA registered laboratory.

Concrete testing methods:
Slump: Test at least one sample from each batch before placing concrete from that batch in the work.
- Standard: To AS 1012.3.1.
- Maximum slump variation: ± 10 mm.
Compressive strength: Test to AS 1012.8.1.
Drying shrinkage: Test to AS 1012.13.
Flexural strength: To AS 1012.8.2 and AS 1012.11.

Project assessment sampling table

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

Acceptance criterion: The average strength of any set of 3 consecutive project samples must be equal to or greater than the specified minimum value.

E16.3.6 INSTALLATION

Junctions with existing pavements
Trimming: Where the pavement is to be joined to an existing pavement remove a strip of the existing pavement at least 300 mm wide for its full depth and trim the edge vertically before placing new pavement material.
Existing sealed pavement: Trim the seal to a neat edge.

Fixed formwork
Description:
- Steel forms.
- Seasoned, dressed timber planks, free of warps, bends or kinks, with the full width of their top edges covered with steel angle sections finishing flush with the form face.

Depth: Equal to the edge thickness of the slab and in one piece.

Tolerances on position:
- Absolute level tolerance: ± 5 mm (maximum departure of top surface from the required level).
- Relative level tolerance: ± 5 mm (maximum departure of top surface from a 3 m straightedge).
- Horizontal tolerance: ± 10 mm (maximum departure of face from a plane surface).
- Verticality: 3 mm departure from vertical.

Staking: Stake forms in position using at least 3 steel stakes per form, not more than 1.5 m apart. Lock joints between form sections to prevent movement.

Release agent: Before placing reinforcement, apply a release agent compatible with the contact surfaces, to the interior of the formwork, except where the concrete is to receive an applied finish for which there is no compatible release agent. Clean the reinforcement to remove all traces of release agent.

Re-use: Clean and recoat the forms each time before placing concrete.
Keyways: Form the keyways of keyed construction joints using steel form strips accurately located at the mid-depth of the slab and securely fastened flush against the formwork face.

Reinforcement

Tolerances in fabrication and fixing: To AS 3600.

Locate reinforcement: Place reinforcement in the top half of the pavement.

Minimum cover to reinforcement: 30 mm.

Splicing mesh: Overlap a minimum of 2 crosswires.

Supports: Provide proprietary concrete, metal or plastic supports to reinforcement in the form of chairs, spacers, stools, hangers and ties, as follows:

- To withstand construction and traffic loads and maintain the concrete cover, as documented.
- With a protective coating if they are ferrous metal extending to the surface of the concrete, or are used with galvanized or zinc-coated reinforcement.

- Minimum spacing:
  . Bars: ≤ 60 diameters.
  . Fabric: ≤ 800 mm.
- Supports over membranes: Prevent damage to waterproofing membranes or vapour barriers. If appropriate, place a metal or plastic plate under each support.
- Projecting reinforcement: If 'starter' or other bars project beyond reinforcement mats or cages, through formwork or from cast concrete, provide a plastic protective cap to each bar until it is incorporated into subsequent work.
- Tying: Secure the reinforcement against displacement by tying at intersections with either wire ties, or clips. Bend the ends of wire ties away from nearby faces of forms so that the ties do not project into the concrete cover.
- Mats: For bar reinforcement in the form of a mat, secure each bar at alternate intersections.

Cores, fixings and embedded items

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

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

E16.3.7 CONCRETE PLACING AND COMPACTION

Concrete placing

General: Place concrete uniformly over the width of the slab or lane and so that the face is generally vertical and normal to the direction of placing. Hand spread concrete using shovels, not rakes.

Remove: Any water ponding on the ground.

Placing sequence: Commence from one corner (usually the lowest point) and proceed continuously out from that point.

Weather: Do not place concrete in temperatures above 30°C or below 10°C without adequate precautions.

Compaction

Thickness 100 mm or less: Compaction through placing screeding and finishing processes. If required use a hand-held vibrating screed at the surface. Do not use immersion vibrators.

Thickness > 100 mm and downturns: Use an immersion vibrator.

Placing records

General: Keep on site and make available for inspection a log book recording each placement of concrete, including the following:

- Date of concrete placement.
- Delivery docket noting the specified grade and source of concrete.
- Slump measurements to AS 1012.3.1.
- The portion of work.
- Volume placed.
Rain
General: During placement and before setting, do not expose concrete to rain.
Protection: Protect surface from damage by covering until hardened.

Concrete placing in cold weather
Cement: Do not use high alumina cement.
Placing concrete: Maintain the temperature of the freshly mixed concrete at 5°C.
Formwork and reinforcement: Before and during placing maintain temperature at 5°C.
Severe weather: If severe weather conditions are predicted, use high early strength cement.
Temperature control: Heat the concrete materials, other than cement, to the minimum temperature necessary to ensure that the temperature of the placed concrete is within the limits specified.
Admixtures: Do not use calcium chloride, salts, chemicals or other material in the mix to lower the freezing point of the concrete.
Frozen materials: Do not allow frozen materials or materials containing ice to enter the mixer, and keep free of frost and ice any forms, materials, and equipment coming in contact with the concrete.
Maximum temperature of water: 60°C when it is placed in the mixer.
Plastic concrete: Prevent plastic concrete from freezing, without using salts or chemicals.

Concrete placing in hot weather
Handling: Prevent premature stiffening of the fresh mix and reduce water absorption and evaporation losses. Mix, transport, place and compact the concrete in conformance with the Elapsed delivery time table.
Placing concrete: Maintain the temperature of the freshly mixed concrete in conformance with the Hot weather placing table.
Formwork and reinforcement: Before and during placing maintain temperature at 35°C.
Severe weather: If ambient shade temperature > 38°C, do not mix concrete.
Temperature control: Select one or more of the following methods of maintaining the specified temperature of the placed concrete:
- Cool the concrete using liquid nitrogen injection before placing.
- Cover the container in which the concrete is transported to the forms.
- Spray the coarse aggregate using cold water before mixing.
- Use chilled mixing water.

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

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

E16.3.8 CONCRETE PRIMARY FINISH

General
Finishing: Do not commence finishing until all bleed water has evaporated from the surface.
Commence: Immediately after placement and spreading and compaction of the plastic concrete, start finishing operations to achieve the documented finish.
Finish: Brushed

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

Formed surfaces
Damage: Do not damage concrete works through premature removal of formwork.
Curing: If forms are stripped when concrete is at an age less than the minimum curing period, commence curing exposed faces as soon as the stripping is completed.
E16.3.9 CONCRETE CURING

General
Curing: Commence curing as soon as possible after finishing and extend for a minimum period of 3 days.
End of curing period: Prevent rapid drying out at the end of the curing period.
Protection: Maintain at a reasonably constant temperature with minimum moisture loss, during the curing period.

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

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

Curing methods
Covering sheet method: Immediately after finishing operations cover concrete using damp hessian or cotton mats overlapped at least 150 mm and anchored against displacement by wind or other interference. Keep the mats continuously damp until covered by the covering sheet material. Repair tears immediately.
Moist curing method: Immediately after finishing operations and once concrete has set sufficiently to be not damaged by the curing process keep the concrete surface continuously damp by ponding or spraying constantly with water, fog, or mist, using suitable spraying equipment. Continue wetting for the curing period.
Self levelling toppings: To AS 3799, if also used for curing.
Coloured concrete: Do not cure with plastic sheeting, damp sand or wet hessian. Use only chemical curing compounds compatible with the sealer or simply use a sealer (it must then comply with the requirements of a chemical compound sealer).

Curing compound
Application: Provide a uniform continuous flexible coating to AS 3799 without visible breaks or pinholes. Ensure coating remains unbroken at least for the required curing period after application. Respray defective areas within 30 minutes. Respray within 3 hours after heavy rain.

E16.3.10 JOINTS

General
General: Construct expansion, contraction and construction joints straight and plumb. Make transverse joints normal to longitudinal joints. Extend transverse expansion and contraction joints continuously from edge to edge of the pavement through interconnected slabs.
Joint layout: Install joints as documented.
Joint spacings: in accordance with the Drawings
Joint widths: in accordance with the Drawings

Contraction joints
Installation: Construct transverse and longitudinal contraction joints by early age power sawing or by placing an insert in the fresh concrete.

Dowelled joints
Dowelled contraction joint: Place dowels at 300 mm centres orthogonal to the joint direction and parallel to the pavement surface, accurate alignment is critical, ensure proper field supervision.
Dowel assembly: Use a dowel-assembly support frame firmly secured to the subbase during concrete placement. Prevent the dowel assembly support frame from passing through the joint. Do not insert dowels during the placement of concrete.
Debond dowel: Coat with a debonding coating to 0.5 length + 25 mm. Embed the unpainted half of the dowels in the slab placed first.

Movement: Do not distort or displace beyond the alignment tolerances under testing or during construction. Do not remove and replace dowels in pre-formed holes.

**Tie bar joints**

Longitudinal contraction joints: Place tie bars at 800 mm centres. Alignment accuracy of tie bars is not critical.

**Construction joints**

Installation: Place header board on the subbase or subgrade at right angles to the pavement centre line.

- Planned location: Terminate each day's placing operation at a transverse construction joint located to coincide with a planned contraction or expansion joint.
- Unplanned joints: If placement is interrupted for 30 minutes or longer, form a tied transverse construction joint within the middle third of the distance between planned joints but no closer than 1.5 m to the nearest planned joint. If necessary remove placed concrete back to the required location.

**Expansion joints**

Expansion joints: Provide formed full depth joints around structures and features which project through, into or against the pavement, and elsewhere as required.

Doweled expansion joints: Cap dowels at one end with a compressible material.

**Formed joints**

Full depth joints: Form the edge of the concrete placed first to provide a smooth, vertical face. After stripping and cleaning fix the joint filler with a suitable waterproof adhesive to the face of the slab, and place the adjoining concrete after the adhesive has set.

Weakened plane joint: Cut a crack-inducing groove by using a suitable tool into the plastic concrete during finishing of the concrete surface. Compact and refinish the plastic concrete around the groove after forming the joint.

Rebated groove joints: Form the rebate by securely fixing removable steel or timber form strips to the form or forms on the slab which is placed first, so that the top of the steel strip is flush with the top of the form. After stripping and cleaning, fix the joint filler in the rebate after placing the adjoining concrete.

**Sawn joints**

Weakened plane joint: Saw the hardened concrete to depth at least ¼ to ⅓ of the pavement thickness and to a uniform width in the range of 3 – 5 mm as follows:

- Timing: Commence sawing, regardless of time or weather conditions, as soon as the concrete has hardened sufficiently to permit cutting with only minor ravelling of the edges of the saw cut. Complete sawing no later than 24 hours after concrete placement.
- Sequence: If possible, saw every third transverse joint initially, then saw the intermediate joints. Start where concrete placement has commenced.
- Cracking: If the concrete has already cracked near the location chosen for a joint, do not saw a joint in that location. If a crack develops ahead of the saw cut, discontinue sawing and submit proposals for extra sawn joints. If uncontrolled cracking occurs, suspend concrete placing.
- Stand-by machines: Provide one stand-by sawing machine for each machine planned to be used.
- Cleaning and protection: Immediately after each joint is sawn, flush the saw cut and adjacent concrete surface using water, until the waste from sawing is removed from the joint. Temporarily caulk the joint using plastic or rubber tubing, or a suitable ‘Tee’ shaped extrusion. Leave the caulk in place until grooving and sealing.

Rebated groove joints: Saw straight, parallel sided grooves for joint seals on top of and centred on the sawn weakened plane joints.

- Timing: Commence sawing after the curing period has ended, immediately before joint sealing. Saw during daylight hours.

Protection: Where there is a time elapse after sawing and before joint sealing, install a thin-spilled rubber strip with a free width slightly larger than the saw cut at the bottom of the saw cut after washing slurry from sawn groove to temporarily prevent ingress of solid material.
Preparing joints
Striping time: At least 12 hours.
Clean: Immediately before installation of the sealer ensure that the joint space is dry, clean and free from loose material. Remove laitance, curing compound and protrusions of hardened concrete from the sides and upper edges of the joint.

Joint sealing
Install backer rod: Install backer rod of closed cell polyethylene strip to the bottom of the sealant groove.
Sealant installation: Use a field moulded sealant gunned into the joint above the backing rod in a semi-liquid form.
Sealant type: Silicone sealant, in accordance with manufacturer’s recommendations.

E16.3.11 SURFACE SEALERS
Thoroughly clean the surface of all concrete before the application of finishes. Remove formwork wax, heavy duty polymer finishes and clear resin sealers etc using a seal stripper.

Transparent acrylic resin sealer, resistant to ultraviolet rays, suitable for exterior or interior applications, rendering the surface impervious to stains of oils, grease, water and acids, non-yellowing, non-discolouring to the base surfaces, cut with a combination of hydrocarbon solvents to give good penetration into the surface.
Total solids: At least 14%.

Surface hardeners
Suitable for cementitious toppings or as laid surfaces. Apply to clean surfaces. Do not apply to non-slip topping.

Sealer: Apply surface sealer after the curing period and when concrete has dried to allow the sealer to penetrate into the concrete surface.
Curing sealer compound: If using the sealer as a curing compound, apply directly after finishing.

Concrete finishes
Conform to: Concrete finishes worksection.

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

E16.3.12 COMPLETION
Protection
General: Keep traffic, including construction plant, off the pavement entirely during curing, and thereafter permit access only to necessary construction plant vehicles that conform to the predetermined load limits appropriate to the use of the concrete.

Reinstating adjacent surfaces
General: Reinstall surfaces next to new pavements and associated elements. Where an existing flexible road pavement has been disturbed, trim it back to a straight and undisturbed edge 250 – 300 mm from and parallel to the new concrete for the full depth of the slab. Backfill with asphalt rammed solid, using suitable rammers.

Traffic on pavement
General: Give notice before opening the pavement to traffic before the work is completed. Provide protection.

Testing
Concrete pavement: Check tolerance criteria for flatness and levelness. Where pavement does not conform submit rectification proposal.
Unplanned cracking:
- 0.3 mm wide crack is acceptable.
- > 1 mm must be assessed, submit a proposal for possible cause and rectification processes.
E16.4 SELECTIONS

E16.4.1 SCHEDULE

Unformed surface finishes schedule
Refer to the Schedule of Finishes
E17 SEGMENTAL PAVERS

E17.1 GENERAL

E17.1.1 RESPONSIBILITIES

General
General: Supply and install external paving:
- Consistent in colour and finish.
- Firmly bonded to substrates for the expected life of the installation.
- Resistant to expected impacts in use.
- Set out with joints accurately aligned in both directions.
- To direct all water flowing from supply points to drainage outlets without leakage to the substrate or adjacent areas.

Selections: Conform to the Selections.

E17.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Landscaping specification
- Stormwater – site.

E17.1.3 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions given below apply.
- Adhesives:
  . Cementitious: Adhesives in which the binders are hydraulic, e.g. Portland cement, with aggregates and organic additives.
  . Dispersion (D): Adhesives in which the binders are in the form of aqueous polymer dispersion with mineral fillers and organic additives.
  . Reaction resin I: Adhesives in which in the binders are synthetic resins with mineral fillers and organic additives. The curing occurs by chemical reaction.
- Substrates: The surface to which a material or product is applied.
- Bedding: Mixtures of materials which are applied to substrates in a plastic state and dry and cure to adhere tiles to substrates.
  . Adhesive bedding: Tiling adhered by adhesives.
  . Mortar bedding: Tiling adhered in a cementitious mortar bed.
- Pavers: Slabs made from clays, stone, precast concrete and/or other inorganic raw materials generally over 20 mm thick used as coverings for floors and supported over continuous substrates.
  . Terrazzo tiles – cementitious: Manufactured cementitious terrazzo tiles formed in a suitable machine to give sufficient compaction and density to the finished surface, and moisture cured before grinding and honed at the place of manufacture. Thickness usually 35 mm.
- Lippage: Height deviation between adjacent pavers.

E17.1.4 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Substrate immediately before paving.
- Trial set-outs before execution.
- Control joints before sealing and grouting.
E17.1.5 STANDARDS

Slip resistance
Classification: To AS/NZS 4586 for the classifications as documented.
Slip resistance measurement of existing installations: To AS/NZS 4663.

Testing authority
General: Independent third party Registered testing authority.

E17.1.6 SUBMISSIONS

Samples
General: Submit labelled samples of pavers, grout and sealants, illustrating the range of variation in colour and finish.

Sample panels
General: Prepare a sample panel of each type of finish as follows:
- Size: As noted in the Samples Schedule.
- Include samples of junction details and trim.
- Preserve each panel until related work is complete.
The sample panel shall be the benchmark of quality of execution for the project.

Sample schedule
Provide a 3m long sample of the platform edge, including coping, yellow warning pavers and tactile indicators.

Execution
Grouting: Submit proposals for grouting methods and materials.
Margins: If it appears that minor variations in joint widths or overall dimensions will avoid cut pavers, submit a proposal.

E17.1.7 TESTS

General
Type tests: Submit as follows:
- Slip resistance to AS/NZS 4586: R11
- Field tests of completed pavement: Slip resistance to AS/NZS 4663.
- Program: Conduct field tests immediately before the date of practical completion.

Flood tests: Submit a report of flood tests conducted on site as follows.
Salt efflorescence: Provide prototype testing of cementitious tiles for salt efflorescence.

Luminance contrast test on:
- Stair nosing to stair paving
- Each type of tactile tiles vs PV-1 and PV-2

Slip resistance
Carry out slip resistance tests on all types of paving. Tests shall be carried out on loose tile samples with sealer, on sample installation, on Stair installation and on concourse and platform installation.

E17.1.8 PRODUCT CONFORMITY

General
General: Submit current assessments of conformity as follows:
- Declaration of conformity by an ISO 9001 quality management system certified supplier:
  . Slip resistance of tiles to AS/NZS 4586.
  . Marking and Classification of tile adhesive to AS 4992.1.

E17.1.9 TOLERANCES

Completed paving
Paving units must have the surfaces of adjacent units align to within 5mm.
Horizontal and vertical joint alignment tolerances are not to exceed 5mm.
General: Conform to the Surface level tolerances table:
Lippage:
- Unpolished pavers: < 2 mm.
- Polished pavers 300 x 300 mm or less: < 1 mm, with 5% not exceeding 1.5%.
- Polished pavers over 300 x 300 mm: < 1.5 mm, with 5% not exceeding 2%.

E17.2 PRODUCTS

E17.2.1 ADHESIVES

General
Standard: To AS 2358 or AS 4992.1.

Type
General: Provide adhesives compatible with the materials and surfaces to be adhered.

Prohibited uses: Do not provide the following combinations:
- Organic PVC-based adhesives and organic natural rubber latex adhesives in damp or wet conditions.
- PVA (polyvinyl acetate) based adhesives in wet areas or externally.

E17.2.2 MORTAR

Materials
Cement: To AS 3972.
- Type: GP or GB.
- White cement: Iron salts content ≤ 1%.
- Off-white cement: Iron salts content ≤ 2.5%.

Lime: To AS 1672.1.
Sand: Fine aggregate with a low clay content selected for grading, sharp and free from efflorescing salts.
Water: To the recommendations of AS 3958.1.

Measurement of volume: Measure binders and sand by volume using buckets or boxes. Do not allow sand to bulk by absorption of water.

Bedding mortar
Proportioning: Select proportions from the range 1 cement:3 sand – 1 cement:4 sand to obtain satisfactory adhesion. Provide minimum water.
Mixing: To AS 3958.1.
Gauging: Site gauged by volume.

E17.2.3 GROUT

Type
Cement based proprietary grout: Mix with water. Fine sand may be added as a filler in wider joints.
Portland cement based grout: Mix with fine sand. Provide minimum water to achieve workability.
- For joints < 3 mm: 1 cement:2 sand.
- For joints ≥ 3 mm: 1 cement:3 sand.

Pigments
Pigments for coloured grout: Provide colourfast pigments compatible with the grout material. For cement-based grouts, provide inorganic mineral pigments or lime-proof synthetic metallic oxides compatible with cement.

Water
General: Clean and free from any deleterious matter.
Grout to resin terrazzo tiles: Resinous material supplied by the tile supplier.

E17.2.4 PAVERS

Standard
Masonry units, pavers and flags: To AS/NZS 4455.2.
Salt attack resistance grade to: AS/NZS 4455.1 Table 2.3: Exposure grade

E17.2.5 OTHER MATERIALS

Tactile ground surface indicators
Standard: To AS/NZS 1428.4.1.

E17.3 EXECUTION

E17.3.1 SUBSTRATES

Drying and shrinkage
General: Before paving, allow at least the following times to elapse (for curing and initial shrinkage) for these substrates:
- Concrete slabs: 28 days.
- Toppings on slabs: A further 21 days.

E17.3.2 PREPARATION

Trial set-out
General: Prepare a trial paving set-out to each area as follows to:
- Maximise the size of equal margins of cut pavers.
- Locate control joints.
- Note minor variations in joint widths to eliminate cut tiles at margins.

Ambient temperature
General: If the ambient temperature is < 5 or > 35°C, do not lay pavers.

Substrates
General: Ensure substrates are as follows:
- Clean and free of any deposit or finish which may impair adhesion or location of pavers.
- Excessive projections are hacked off and voids and hollows are filled with a cement:sand mix not stronger than the substrate nor weaker than the bedding.

Absorbent substrates: If suction is excessive, control it by dampening but avoid over-wetting and do not apply mortar bedding to substrates showing surface moisture.

Concrete: If not sufficiently rough to provide a mechanical key, roughen by scabbling or the like to remove 3 mm of the surface and expose the aggregate; then apply a bonding treatment.

Fixtures
General: Before paving ensure that fixtures interrupting the surface are accurately positioned in their designed or optimum locations relative to the paving layout.

E17.3.3 PAVING GENERALLY

Variations
General: If necessary, distribute variations in hue, colour, or pattern uniformly, by mixing pavers or paving batches before laying.

Paving joints
Joint widths: Set out pavers to give uniform joint widths of 6 to 12 mm.

Margins
General: Provide whole or purpose-made pavers at margins where practicable, otherwise set out to give equal margins of cut pavers. If margins less than half paver width are unavoidable, locate the cut pavers where they are least conspicuous.

Protection
Traffic: Keep pedestrian and vehicular traffic off paving until the bedding has set and attained its working strength.

Cleaning: Keep the work clean as it proceeds and protect finished work from damage.
E17.3.4 MORTAR BEDDING

Preparation of pavers
Suction: Soak porous pavers in water for half an hour and then drain until the surface water has disappeared.

Bedding
General: Use bedding methods and materials which are appropriate to the paver, the substrate, the conditions of service, and which leave the paver firmly and solidly bedded in the bedding material and adhered to the substrate. Form falls integral with the substrate.

Mortar beds
Substrate preparation: Either lightly dust the screeded bed surface with dry cement and trowel level until the cement is damp, or spread a thin slurry of neat cement, or cement-based thin bed adhesive, on to the tile back. Do not provide mortar after initial set has occurred.

Sealer
Sealer to paving shall be Sure Seal sure sealer 24/7 Stone impregnator in a clear finish.

E17.3.5 MOVEMENT JOINTS

General
General: Provide control joints as follows:
- Location:
  - Over structural control joints.
  - At internal corners.
  - Close to external corners in large paved areas.
  - Around the perimeter at abutments.
  - At junctions between different substrates.
  - To divide large paved areas into bays, maximum 5 m wide, maximum area 16 m².
  - At abutments with the building structural frame and over supporting walls or beams where flexing of the substrate is anticipated.
- Depth of joint: Right through to the substrate.
- Sealant width: 6 – 25 mm.
- Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

Control joint types
Divider strip: A proprietary expansion joint consisting of a neoprene filler sandwiched between plates with lugs or ribs for mechanical keying. Set flush with the finished surface.
Proprietary slide plate divider strip: An arrangement of interlocking metal plates grouted into pockets formed in the concrete joint edges.
Sealant: Two-pack self-leveling flexible mould resistant, one-part silicone or polyurethane sealant applied over a backing rod. Finish flush with the tile surface.
- Floors: Trafficable, shore hardness > 35.
Backign rod: Compressible closed cell polyethylene foam with a bond-breaking surface.

E17.3.6 GROUTED AND SEALANT JOINTS

Grouted joints
General: Commence grouting as soon as practicable after bedding has set and hardened sufficiently. Clean out joints as necessary before grouting.
Face grouting: Fill the joints solid and tool flush. Clean off surplus grout. Wash down when the grout has set. When grout is dry, polish the surface with a clean cloth.

E17.3.7 ACCESS COVERS

General
Where access covers to pits are located in paved areas, lay pavers in the metal cover to achieve a level surface with the surrounding paving. Cut and trim pavers as required to fit within the frame of the cover and to match the pattern of the surrounding pavers.
E17.3.8 COMPLETION

Spare pavers
General: Supply spare matching pavers of each type for future replacement purposes. Store the spare materials on site.
Quantity: At least 1% of the quantity installed.

Cleaning
Completion: Clean progressively and leave pavements clean on completion.

Operation and maintenance manuals
General: Submit a manual describing care and maintenance of the tiling, including procedures for maintaining the slip-resistance grading stating the expected life of the slip-resistance grade.

E17.4 SELECTIONS

E17.4.1 PAVER SCHEDULE

<table>
<thead>
<tr>
<th>Platform Coping</th>
<th>Location</th>
<th>Existing platforms and extensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tiles</td>
<td>Type</td>
<td>Exposed aggregate concrete pavers</td>
</tr>
<tr>
<td></td>
<td>Supplier</td>
<td>Urbanstone</td>
</tr>
<tr>
<td></td>
<td>Size</td>
<td>400mm x 300mm x 40mm thick</td>
</tr>
<tr>
<td></td>
<td>Colour</td>
<td>As noted in the Finishes Schedule</td>
</tr>
<tr>
<td></td>
<td>Pattern</td>
<td>Tiles to be laid in 2 rows of stack bond to provide a continuous strip 800mm wide</td>
</tr>
<tr>
<td></td>
<td>Bedding</td>
<td>Thick cement based bedding</td>
</tr>
<tr>
<td></td>
<td>Grout</td>
<td>Proprietary, cement based, natural colour</td>
</tr>
<tr>
<td></td>
<td>Slip resistance classification</td>
<td>R13</td>
</tr>
<tr>
<td>Sealer</td>
<td></td>
<td>SureSeal stone sealer 24/7 stone impregnator – clear</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tactile ground surfaces indicators</th>
<th>Location</th>
<th>Existing platforms and extensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tiles</td>
<td>Type</td>
<td>Exposed aggregate concrete pavers</td>
</tr>
<tr>
<td></td>
<td>Supplier</td>
<td>Stone directions</td>
</tr>
<tr>
<td></td>
<td>Size</td>
<td>300mm x 300mm x 40mm thick</td>
</tr>
<tr>
<td></td>
<td>Colour</td>
<td>As noted in the Finishes Schedule</td>
</tr>
<tr>
<td></td>
<td>Pattern</td>
<td>Tiles to be laid in 2 rows of stack bond to provide a continuous strip 600mm wide</td>
</tr>
<tr>
<td></td>
<td>Finish</td>
<td>Shotblast or off-form</td>
</tr>
<tr>
<td></td>
<td>Bedding</td>
<td>Thick cement based bedding</td>
</tr>
<tr>
<td></td>
<td>Grout</td>
<td>Proprietary, cement based, natural colour</td>
</tr>
<tr>
<td></td>
<td>Slip resistance classification</td>
<td>R13</td>
</tr>
<tr>
<td>Sealer</td>
<td></td>
<td>SureSeal stone sealer 24/7 stone impregnator – clear</td>
</tr>
</tbody>
</table>
## Yellow warning strip

<table>
<thead>
<tr>
<th>Location</th>
<th>Existing platforms and extensions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tiles</strong></td>
<td></td>
</tr>
<tr>
<td>- Type</td>
<td>Pigmented concrete pavers</td>
</tr>
<tr>
<td>- Supplier</td>
<td>Urbanstone</td>
</tr>
<tr>
<td>- Size</td>
<td>100mm x 300mm x 40mm thick</td>
</tr>
<tr>
<td>- Colour</td>
<td>As noted in the Finishes Schedule</td>
</tr>
<tr>
<td>- Bedding</td>
<td>Thick cement based bedding</td>
</tr>
<tr>
<td>- Grout</td>
<td>Proprietary, cement based, natural colour</td>
</tr>
<tr>
<td>- Slip resistance classification</td>
<td>R13</td>
</tr>
<tr>
<td><strong>Sealer</strong></td>
<td>SureSeal stone sealer 24/7 stone impregnator – clear</td>
</tr>
</tbody>
</table>
E18 PAVEMENT ANCILLARIES

E18.1 GENERAL

E18.1.1 RESPONSIBILITIES
General
General: Provide channels, kerbs and linemarking.
Selections: Conform to Execution.

E18.1.2 CROSS REFERENCES
General
Requirement: Conform to the following:
- General requirements.
- Site management.
- Earthwork.
- Pavement base and subbase.

E18.1.3 INTERPRETATION
Definitions
General: For the purposes of this worksection the definitions of AS 1348 and those given below apply.
- Absolute level tolerance: Maximum deviation from design levels.
- Relative level tolerance: Maximum deviation from a 3 m straightedge laid on the surface
- Channels and kerbs: Includes all forms of concrete gutters, dish drains, grated drains and mountable median and barrier kerbing.

E18.1.4 SUBMISSIONS
Linemarking materials
General: Submit NATA Registered Laboratory Test Reports, at least seven days before work is scheduled to commence, on the properties of the materials, including paint.

E18.2 PRODUCTS

E18.2.1 MATERIALS
Concrete
Standard: To AS 1379 – Grade N20.

Pavement marking paint
Standard: To AS 4049.1, AS 4049.3 and AS 4049.4.

E18.2.2 VEHICLE BARRIERS
Log barriers
General: Hazard class 4 to AS 1604.1.
Size: Diameter range 125 – 150 mm.

Precast concrete wheel stops
Material: Precast concrete units with predrilled holes located 300 mm from each end for fixing to ground surface.
Size: 2000 x 150 x 100 mm high.

Steel tube bollards
Type: Bollards fabricated from heavy steel tube, to minimum nominal size DN 100, to AS 1074. Seal free ends with fabricated end caps, spot welded and ground smooth.
Finish: Galvanize after fabrication.
E18.2.3 BICYCLE RACKS

General
Standards: Layout and location to AS 2890.3.
Product: Contractor to submit details of proprietary product for approval by the Client.
Style: Contractor to submit details for approval by the Client. Finish shall be stainless steel finish.
Material: Contractor to submit details for approval by the Client
Location: In accordance with the Drawings

E18.2.4 VEHICULAR GUARDRAILS / CRASH BARRIERS

Provide fabricated guardrails / crash barriers where indicated in the Drawings.
Steel guardrail barriers shall be galvanised.
Vehicular guardrails shall be in accordance with RTA Specification R132.
Manufactured steel barriers and guardrails shall be equal to Ingal:
- Spring Buffa with Classic or Standard post to suit application
- Flexi Post
- Rigid Post with surface bolted or in-ground fixings to suit application.
Guardrail shall be installed in accordance with the manufacturer's recommendations and RTA Specification R132.

E18.3 EXECUTION

E18.3.1 LINEMARKING

Setting out
General: Set out the work to ensure that all markings are placed in accordance with the drawings and as agreed with the Superintendent.

The Contractor shall linemark the car spaces of the Upper Accessway south of the Shared Zone in order to provide 2.4 metre wide by 5.4 metre long car spaces.

Surface preparation
Surface: Clean, dry and free of any deposit which may impair adhesion of the paint finish.
Wet weather: Do not apply pavement marking during wet weather or if rain is likely to fall during the process or paint drying time.
Scabbling: Scablle the full area of concrete wearing surfaces to raised pavement markers and remove fine mortar material.
Provision for traffic: Allow for traffic during application and protect pavement markings until the material has hardened sufficiently to carry traffic without damage.
Mixing of paint: Mix all paint in its original container before use and produce a smooth uniform product consistent with the freshly manufactured product.
Application of paint
Longitudinal lines: Spray all longitudinal lines with a self propelled machine. Spray concurrently the two sets of lines forming a one-way or two-way barrier line pattern.
Hand spraying: Hand spray transverse lines, symbols, legends, arrows and chevrons with templates.
Paint thickness: Uniform wet film thickness: ≥ 0.35 mm to ≤ 0.40 mm.
Pavement markings: Straight or with smooth, even curves where intended.
Edges: Clean with a sharp cut off. Remove any marking material applied beyond the defined edge of the marking and leave a neat and smooth marking on the wearing surface of the pavement.
Paint shall be water based - colour 'White'.

Contract No
Cardiff Railway Station Easy Access Upgrade 122 of 301
Tender Issue
February 2012
Tolerances
Longitudinal line lengths: Do not vary by more than 20 mm from the lengths shown in AS 1742.2.
Longitudinal line widths: Do not vary by more than 10 mm from the widths shown in AS 1742.2.
Transverse line lengths and widths: Do not vary by more than 10 mm from the lengths and widths shown in AS 1742.2.
Dimensions: Do not vary the dimensions of arrows, chevrons, painted medians, painted left turn islands and speed markings by more than 50 mm from the dimensions shown on the drawings or in AS 1742.2 as appropriate. Place arrows and speed markings square with the centreline of the traffic lane.

Removal of pavement markings
General: Remove pavement markings, no longer required, from the wearing surface of pavements without significant damage to the surface.

E18.3.2 CHANNELS AND KERBS

Foundation preparation
Foundation material: Shape and compact to form a firm base before placing any kerb and/or gutter.
Construction not on a pavement course: Relative compaction To AS 2876.
Construction on a pavement course: To the requirements of the Pavement base and subbase worksection.
Standard: Construct kerb and/or gutters in fixed forms, by extrusion or by slip forming to AS 2876 Foundation, concrete quality, curing and testing details: To AS 2876.

Tolerances
Design level deviation at any point on the surface of gutters: ± 10 mm.
Surface deviation to top or face of kerbs, and to the surface of gutters: 5 mm in 3000 mm.
Design alignment deviation: 25 mm.
Exception: Kerb laybacks, grade changes or curves, or at gully pits requiring gutter depression.

Joints
Standard: To AS 2876.
Concrete pavement: Where kerbs and/or gutters are cast adjacent with a concrete pavement, continue the same type of expansion, contraction and construction joints documented for the concrete pavement across the kerb and/or gutter.

Backfill
Timing: Not earlier than three days after placing kerb and gutter concrete, backfill and reinstate the spaces on both sides of the kerb and/or gutters.
Material: Granular material, free of organic material, clay and rock in excess of 50 mm diameter.
Compaction: Compact backfilling in layers not greater than 150 mm thick, to a relative compaction of 95% when tested in accordance with AS 1289.5.4.1, for standard compactive effort.
Pavement: Backfill pavement material adjacent to new gutter in accordance with the drawings and the Pavement base and subbase worksection.

E18.3.3 VEHICLE BARRIERS

Log barriers
Installation: Check out the posts to receive the rails. Set each post 600 mm into the ground and surround with compacted fine crushed rock, gravel or cement stabilised rammed earth. Bolt rails to posts with M12 diameter galvanised bolts and washers, with bolt heads and nuts recessed.

Precast concrete wheel stops
Installation: Drive 12 mm diameter galvanised steel rods 600 mm into the ground to finish 25 mm below the top of the wheel stop, or bolt the stop to masonry anchors in concrete slabs. Grout the holes flush to match the concrete finish.
Provide proprietary wheel stops suitable for B99 vehicles. Wheel stops shall be manufactured from recycled rubber similar to "Ingal Wheel Stop" by Ingal Civil or approved equivalent.
Colour shall be yellow and black.
Locate wheel stops at each car space of the Upper Accessway as indicated on the Drawings.
Fix wheel stops in accordance with the manufacturer’s recommendations.

**Steel tube bollards**
Footing: Encase in a concrete footing at least 600 mm deep x 250 mm diameter.
On slabs: Weld on a 10 mm thick baseplate drilled for 4 bolts, and bolt to masonry anchors.
Filling: Fill the tube with 15 Mpa concrete.

**E18.3.4 BICYCLE RACKS**

**Installation**
To concrete pavements: Install in accordance with the recommendations of the manufacturer.
Provide racks in multiples to provide the required number of bicycle storage positions indicated on the drawings.

**E18.3.5 REMOVAL OF REDUNDANT PITS**
The Contractor shall be responsible for demolition and disposal of existing redundant structures where they interfere with proposed works as indicated in the Drawings.

**E18.4 SELECTIONS**

**E18.4.1 BOLLARDS**

**General**
Location: Shared area of proposed accessible parking spaces at Lower Ground Level
Manufacturer: Leda Security
Type: Fixed aluminium bollard with heavy duty galvanised pipe.
Code Number: AAE 150NB
Finish and colour: Powdercoated Precious Silver Pearl

**E18.4.2 BICYCLE RACKS**

**General**
Location: As shown on drawings
Manufacturer: Leda Security
Type: 5 Secure racks allowing storage for 10 bicycles.
Code Number: BR85F
Material: Stainless steel
E19 SERVICE TRENCHING

E19.1 GENERAL

E19.1.1 RESPONSIBILITIES

General
General: Provide trenching for underground services.
Authority requirements: Refer to Services and Civil Engineers specifications and drawings.

Design
Steel shoring and trench lining systems: To AS 4744.1.
Hydraulic shoring and trench lining equipment: To AS 5047.

E19.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Earthwork.
- Pavement base and subbase.
- Asphalitic concrete.
- Services specifications.

E19.1.3 STANDARDS

General
Earthworks: To AS 3798.

E19.1.4 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
- CBR value: California Bearing Ratio value.

E19.1.5 INSPECTION

Notice
Inspection: Give notice so that inspection may be made at the following stages:
- Service trenches excavated before laying the service.
- Services laid in trenches and ready for backfilling.

E19.1.6 TOLERANCES

General
Earthworks: To Tolerances in the Earthwork worksection.

E19.1.7 SUBMISSIONS

General
Extent: Submit a plan of trench works noting the location and type of service.
Notice: Advise proposed duration of open excavation.
Construction: Submit details of proposed equipment and method of excavation.
Stability: If shuttering and/or bracing of the sides of a trench is required for safety and stability, provide proposals.
Geotechnical data: Provide a geotechnical report supporting the procedures proposed for trenching and/or boring.
Hazards: Identify OH&S hazards that may be encountered with deep trenches including toxic gases and liquids.
Boring: Submit proposals for the following:
Service trenching

- Limits on length.
- Existence of other services and method of protection.
- Pressure grouting to voids.
- The effect of pressure grouting on other services, ground heave and proposals for minimising such effects.
- Access to properties outside the site.
- Council permits.
- Service interruptions including a plan for minimising unintended interruptions.

Off site disposal
Disposal location: Submit the locations and evidence of compliance with the relevant authorities for the disposal of material required to be removed from the site.

E19.2 PRODUCTS

E19.2.1 FILL MATERIALS

General
Requirement: Provide fill materials including borrow or imported fill to Fill materials and Borrow or imported fill in the Earthwork worksection.

E19.3 EXECUTION

E19.3.1 EXISTING SERVICES

Location
Requirement: Before commencing service trenching, locate and mark existing underground services in the areas which will be affected by the service trenching operations.
Utility services: Contact DIAL BEFORE YOU DIG to identify location of underground utility services pipes and cables.

Excavation
General: Do not excavate by machine within 1 m of existing underground services.

E19.3.2 EXISTING SURFACES

Concrete and asphalt pavements
Method: Sawcut trench set out lines for the full depths of the bound pavement layers except where the set out line is located along expansion joints.
Removal of concrete and asphalt: Break out concrete or asphalt pavement material between the trench set out lines, remove and dispose of off-site.

Segmental paving units
Removal: Take up segmental paving units both full and cut by hand, between the trench set out lines, and neatly stack on wooden pallets.
Concrete edging: Break out, remove and dispose of off-site.
Concrete subbase: If present, sawcut along the trench set out lines.

Grass
Method: Neatly cut grass turf between trench set out lines into 300 mm squares. If the grass is suitable for re-use, take up and store the turf and water during the storage period, otherwise remove and dispose of it off-site.

Small plants, shrubs and trees
Storage: If required for re-planting, take up small plants and store. Wrap the root ball in a hessian or plastic bag with drain holes and water during the storage period.
Unsuitable vegetation: Remove and dispose of off-site.

E19.3.3 EXCAVATING

Site preparation
As found site conditions: To Geotechnical in the Earthwork worksection.
Records of measurement: If Records of measurement are required, to Records of measurement in the Earthwork worksection.

Remove topsoil: To Removal of topsoil in the Earthwork worksection.

Excavation
General: Excavate for underground services in conformance with the following:
- To required lines and levels, with uniform grades,
- Straight between access chambers, inspection points and junctions.
- With stable sides.
- To a width tolerance of ± 50 mm unless constrained by adjacent structures.
- Excavation: To the Earthwork worksection Excavation and Adjacent structures.

Trench widths
General: Keep trench widths to the minimum consistent with the laying and bedding of the relevant service and construction of access chambers and pits.

Trench depths
General: As required by the relevant service and its bedding method.
Adjacent to footings: If excavation is necessary below the zone of influence of the underside of adjacent footings, give notice, and provide support for the footings as instructed.

Obstructions
General: Clear trenches of sharp projections. Cut back roots encountered in trenches to at least 600 mm clear of services. Remove other obstructions including stumps and boulders which may interfere with services or bedding.

Tree protection: To AS 4970.

Dewatering
General: Keep trenches free of water. Place bedding material, services and backfilling on firm ground free of surface water.

Pumping: Provide pump-out from adjacent sumps or install well points.

Adjacent subsidence: Provide recharge points to isolate the dewatering zone.

Excess excavation
General: If trench excavation exceeds the correct depth, reinstate to the correct depth and bearing value using compacted bedding material or sand stabilised with 1 part of cement to 20 parts of sand by volume.

Stockpiles
Excavated material for backfill: If required, segregate the earth and rock material and stockpile, for re-use in backfilling operations.

Locations: Do not stockpile excavated material against tree trunks, buildings, fences or obstruct the free flow of water along gutters where stockpiling is permitted along the line of the trench excavation.

Disposal: If stockpiling is not permitted, dispose of excavated material off-site.

Unsuitable material
Disposal: Remove unsuitable material from the bottom of the trench or at foundation level and dispose of off-site. Replace with backfill material to Backfill material.

Boring
Subcontractor: If under road boring is required in lieu of trenches, engage a suitably qualified subcontractor to do the work.

E19.3.4 TRENCH BACKFILL

General
Timing: Backfill service trenches as soon as possible after laying and bedding the service, if possible on the same working day.

Marking services: Underground marking tape to AS/NZS 2648.1.

Place fill: To Placing fill in the Earthwork worksection.

Bedding, haunch, side and overlay zones
Installation and material: To the particular utility authority or utility service requirements. Secure pipes against floatation.
Overlay zone thickness: Maximum of 300 mm immediately over the utility service.

Topsoil areas: Complete the backfilling with at least 100 mm of topsoil. Material in reactive clay areas: In sites classified M, M-D, H1, H1-D, H2, H2-D, E or E-D to AS 2870, re-use excavated site material at a moisture content within ± 1% of that of the adjoining in situ clay.

**Selected material zone**

Extent: The section of trench within the zone, if applicable.

Backfill material: Selected material free from stones larger than 100 mm maximum dimension and the fraction passing a 19 mm Australian Standard sieve to have a 4 day soaked CBR value, in conformance with AS 1289.6.1.2, and not less than that of the adjacent selected material zone.

**Trees**

General: Backfill at trees, for a minimum 300 mm thickness, around tree roots with a topsoil mixture, placed and compacted in layers of 150 mm minimum depth to a dry density equal to that of the surrounding soil.

Backfill level: Do not place backfill material above the original ground surface around tree trunks or over the root zone.

Watering: Thoroughly water immediately after backfilling the tree root zone.

**Compaction**

Control moisture within backfill: To Fill moisture control in the Earthwork worksection.

Layers: Compact all material in layers not exceeding 150 mm compacted thickness. Compact each layer to the relative compaction specified before the next layer is commenced.

Compaction: To Compaction requirements for fill and subgrade in the Earthwork worksection and AS 3798 Section 5.

Frequency of testing: To AS 3798 clause 8.7.

Precautions: If compacting adjacent to utility services, use compaction methods which do not cause damage or misalignment.

**Density tests**

Testing authority: Have density tests of pipe bedding and backfilling carried out by a Registered testing authority.

Test methods:

- Compaction control tests: To AS 1289.5.4.1 or AS 1289.5.7.1.
- Field dry density: AS 1289.5.3.2 or AS 1289.5.3.5.
- Standard maximum dry density: AS 1289.5.1.1.
- Dry density ratio: AS 1289.5.4.1.
- Density index: AS 1289.5.6.1.

**E19.3.5 SURFACE RESTORATION**

**Subbase and base**

Material: Provide crushed rock, DGS20 or DGB20 material and configure in layers and depths to match existing and adjacent work.

Supply and installation: To the Pavement base and subbase worksection.

Compaction: Uniformly compact each layer of the subbase and base courses over the full area and depth within the trench to a relative compaction of 100 per cent when tested in conformance with AS 1289.5.4.1.

Tests: Test for compaction at a minimum frequency of 1/ every second layer/50 m² of restoration surface area.

**Pathways and paved areas generally**

Materials: Provide material consistent with the surface existing before commencement of the works. Unless shown otherwise on the drawings, pathways and paved areas shall be constructed on subbase: 150 mm crushed stone DGB20 compacted to 100 percent relative compaction in conformance with AS 1289.5.4.1.

Lippage at patches: Match the surface level at any point along the patch's edge with the adjoining footpath surface within ± 5 mm.
Concrete surfaces
Construction: Conform to the following:
- Prime coat the cut edges of the existing surfaces with cement slurry. Lay and compact concrete so that the edges are flush and the centre is cambered 10 mm above the adjoining existing surfaces.
- Material: 25 Mpa concrete
- Surface finish and pattern: Match existing adjoining work.
- Minimum thickness: 75 mm or the adjacent pavement thickness, whichever is thicker.
- Reinforcement and dowels: If required, provide steel reinforcement with dowels into the adjacent concrete.
- Expansion joints: 15 mm thick preformed jointing material of bituminous fibreboard placed where new concrete abuts existing concrete and in line with joints in existing concrete.
- Control joints:
  . Form control joints strictly in line with the control joints in existing concrete.
  . Around electricity supply poles: Terminate the concrete paving 200 mm from the pole and fill the resulting space with cold mix asphalt.
Curing: Cure by keeping continuously wet for 7 days.
Landscaped areas
In topsoil areas: Complete the backfilling with topsoil for at least the top 100 mm.
Lawn: Re-lay stockpiled turf. If existing turf is no longer viable, re-sow the lawn over the trench and other disturbed areas.
Planted areas: Overfill to allow for settlement.
E20 FENCES AND BARRIERS

E20.1 GENERAL

E20.1.1 RESPONSIBILITIES
General
General: Provide fences and barrier systems:
- Complete for their function.
- Conforming to the detail and location drawings.
- Firmly fixed in position.

E20.1.2 CROSS REFERENCES
General
Requirement: Conform to the following:
- General requirements.

Notice
Inspection: Give notice so inspection may be made of the following:
- Boundary survey location if applicable.
- Setout before construction.
- Foundation conditions before placing concrete in footings.

E20.2 PRODUCTS

E20.2.1 STEEL
Steel tubes
Posts, rails, stays and pickets: To AS/NZS 1163.
- Grade: C 350 L0.

Wire
Cable wire, tie wire and barbed wire: To AS 2423.
Coating: Powdercoat

E20.2.2 CONCRETE
General
Standard: To AS 1379.
Exposure classification: To AS 3600 Table 4.3.

E20.3 EXECUTION

E20.3.1 CONSTRUCTION GENERALLY
Set out
General: Set out the fence line and mark the positions of posts, gates and bracing panels.
Property boundaries: Confirm by survey.

Clearing
Fence line: Except trees or shrubs to be retained, clear vegetation within 1 metre of the fence alignment. Grub out the stumps and roots of removed trees or shrubs and trim the grass to ground level, but do not remove the topsoil.

Excavation
Posts: Excavate post holes so that they have vertical sides and a firm base. Spread surplus material on the principal's side of the fence.

Erection
Line and level: Erect posts vertically. Set heights to follow the contours of natural ground.
Concrete footings
In ground: Place mass concrete around posts to protect posts from waterlogged conditions and finish with a weathered top falling 25 mm from the post to ground level.
On slabs: Provide welded and drilled post base flanges for fixing with masonry anchors to the concrete.

E20.3.2 GATES
Hardware
Provide the following:
- Drop bolt and ferrule to each leaf of double gates.
- Latch to one leaf of double gates.
- Provision for locking by padlock.
- Hinges to ensure smooth operation and adjustment for future sagging.

Hand access
General: Where required, provide hand holes to give access from outside to reach locking provision.
Standard: To AS 1725.1.

E20.3.3 WELDED MESH FENCING
Fence dimensions
Maximum post spacing: 2440 mm.

Component sizes
End, corner and intermediate posts: 42.4 mm diameter, 2.6 mm wall thickness.
Gate posts (personnel): 60.3 mm diameter, 2.9 mm wall thickness.
Gate posts (vehicle): 88.9 mm diameter, 3.2 mm wall thickness.
Panel wire:
- Horizontal: 4.95 mm diameter at 75 mm centres.
- Vertical: 4.95 mm diameter at 50 mm centres.

Installation
General: Fit tightly fittings caps to steel posts. Attach panels to posts with fixing clips and M8 x 75 mm hexagon head bolts before concreting footing.

Footing type: Concrete.

Gates
Frame tubes: 33.7 mm diameter, 2 mm wall thickness.
Wire: Match fence.

E20.3.4 TEMPORARY FENCING
Fence dimensions
Height: 1200 mm.
Maximum post spacing: 5000 mm.

Component sizes
Corner and gate posts: Hardwood or preservative-treated softwood, 250 mm diameter.
Intermediate posts: Star picket.
Gate: Provide a suitable hinged gate with a gate latch.

Wire: Top, intermediate and bottom rows of 3.2 mm plain galvanized steel wire. Thread the top wire through pieces of plastic tube and through corner posts.

Removal
Completion: Remove the fence at the end of the planting establishment period.
E20.4 SELECTIONS

E20.4.1 FENCES

Design and install various types of fencing throughout the site. The fencing shall be designed and installed in accordance with TfNSW Standards SPC 511 “Boundary Fences Version 1.1” issued December 2009 and ESC 510 “Boundary Fences Version 2.1” issued in December 2009 and TMC 511.

Approved Manufacturers: Leda Security or Bluedog Fences.

Carpark fencing (SF01)
Location: As shown on drawings to define the boundary of the commuter car park and road areas in the vicinity of the Station.
Type: Steel palisade security fence with ‘W’ profile palings with triple-point spear top.
Height: 2400mm
Installation: Install in accordance with the recommendations of the designer/manufacturer, including tamper resistant, security type fasteners.
Finish: Powdercoated
Colour: Black

Rail Corridor fencing (SF02)
Location: As shown on drawings to define the Operational Rail Corridor and Station Platform.
Type: Enhanced Urban Fence tubular steel fencing constructed from square sections of 2.5mm wall thickness, with crimped spear pointed top.
Height: 2400mm
Installation: Install in accordance with the recommendations of the designer/manufacturer, including tamper resistant, security type fasteners.
Finish: Powdercoated
Colour: Black
Gates: Provide lockable gates as shown on drawings and as required by TfNSW.

Garbage bin area (SF02)
Similar to Rail Corridor Fence.
Provide one lockable gate as shown.

Fences at Platform ends (SF03)
Supply and install proprietary Loop Style fencing to end of platforms.
Standard: AS 1725
Manufacturer: ARC
Design: To TfNSW standards
Height: 1200mm.
Material: Steel
Finish: Powdercoated
Colour: Refer to Schedule of Materials and Finishes
Gates: Supply and install gates to the fence at the end of each platform. The gates shall match the fence in design and height and shall be fitted with hinges, locks and all necessary hardware.
E21 LANDSCAPE – GARDENING

E21.1 GENERAL

E21.1.1 RESPONSIBILITIES

General
General: Provide plants that have been grown to a standard that allows them to establish rapidly and grow to maturity.
Maintenance: Encourage and maintain healthy growth for the duration of the contract.
Program: Provide a suitable irrigation, pruning, fertiliser and monitoring program for all plant materials held by the supplier. Take any other precautions required to safeguard the health and well-being of all plant materials before and including their delivery to site.
Selections: Conform to the SELECTIONS.

E21.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.

E21.1.3 STANDARDS

Soils
Site and imported topsoil: To AS 4419.
Potting mixes: To AS 3743.
Composts, soil conditioners and mulches: To AS 4454.

E21.1.4 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions given below apply.
Imported topsoil: Similar to naturally occurring local topsoil, suitable for the establishment and ongoing viability of the selected vegetation, free of weed propagules and of contaminants, and classified by texture to AS 4419 Appendix 1, as follows:
- Fine: Clay loam, fine sandy loam, sandy clay loam, silty loam, loam.
- Medium: Sandy loam, fine sandy loam.
- Coarse: Sand, loamy sand.
Site topsoil: Soil excavated from the site which contains organic matter, supports plant life, conforms generally to the fine to medium texture classification to AS 4419 (loam, silt, clay loam) and is free from:
- Stones > 25 mm diameter.
- Clay lumps > 75 mm diameter.
- Weeds and tree roots.
- Sticks and rubbish.
- Material toxic to plants.
E21.1.5 INSPECTION

Notice – on site
Inspection: Give notice so inspection may be made of the following:
- Setting out completed.
- Subgrades cultivated or prepared for placing topsoil.
- Topsoil spread before planting.
- Plant holes excavated and prepared for planting.
- Plant material set out before planting.
- Planting, staking and tying completed.
- Completion of planting establishment work.

Hold points:
- Practical completion
- Completion of planting establishment work.
- End of maintenance period

E21.1.6 SUBMISSIONS

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

Suppliers
Statements: Submit statements from suppliers, giving the following, where applicable:
- Particulars of the supplier’s experience in the required type of work.
- Production capacity for material of the required type and quantity.
- Lead times for delivery of the material to the site.

Materials
Supplier’s data: Submit supplier’s data including the following:
- Material source of supply for topsoil, filling, stone and filter fabrics.
Compost: Submit a certificate of proof of compost pH value.

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

Accreditation
Proof: Submit evidence of accreditation as follows:
Accreditation body: NSW Nurseriesmen’s Industry Association.

Log book
Records: Log the following on a weekly basis:
• Description, time and method of application of toxic material.
• Maintenance work details.
• Inclement weather to verify inability to carry out work within the specified time frame.
Availability: Upon request.

Replacement plants
Species: Provide written certification that all plant material is true to the required species and type.

E21.2 PRODUCTS
E21.2.1 TOPSOIL

Source
General: Import topsoil to Table 3 Imported/Site Topsoil Schedule and AS 4419 unless the topsoil type can be provided from material recovered from the site.

Imported topsoil
Particle size: Provide soil to the Particle size table for the textures nominated in SELECTIONS.

Table 1  Topsoil particle size table (% passing by mass)

<table>
<thead>
<tr>
<th>AS sieve aperture to AS 1152</th>
<th>Soil textures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fine</td>
</tr>
<tr>
<td>2.36</td>
<td>100</td>
</tr>
<tr>
<td>1.18</td>
<td>90 - 100</td>
</tr>
<tr>
<td>0.60</td>
<td>75 - 100</td>
</tr>
<tr>
<td>0.30</td>
<td>57 - 90</td>
</tr>
<tr>
<td>0.15</td>
<td>45 - 70</td>
</tr>
<tr>
<td>0.075</td>
<td>35 - 55</td>
</tr>
<tr>
<td>0.002</td>
<td>2 - 15</td>
</tr>
</tbody>
</table>

Nutrient levels: Provide soil to the Topsoil nutrient level table.

Table 2  Topsoil nutrient level table

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Unit</th>
<th>Sufficiency range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrate-N (NO₃)</td>
<td>mg/kg</td>
<td>&gt; 25</td>
</tr>
<tr>
<td>Phosphate-P (PO₄) - P tolerant</td>
<td>mg/kg</td>
<td>43 - 63</td>
</tr>
<tr>
<td>Phosphate-P (PO₄) - P sensitive</td>
<td>mg/kg</td>
<td>&lt; 28</td>
</tr>
<tr>
<td>Phosphate-P (PO₄) - P very sensitive</td>
<td>mg/kg</td>
<td>&lt; 6</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>mg/kg</td>
<td>178 - 388</td>
</tr>
</tbody>
</table>
### Sulphate-S (SO₄²⁻) mg/kg
39 - 68

### Calcium (Ca) mg/kg
1200 - 2400

### Magnesium (Mg) mg/kg
134 - 289

### Iron (Fe) mg/kg
279 - 552

### Manganese (Mn) mg/kg
18 - 44

### Zinc (Zn) mg/kg
2.6 - 5.1

### Copper (Cu) mg/kg
4.5 - 6.3

### Boron (B) mg/kg
1.4 - 2.7

### Method References
- pH in H₂O (1:5), pH in CaCl₂ (1:5) and Electrical Conductivity (EC) by Rayment & Higginson (1992) method 4A2, 4B2, 3A1
- Soluble Nitrate-N by APHA 4500
- Soluble Chloride by Rayment & Higginson (1992) modified method 5A2
- Extractable P by Mehlich 3 – ICP
- Exchangeable cations – Ca, Mg, K, Na by Mehlich 3 – ICP
- Extractable S by Mehlich 3 – ICP
- Extractable trace elements (Fe, Mn, Zn, Cu, B) by Mehlich 3 – ICP

### Site topsoil

**General:** Import topsoil to Table 3 Imported/Site Topsoil Schedule and AS 4419, unless the topsoil type can be provided from material recovered from the site. Material recovered from site is to be treated to meet the requirements of the Table 3 Imported/Site Topsoil Schedule and AS 4419.

- Soil blend: Stripped topsoil with ameliorants noted in Table 3 Imported/Site Topsoil Schedule and AS 4419 to AS 4419 clause 4.6.

### Table 3 Imported/Site Topsoil Schedule

<table>
<thead>
<tr>
<th>Location</th>
<th>Type</th>
<th>Composition</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planting Onslab or constructed</td>
<td>Imported topsoil</td>
<td>45% coarse sand</td>
<td>300mm</td>
</tr>
<tr>
<td>or constructed planters</td>
<td></td>
<td>15% blacksoil</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10% mushroom compost</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10% horticultural graded pine bark</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20% screened ash</td>
<td></td>
</tr>
<tr>
<td>Or site topsoil</td>
<td>Site topsoil blended</td>
<td></td>
<td>Below planting soil and</td>
</tr>
<tr>
<td>or Subsoil</td>
<td>with organic admixture</td>
<td></td>
<td>turf topsoil at varied</td>
</tr>
<tr>
<td></td>
<td>as determined by</td>
<td></td>
<td>depths</td>
</tr>
<tr>
<td></td>
<td>testing results.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Below planting soil and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>turf topsoil at various</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>depths</td>
</tr>
</tbody>
</table>
E21.2.2 FERTILISER

Fertiliser
General: Provide proprietary fertilisers, delivered to the site in sealed bags marked to show manufacturer or vendor, weight, fertiliser type, N:P:K ratio, recommended uses and application rates.

Fertiliser schedule

<table>
<thead>
<tr>
<th>Fertiliser key</th>
<th>Location</th>
<th>N:P:K ratio</th>
<th>Application rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriform slow release planting tablets. Refer CV0420811 - Rev 2</td>
<td>All garden bed and tree planting areas</td>
<td>Follow manufacturers specification for N:P:K ratios</td>
<td>Follow manufacturers specification for application rates</td>
</tr>
</tbody>
</table>

E21.2.3 PLANTS

Labelling
General: Clearly label individual plants and batches.
Label type: To withstand transit without erasure or misplacement.
Label frequency: Every 3rd plant

Health and vigour
Health: Supply plants with foliage size, texture and colour at time of delivery consistent with the size, texture and colour shown in healthy specimens of the nominated species.
Vigour: Supply plants with extension growth consistent with that exhibited in vigorous specimens of the species nominated.
Damage: Supply plants free from damage and from restricted habit due to growth in nursery rows.
Stress: Supply plants free from stress resulting from inadequate watering, excessive shade or excessive sunlight experienced at any time during their development.
Site environment: Supply plants that have been grown and hardened off to suit the conditions that could reasonably be anticipated to exist on site at the time of delivery.

Root development
Containers: Grow plants in their final containers for the following periods:
- Plants < 25 l size: > 6 weeks.
- Plants > 25 l size: > 12 weeks.

Freedom from pests and disease
Pests and disease: Supply plants with foliage free from attack by pests or disease.
Native species with a history of attack by native pests: Restrict plant supply to those with evidence of previous attack to < 15% of the foliage and ensure absence of actively feeding insects.

Root system
Requirement: Supply plant material with the root system:
- Well proportioned in relation to the size of the plant material.
- Conductive to successful transplantation.
- Free of any indication of having been restricted or damaged.
Root inspection by the removal of soil test as follows:
- For > 100 samples: Inspect 1%.
- For <100 samples: Inspect 1 sample.
  Sample plants: Replace.

Defective samples: Reject the entire line represented by the defective sample.
  Rejection: Root bound stock.

**E21.3 EXECUTION**

**E21.3.1 PREPARATION**

**Weed eradication**

Herbicide: Eradicate weeds using environmentally acceptable methods, such as a non-residual glyphosate herbicide in any of its registered formulae, at the recommended maximum rate.

Manual weeding: Regularly remove, by hand, rubbish and weed growth throughout grassed, planted and mulched areas. Remove weed growth from an area 750 mm diameter around the base of the trees in grassed areas. Continue eradication throughout the course of the works and during the planting establishment period.

**Vegetative spoil**

Remove vegetative spoil from site. Do not burn.

**E21.3.2 SUBSOIL**

**Ripping**

General: Rip parallel to the final contours wherever possible. Do not rip when the subsoil is wet or plastic. Do not rip within the dripline of trees and shrubs to be retained.

Ripping depths: Rip the subsoil to the following typical depths:
- Compacted subsoil: 300 mm.
- Heavily compacted clay subsoil: 450 mm.

**Planting beds**

Excavated: Excavate to bring the subsoil to at least 300 mm below finished design levels. Shape the subsoil to fall to subsoil drains where applicable. Break up the subsoil to a further depth of 100 mm.

Unexcavated: Remove weeds, roots, builder's rubbish and other debris. Bring the planting bed to 75 mm below finished design levels.

**Cultivation**

Minimum depth: 100 mm.

Cultivation depths (mm): 150mm

Planting areas: 150mm

Services and roots: Do not disturb services or tree roots; if necessary cultivate these areas by hand.

Cultivation: Thoroughly mix in materials required to be incorporated into the subsoil. Cultivate manually within 300 mm of paths or structures. Remove stones exceeding 25 mm, clods of earth exceeding 50 mm, and weeds, rubbish or other deleterious material brought to the surface during cultivation. Trim the surface to design levels after cultivation.

**Additives**

General: Test the subsoil by chemical and physical analysis to determine appropriate remediation methods. Apply additives after ripping or cultivation and incorporate into the upper 100 mm layer of the subsoil ensure sub soil additives comply with the advice provided in test results.

Gypsum: Incorporate at the rate of 0.25 kg/m².
Herbicide: Prior to spreading topsoil apply a herbicide treatment as follows:

- **Description**: Knock Down Herbicide
- **Attributes**: Knock-down herbicide shall be a broad spectrum, non residual, glyphosate based herbicide that has been specifically manufactured for low aquatic toxicity.

**Placing topsoil**

Site topsoil: Do not incorporate site topsoil into the works until soil testing certification and remediation works have been approved. Remove unauthorised material from the site.

General: Spread the topsoil on the prepared subsoil and grade evenly, making the necessary allowances to permit the following:

- **Spreading**: On steep batters, if using a chain drag, ensure there is no danger of batter disturbance.
- **Finishing**: Feather edges into adjoining undisturbed ground.

**Consolidation**

General: Compact lightly and uniformly in 150 mm layers. Avoid differential subsidence and excess compaction and produce a finished topsoil surface which has the following characteristics:

- Finished to design levels.
- Smooth and free from stones or lumps of soil.
- Graded to drain freely, without pending, to catchment points.
- Graded evenly into adjoining ground surfaces.
- Ready for planting.

**Topsoil depths**

General: Spread topsoil to the following typical depths:

- Excavated planting areas: 300 mm.

**Surplus topsoil**

General: Dispose off site.

**E21.3.3 PLANTING**

**Individual plantings in grassed areas**

Method: Excavate a hole to twice the diameter of the root ball and at least 100 mm deeper than the root ball. Break up the base of the hole to a further depth of 100 mm, and loosen compacted sides of the hole to prevent confinement of root growth.

**Locations**

General: If it appears necessary to vary plant locations and spacings to avoid service lines, or to cover the area uniformly, or for other reasons, give notice.

**Planting conditions**

Weather: Do not plant in unsuitable weather conditions such as extreme heat, cold, wind or rain. In other than sandy soils, suspend excavation when the soil is wet, or during frost periods.

**Watering**

Timing: Thoroughly water the plants before planting, immediately after planting, and as required to maintain growth rates free of stress.
Placing
Method: Remove the plant from the container with minimum disturbance to the root ball, ensure that the root ball is moist and place it in its final position, in the centre of the hole and plumb, and with the top soil level of the plant root ball level with the finished surface of the surrounding soil.

Fertilising – plants
Pellets: In planting beds and individual plantings, place fertiliser pellets around the plants at the time of planting.
Product: 'Agriform' Slow release fertilizer or approved equivalent
Application Rate: Follow manufacturers specification for N:P:K ratios and application rates.

Backfilling
General: Backfill with topsoil mixture. Lightly tamp and water to eliminate air pockets. Ensure that topsoil is not placed over the top of the root ball, so that the plant stem remains the same height above ground as it was in the container.

Watering basins for plants in grass
Method: Except in irrigated grassed areas and normally moist areas, construct a watering basin around the base of each individual plant, consisting of a raised ring of soil capable of holding at least 10 L.

E21.3.4 MULCHING

Placing mulch
General: Place mulch to the required depth, clear of plant stems, and rake to an even surface flush with the surrounding finished levels. Spread and roll mulch so that after settling, or after rolling, it is smooth and evenly graded between design surface levels sloped towards the base of plant stems in plantation beds, and not closer to the stem than 50 mm in the case of gravel mulches.
In mass planted areas: Place after the preparation of the planting bed but before planting and other work.
In smaller areas (e.g. planter boxes): Place after the preparation of the planting bed, planting and other work.
Extent: To surrounds of plants planted in riplines and grass areas, provide mulch to 750 mm diameter.
Depth: Spread organic mulch to a depth of 75 mm, and gravel mulch to a depth of 50 mm.

Table 4 Mulching Schedule

<table>
<thead>
<tr>
<th>Location</th>
<th>Mulch type</th>
<th>Depth</th>
<th>Stabilisation method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garden Beds and Tree Planting</td>
<td>Hardwood chips or other chunky wood material with no more than 5% fines by volume 30 mm x 20 mm x 5 mm and the maximum length of chip is not to exceed 50 mm. It must be free of soil, weeds, stones, vermin, insects or other foreign material.</td>
<td>100m m</td>
<td>Mesh for slopes greater than 1:3</td>
</tr>
</tbody>
</table>

E21.3.5 SPRAYING

Notice
General: Immediately give notice of evidence of insect attack or disease amongst plant material.

Spraying
Product: Where required, spray with insecticide, fungicide or both.
E21.3.6 STAKES AND TIES

Stakes
Material: Hardwood, straight, free from knots or twists, pointed at one end.
Installation: Drive stakes into the ground at least one third of their length, avoiding damage to the root system.
Stake sizes:
- For plants ≥ 2.5 m high: Three 50 x 50 x 2400 mm stakes per plant.
- For plants 1 – 2.5 m high: Two 50 x 50 x 1800 mm stakes per plant.
- For plants < 1 m high: One 38 x 38 x 1200 mm stake per plant.

Ties
General: Provide ties fixed securely to the stakes, one tie at half the height of the main stem, others as necessary to stabilise the plant.
Tie types:
- For plants ≥ 2.5 m high: Two strands of 2.5 mm galvanized wire neatly twisted together, passed through reinforced rubber or plastic hose, and installed around stake and stem in a figure of eight pattern.
- For plants < 2.5 m high: 50 mm hessian webbing stapled to the stake.

Trunk protection
Collar guards: 200 mm length of 100 mm diameter agricultural pipe split lengthways.

E21.3.7 COMPLETION

Product certification
Certification: Submit the supplier’s written statement certifying that plants are true to the required species and type, and are free from diseases, pests and weeds.

Cleaning
Stakes and ties: Remove those no longer required at the end of the planting establishment period.
Temporary fences: Remove temporary protective fences at the end of the planting establishment period.

Warranty
Parties: Supplier(s) to the principal.
Form: All the plants supplied under these works are true-to-species and type, and free of disease, fungal infection and/or any other impediment to their future growth and that they have been fully acclimatised for the conditions of the site.
Submission of warranty: At the time of each delivery.

E21.4 ESTABLISHMENT

E21.4.1 GENERAL

Responsibilities
Plant establishment: Maintain the contract area during the plant establishment period.
Plant establishment period: 12 Weeks after the date of practical completion and before the date of final completion.
Reporting
Monthly report: Submit regular reports by the last Friday of each month:
- Of the general status of works.
- Include soil test results as required for the fertilising programs.
- Plant replacement requirements.
Incident reports: Report immediately verbally and confirmed in writing any disturbance or incidence affecting or likely to affect the day to day scheduling of works.

Disruption of works by others
Other contractors: Make arrangements to work around the disturbance.

E21.4.2 PLANTING WORKS

Planting
Planting: Ensure the general appearance and presentation of the landscape and the quality of plant material at date of practical completion is maintained for the full planting establishment period.
Existing plant material: Maintain existing planting and grass within the landscape contract area as specified for the corresponding classifications of new grassland or planting.
Replacements: Replace failed, dead and/or damaged plants at minimum 3 week intervals as necessary throughout the full plant establishment period.

Pruning
General: Prune to the industry standards.
Pruning: To conform to AS 4373.

Fertilising
Soil tests: Take samples from both planting beds and lawn areas and conduct tests.
Fertilising: Base the fertilisation program on the soil testing results. Fertilise trees once every two years except where specific problems exist. Generally apply an all purpose fertiliser of N:P:K 10:4:6 at recommended rates. Alternatively apply 12 month slow release fertiliser (such as Nutricote) at the manufacturer’s recommended rate. Apply all purpose fertiliser to shrubs annually in two bands and cultivated into the soil 100 mm deep.
Slow release fertiliser: Such as Nutricote.
Season: Fertilise shrubs and trees in September and March according to their seasonal growth requirement.

Insect and disease control
Responsibility for insect and disease control: Contractor
Period for treatment: Until the problem has been eliminated.
Chemical spray: Apply outside of normal working hours.

Stakes and ties
Generally: If plants are unable to be self supported or if stakes are damaged, stake or restake the plants as follows:
- Drive three hardwood stakes placed obliquely with the first stake on the opposite side to the prevailing winds.
- Do not single stake large plants.
Removal: If plants are robust with well developed systems and are strong enough to no longer require support, remove stakes and ties.
Weeding
Weeds: Unwanted plants and grasses considered invasive to the locality.
Program:
- Trees and shrubs: As required for planted, paved and mulched areas to be weed free when observed at bi-weekly intervals.
Method: Clear and keep clear vigorous ground covers 200 mm from the base of any shrub or tree:
- Small areas: By hand.
- Large areas: Proprietary herbicides.
Herbicide application: Avoid windy days or if rain is likely to follow within 12 hours and apply:
  - To the manufacturer's instructions and material data and safety sheets.
  - When the weather is humid with moderate temperatures and maximum sunlight.
  - When the ground has the recommended soil moisture level.

Rubbish removal
Rubbish: Remove loose rubbish such as bottles, papers, and cigarette butts from the site. Execute this work regularly so that all areas are free from rubbish when observed at bi-weekly intervals.
Leaf litter: Remove from all path and lawn areas.
Leaf litter distribution: Evenly distribute over the mown areas, or removed from the mown areas and spread evenly over the planted and mulched areas or removed from site as directed.

Mulched surfaces
Inspection: Bi-weekly to determine mulch requirements.
Mulch depth: Maintain 75 mm cover and ensure weed suppression and the quality of finish.
Re mulching: Maintain the original ground levels around the base of plants.

E21.4.3 WATERING

Establishment
Extent: All irrigated and non-irrigated plantings, lawn areas and street trees.
Water quality:
  - pH between 5.5 and 7.5.
  - Total soluble salts less than 1000 mg/litre.
  - No substances that would be toxic to plant growth.
Watering program: Minimum three complete waterings soaking to a depth of 150 mm at fortnightly intervals for the first 6 weeks of plant establishment irrespective of natural rainfall.
Water restrictions: Coordinate the water supply and confirm the watering regime against federal, state and territory government legislation and restrictions at the time.

Irrigation

Hand watering
General: Manually water all lawn and planting areas in the absence of an irrigation system or until the proposed irrigation system is fully operational, soaking to a depth of 150 mm for lawn and 300 mm for planting. Avoid frequent dampening of the surface. Allow the surface of the soil to partially dry out between waterings.
E21.4.4 COMPLIANCE

Criteria
Generally: Plant establishment shall be deemed complete, subject to the following:
- Repairs to planting media completed.
- Ground surfaces are covered with the specified treatment to the specified depths.
- Pests, disease, or nutrient deficiencies or toxicities are not evident.
- Organic and rock mulched surfaces have been maintained in a weed free and tidy condition and to the specified depth.
- Vegetation is established and well formed.
- Vegetation cover to cell, seeded and/or hydromulched areas to the Plant establishment compliance schedule.
- Plants have healthy root systems that have penetrated into the surrounding, undisturbed ground and not able to be lifted out of its planting hole.
- Vegetation is not restricting essential sight lines and signage.
- Only frangible species are growing within road side clear zones.
- Specified vegetation setbacks from services and road furniture are evident.
- All hard landscape works have been installed and are operating as specified.
- Collection and removal of litter.
- Removal of mulch from drainage and access areas.
- All non-conformance reports and defects notifications have been closed out.

Table 5 Plant Establishment compliance table

<table>
<thead>
<tr>
<th>Plant material</th>
<th>Acceptable failure per area</th>
<th>Acceptable concentration of failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube stock</td>
<td>&lt; 10%</td>
<td>&lt; 15% in any given location</td>
</tr>
<tr>
<td>140 mm</td>
<td>&lt; 5%</td>
<td>&lt; 15% in any given location</td>
</tr>
<tr>
<td>300 mm or larger</td>
<td>&lt; Nill%</td>
<td>Nill %</td>
</tr>
<tr>
<td>Cells</td>
<td>&lt; 5%</td>
<td>&lt; 15% in any given location</td>
</tr>
</tbody>
</table>
E22 LANDSCAPE – MAINTENANCE

E22.1 GENERAL
E22.1.1 RESPONSIBILITIES

General
Selections: Conform to Selections.
Landscape maintenance: Maintain the contract area during the landscape maintenance period.
Landscape maintenance period: 52 Weeks

Summary of responsibilities:
• Watering of lawn, garden bed areas, pots.
• Weeding of lawn, garden bed areas, and pavement.
• Supply and spreading of fertiliser to lawn, garden bed areas and pots.
• Supply and installation of mulch to existing garden bed areas and pots.
• Pruning, trimming and tree surgery.
• Pest and disease control of lawn, shrubs and trees.
• Replacement of dead or failed plants.
• Maintenance of irrigation systems.
• Removal of rubbish and debris in garden areas.
• Keeping of a log book.
• Monthly reports.

Maintenance procedures: To accepted horticultural and arboricultural practice.

E22.1.2 THE SITE

Record drawings
Availability: Obtain from superintendent

Site restrictions
Entry permits: Make available, to persons entering designated secure areas, valid entry permits. Ensure these persons comply with conditions of entry.
List: At least 10 working days before entry is required, submit the full name, address, and date and place of birth of persons required to enter designated secure areas.
Access: Access onto and within the site, use of the site for temporary works and constructional plant, including working and storage areas, location of offices, workshops, sheds, roads and parking, is restricted to the following areas: To be determined

Occupied premises
General: For the parts of the site designated as occupied premises in the Occupied premises schedule:
• Allow occupants to continue in secure possession and occupancy of the premises for the required period.
• Make available safe access for occupants.
• Arrange work to minimise nuisance to occupants and ensure their safety.
- Protect occupants against weather, dust, dirt, water or other nuisance, by such means as temporary screens.

Proposals: Submit details of proposed methods.

No smoking policy
Policy: No smoking onsite.

Protection of persons and property
Temporary works: Provide and maintain required barricades, guards, fencing, shoring, temporary roadways, footpaths, signs, lighting, watching and traffic flagging.
Accessways, services: Do not obstruct or damage roadways and footpaths, drains and watercourses and other existing services in use on or adjacent to the site. Determine the location of such services.
Property: Do not interfere with or damage property which is to remain on or adjacent to the site, including adjoining property encroaching onto the site, and trees.

Rectification
Accessways, services: Rectify immediately any obstruction or damage to roadways and footpaths, drains and watercourses and other existing services in use on or adjacent to the site. Provide temporary services whilst repairs are carried out.
Property: Rectify immediately any interference or damage to property which is to remain on or adjacent to the site, including adjoining property encroaching onto the site, and trees.

E22.1.3 GENERAL

Contract
Form of contract: AS 4921 together with AS 2127.
Parties to the contract: The contractor and the principal.
Renegotiation: At the expiry of the contract and after reassessment of the specification.

Payment
Retention: The contract amount, for payment during the maintenance period.
Payment period: e.g. End of each calendar month.
Bond: Equal to one months maintenance.
Expenditure of the bond: By the principal upon unsatisfactory maintenance, to employ others to carry out such work.

Contractor and staff
Affiliation: Suitable professional qualifications acceptable to the principal.
Representative: Nominate a senior partner/personal experienced in maintenance nursery practices and horticulture, to be responsible for taking and carrying out instruction, and reporting to the principal.

Special instructions
Priority: If instructed by the principal attend to certain areas and procedures as a priority. Obtain approval for additional costs prior to commencement of works.

Reporting
Monthly report: Submit regular reports by the last Friday of each month:
- Of the general status of works.
- Include soil test results as required for the fertilising programs.
- Plant replacement requirements.
Incident reports: Report immediately verbally and confirmed in writing any disturbance or incidence affecting or likely to affect the day to day scheduling of works.

**Notice**
Inspection: Provide two days notice of the following operations:
- Application of herbicide.
- Application of fertiliser.
- Watering.
- Each site maintenance visit.
- Public amenity: Give notice of any work affecting public access or amenity on the Thursday of the week before the work is planned.

**Log book**
Records: Log the following on a weekly basis:
- Description, time and method of application of toxic material.
- Maintenance work details.
- Inclement weather to verify inability to carry out work within the specified time frame.
Availability: Upon request.

**Disruption of works by others**
Other contractors: Make arrangements to work around the disturbance.

**Warranty**
Parties: Supplier(s) to the principal.
Form: All the plants supplied under these works are true-to-species and type, and free of disease, fungal infection and/or any other impediment to their future growth and that they have been fully acclimatised for the conditions of the site.
Submission of warranty: At the time of each delivery.

**Plant hire**
Existing arrangements: Take responsibility for the re-hiring, installation, care and maintenance of all internal plant material currently under existing plant hire contract for the duration of the maintenance contract.

**E22.2 EXECUTION**

**E22.2.1 GENERALLY**

**Weeding**
Weeds: Unwanted broadleaf plants and grasses considered invasive to the locality.
Program:
- Trees and shrubs: As required for planted, paved and mulched areas to be weed free when observed at bi-weekly intervals.
Method: Clear and keep clear vigorous ground covers 200 mm from the base of any shrub or tree:
- Small areas: By hand.
- Large areas: Proprietary herbicides.
Herbicide application: Avoid windy days or if rain is likely to follow within 12 hours.
Apply:
• To the manufacturer's instructions and material data and safety sheets.
• When the weather is humid with moderate temperatures and maximum sunlight.
• When the ground has adequate soil moisture.

**Pest and disease control**
The contractor is responsible for the control of any pest or disease which may affect the lawn and garden bed areas.

Actions:
• Identify the problem.
• Execute the correct treatment until the problem has been eliminated.
• Apply hazardous material out of normal working hours.
• Protect staff and public.

**E22.2.2 TREES AND SHRUBS**

**Pruning and trimming**
General: Prune to reflect the natural growth flowering and regrowth habit of the individual species.
Shrubs: Prune after flowering.
Program: Spring and Summer and on a spot basis as required.
Hedge trimming: Schedule trimming at times which will maintain the character and design of hedges. Allow up to three times per season.
Tip pruning: Do not remove buds before the flowering season in those plants that have terminal flowers.
• Purpose: To encourage development of new shoots during the active growing season.
• Method: The removal of the top 25 mm or growing tip of each branch.

**Radical pruning:**
• Purpose: To maintain a hedge or formal shape or when a particular problem, growth habit, damage, or disease requires branch removal.
• Clear and keep clear vigorous groundcovers 200 mm from the base of any shrub or tree.
• Use only tools fit for purpose.

Trees: Prune to:
• Eliminate diseased or damaged growth, avoid inter-branch contact and thin out crowns in a natural manner.
• Maintain sight lines to signs and lights.
• Maintain visibility for personal security.

Tree branch removal:
• To AS 4373.
• Give notice and engage a suitably qualified 'arborist'.

**Fertilising**
Fertilising program: Base the program on soil testing results.
Soil testing: Undertake soil tests as follows:
• At the commencement of the contract.
• Take samples from a cross section of planting beds.
Soil pH adjustment: Apply additional fertilisers and soil conditioners as indicated from soil testing or from the physical soil structure. Maintain a pH range of 5.5 – 6.5.

Shrubs:
- e.g. ‘Multigrow’ or ‘Shirley’s No. 17’. Alternative: Apply 12 month slow release fertiliser (such as Nutricote).
- Rate: To the manufacturer’s recommendation and cultivate two rows into the soil 100 mm deep.
- Regular application: Each September and March.
- Ensure the appropriate dosage for sensitive native species.

Trees:
Dose:
- 3 tablets/plant over 500 mm in height, or
- 2 tablets/plant over 300 mm in height, or
- 1 tablet/small plant and groundcover.

Application: Apply pill to the root zone at a distance from the trunk equal to the spread of the foliage. Make holes 400 mm deep to take the pill. Backfill with sand, equally spaced around the plant.

Micro nutrients: Apply 1 kg of urea in 20 litres of water per 100 m², through a hose proportioner every four weeks during Summer.

**Stakes and ties**
Generally: If plants are unable to be self supported or if stakes are damaged, stake or restake the plants as follows:
- Drive three hardwood stakes placed obliquely with the first stake on the opposite side to the prevailing winds.
- Do not single stake large plants.

If plants are robust with well developed systems and are strong enough to no longer require support, remove stakes and ties.

**Plant replacements**
General: Replace all evergreen plants that have died or lost 50% of their normal foliage cover.
Provide replacement plants as follows:
- Of the same species and variety and of the closest commercially available size.
- Of uniformly high quality stock equal to the best commercially available.
- Representative of optimum growth for the species as restricted by the container size.
- With a balanced root system in relation to the size of the plant and conducive to successful transpiration. Inspect the root conditions of plants by knocking plants from their containers.
- Without signs of having been stressed at any stage during their development due to inadequate watering, excessive shade/sunlight, suffered physical damage or have restricted habit due to growth in nursery rows.
- Healthy, well grown, hardened off specimens of good shape and free from pests and disease.
- Well rooted and without any indication of having been restricted (pot bound) or damaged at any time.
- Been grown in their final containers for not less than twelve (12) weeks.
E22.2.3 WATERING

Lawn and planted areas
Generally: Maintain a vigorous healthy appearance.
Application rates: Soak to a depth of 150 mm for lawn and 300 mm for planting. Avoid frequent dampening of the surface. Allow the surface of the soil to partially dry out between waterings. Confirm soaked depth and record in the log book.
Timing: Water at times of day to minimise water evaporation loss. Do not water during the hottest period of Summer days.
Public areas without installed watering systems: Water only in excessive dry periods. Make available all necessary equipment to carry out hand and sprinkler watering as required.
Water restrictions: Coordinate the water supply and confirm the watering regime against federal and state government legislation and restrictions at the time.

Hand watering
General: Manually water all planting areas in the absence of an irrigation system or until the proposed irrigation system is fully operational.

E22.2.4 MULCHING

General
Clean up: Remove all mulching materials off lawn or paved areas and maintain a clean and tidy appearance when viewed on a weekly basis.
Depth: Maintain a minimum depth of:
- 75 mm for organic mulch.
- 50 mm for gravel mulch.
Top up: Areas of excessive wear.

Pinebark
Existing material: Hardwood chips or other chunky wood material with no more than 5% fines by volume 30 mm x 20 mm x 5 mm and the maximum length of chip is not to exceed 50 mm. It must be free of soil, weeds, stones, vermin, insects or other foreign material.
Appearance: Maintain to keep clean and tidy with no soil disturbance evident on the surface of the mulch.

E22.2.5 INCIDENTAL WORKS

Undocumented work
Separate contracts: Rubbish removal

Supplementary works
General: Execute the following:
- Removal of rubbish arising from maintenance work.
- Removal of leaf litter fortnightly during leaf fall.
- Wash paving on completion of herbicide application.

Drains
General: Inspect and clean all drainage structures and pit covers and ensure that they are in proper working order.
Frequency: As required so that all overflow drains are cleared when observed at fortnightly intervals.
E22.3 SELECTIONS
E22.3.1 MAINTENANCE REPORT SCHEDULE

Monthy reports
Minimum requirements: Check list.

Table 6 Maintenance Report Schedule

<table>
<thead>
<tr>
<th>Item</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant material</td>
<td>Replace failed plants</td>
</tr>
<tr>
<td></td>
<td>Additional planting</td>
</tr>
<tr>
<td></td>
<td>Treat for disease or insect attack</td>
</tr>
<tr>
<td></td>
<td>Tree surgery</td>
</tr>
<tr>
<td></td>
<td>Fertilising generally</td>
</tr>
<tr>
<td></td>
<td>Fertilising for specific nutrient deficiencies</td>
</tr>
<tr>
<td></td>
<td>Thin out planting</td>
</tr>
<tr>
<td></td>
<td>Pruning/trimming</td>
</tr>
<tr>
<td>Soil</td>
<td>Erosion/bank stabilisation</td>
</tr>
<tr>
<td></td>
<td>Additional soil</td>
</tr>
<tr>
<td></td>
<td>Soil conditioner</td>
</tr>
<tr>
<td></td>
<td>Weeding</td>
</tr>
<tr>
<td>Mulch</td>
<td>Top up mulch</td>
</tr>
<tr>
<td>Rubbish removal</td>
<td>Generally remove bottles, paper, cigarette butts etc.</td>
</tr>
<tr>
<td></td>
<td>Remove leaf, litter from path and paved areas</td>
</tr>
</tbody>
</table>

E22.3.2 MAINTENANCE PROCEDURE SCHEDULE

Maintenance scope of works
Minimum attendance: Check list.

Table 7 Maintenance Scope of works

<table>
<thead>
<tr>
<th>WEEK</th>
<th>SPRING (Sept, Oct, Nov)</th>
<th>SUMMER (Dec, Jan, Feb)</th>
<th>AUTUMN (Mar, Apr, May)</th>
<th>WINTER (Jun, Jul, Aug)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>weed</td>
<td>Weed</td>
<td>Weed</td>
<td>Weed</td>
</tr>
<tr>
<td>2</td>
<td>Weed; trim and adjust trees and shrubs</td>
<td>Weed; trim and adjust trees and shrubs</td>
<td>Weed; trim and adjust trees and shrubs</td>
<td>Trim and adjust trees and shrubs</td>
</tr>
<tr>
<td></td>
<td>Landscape – maintenance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>treat plant material for insects and disease</td>
<td>weed; treat plant material for insects and disease</td>
<td>Weed</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Weed; issue maintenance report</td>
<td>Weed; issue maintenance report</td>
<td>Weed; issue maintenance report</td>
<td></td>
</tr>
</tbody>
</table>
| 5 | Fertilise all trees and shrubs in garden beds; | weed | weed;
| 6 | Weed; inspect mulch for deficiencies in cover; | Weed; inspect mulch for deficiencies in cover; treat for insects and disease; | weed;
| 7 | Reinstall mulch as required; treat plant material for insects and disease; | weed | Reinstall mulch as required; Weed |
| 8 | Weed; issue maintenance report | issue maintenance report | Weed; issue maintenance report |
| 9 | treat plant material for insects and disease | Weed | Weed |
| 10 | Weed; | Weed; treat plant material for insects and disease | Weed |
| 11 | trim and adjust trees and shrubs | weed | trim and adjust trees and shrubs; Prune back trees and shrubs after flowering |
| 12 | Weed; treat plant material for insects and disease | Weed | weed; treat plant material for insects and disease |
| 13 | issue maintenance report | weed; issue maintenance report | weed; issue maintenance report |
E23.1 GENERAL

E23.1.1 SCOPE OF WORKS

General
Work in this section shall include, without necessarily being limited to, the supply of all labour and materials for the installation of bored piles.

- "RTA QA Specification B59 Bored Cast-In-Place Reinforced Concrete Piles (Without Permanent Casing)".

E23.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Concrete in situ.
- Concrete formwork.
- Concrete finishes.
- Concrete reinforcement

E23.1.3 STANDARD

General
Standard: To AS 2159.

E23.1.4 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Setting out.
- Piles and piling material after delivery to site and before installation.
- Installation of piling.
- Pile heads after preparation.
- Pile load tests.

Concrete piles: Give notice so that inspection may be made of the following:
- Reinforcement cages after assembly and before installation.
- Excavated shafts, including casings and sockets before placing reinforcement.
- Reinforcement in excavated shafts, before concreting.
- Concreting of piles.

E23.1.5 TOLERANCES

General
Standard: For positional tolerances, cut-off levels, dimensional tolerances, straightness and inclination, conform to AS 2159 Section 7.2 and to the Tolerances schedule.

E23.1.6 SUBMISSIONS

Execution details
Subcontractor: Submit name and contact details for the proposed subcontractor specialising in foundation engineering.

Equipment: Submit details of proposed piling methods, equipment and sequence.

Jetting and pre-boring: If jetting or pre-boring methods are proposed in conjunction with pile driving, submit details of the proposed equipment and methods.
Concrete piles: Submit proposal for using high alumina and early strength cements.
Warranty: Submit details of the proposed warranty for the piling.
Submit: Record of data for piles showing information in AS 2159 clause 7.7.
Preservative treated timber piles: Submit treatment records.
 Tests
Load tests: Submit load test report.
Acid ortland soil test: Ascertain actual and potential acid ortland to AS 4482.1.
Site geotechnical investigations: Submit all findings including Cone penetration test (CPT), sampling analysis and water table information.
 Warranty
Some piling contractors offer standard forms of guarantee. If these are unsatisfactory it may be possible to negotiate better terms. But bear in mind that a guarantee is only as reliable as the firm that gives it. If the piling system is specified prescriptively, the contractor's warranty would be merely in terms of faulty materials and workmanship.
Rectification: Submit details of proposed warranty to correct faults and make good damage which is caused by the pile installation or subsequent movement to that part of the superstructure supported on the piling, or to adjacent property, or to both.

E23.2 PRODUCTS

E23.2.1 CONCRETE AND GROUT PILES

Standard
Concrete: To AS 2159, AS 3600 and AS 1379.
Grout: To AS 3600 and AS 3972.
Steel reinforcement: To AS/NZS 4671.

Durability
Restrictions on chemical content in concrete pile: To AS 3600 and AS 5100.5 for 100 year design.
Crack width: < 0.3 mm.

Tests
Moisture content: Testing for grout to ASTM C566-97 with expansion < 4%.

Minimum cement content
Generally: 320 kg/m³.

High alumina and high early strength cements
General: Do not use.

Reinforcement
Standard: To AS/NZS 4671.
Cover: Provide spacers on the reinforcement cage to maintain the correct cover. During installation of reinforcement in uncased holes keep the reinforcement cage clear of the sides of the hole.

E23.3 EXECUTION

E23.3.1 INSTALLATION

Adjoining property
Damage: If damage is caused to adjoining property, stop piling operations and give notice.
Setting out
Requirement: Peg the position of each pile and establish a grid of recovery pegs to enable the setting out to be checked. Provide survey record of in situ piles.

Inspection
General: Provide facilities necessary for inspection of piling including safe access, lighting and ventilation.
Monitor: Maintain pile integrity during driving. Stop and re-assess hammer type/size/drop if damage is detected.
Piling system
Installation: To AS 2159 Section 7.
Concrete bored piles:
- Loose material: Do not allow loose material to fall down pile holes before or during concreting.
- Liner: Pack well into position.

Pile capacity
Requirements: Conform to the Pile capacity schedule.

Overdriven piles
General: If the pile is driven below the specified level, give notice.

Records of data
Ground level: Record the level of the surrounding ground at the time when the pile is installed.
Records: During installation, keep records to conform to AS 2159 clause 7.7.

E23.3.2 TESTING

Load tests
Strength reduction factor: If the basic geotechnical strength reduction factor ≤ 0.4 no load testing is required unless documented for the confirmation of construction methods or integrity testing.
Failure: If a test pile fails to meet the load test requirements, give notice.

Concrete and grout
During installation: Sample and test concrete/grout to AS 1012.

E23.3.3 PREPARING PILE HEADS

General
Requirement: Prepare pile heads for inclusion into the structure.
Defective material: If the pile at or below cut-off level, is damaged by driving, or is otherwise unsound, give notice.

Concrete piles
Preparation: Roughen the surface at cut-off level. Clean and straighten any projecting reinforcement.
E24 CONCRETE FORMWORK

E24.1 GENERAL

E24.1.1 SCOPE OF WORKS

General
Work in this section shall include, without necessarily being limited to, the supply of all labour and materials for the supply and fixing of formwork, and reinforcement and the placement of insitu concrete.
All works to conform to the standard unedited version of:
- "RTA QA Specification B80 Concrete Works for Bridges", edition 5, revision 5, dated January 2010,
The most stringent requirement will be applied when two or more standards specify conflicting requirements.

E24.1.2 RESPONSIBILITIES

General
General: Construct formwork so that the concrete, when cast in the forms, has the required:
- Dimensions.
- Location.
- Profile.
- Shape.
- Finish.
Allowances: Allow for dimensional changes, deflections and cambers resulting from the following:
- Imposed actions.
- Concrete shrinkage and creep.
- Temperature changes.
- The application of prestressing forces (if any).
Selections: Conform to the Selections.
Design
General: The design of formwork, other than profiled sheeting composite formwork, is the contractor's responsibility.

E24.1.3 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Concrete in situ.
- Concrete finishes.
- Concrete reinforcement.
- Precast concrete.

E24.1.4 TOLERANCES

General
Plumb of elements ≥ 8 m high: 1 in 1000.
Plumb of elements > 8 m high: To AS 3610.1.
Position: Construct formwork so that finished concrete conforms to AS 3600 clause 17.5 and the Dimensional deviations schedule.
E24.1.5 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Completed formwork before concrete placing.

E24.2 EXECUTION

E24.2.1 CERTIFICATION

General
All requested certification within structural specification to be issued by qualified Structural Engineer with NPER.

E24.2.2 COMPLETION

Formwork removal
Extent: Remove formwork, other than profiled steel sheeting composite formwork, including formwork in concealed locations, but excepting lost formwork.
Timing: Do not disturb forms until concrete is hardened enough to withstand formwork movements and removal without damage.

Stripping:
- General: To AS 3600 where it is more stringent than AS 3610.1.
- Vertical forms: Remove formwork that does not support weight of concrete from faces of beams, walls and columns not less than a cumulative 24 hours after placing concrete during which the ambient outdoor temperature has been greater than 10°C.

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

E24.3 SELECTIONS

E24.3.1 SCHEDULE

<table>
<thead>
<tr>
<th>Dimension or measurement</th>
<th>Location or element</th>
<th>Deviation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute position</td>
<td>Class 1 surface</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Class 2 surface</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Class 3 surface</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Class 4 surface</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Class 5 surface</td>
<td>30</td>
</tr>
</tbody>
</table>
E25 CONCRETE REINFORCEMENT

E25.1 GENERAL

E25.1.1 SCOPE OF WORKS

General
Work in this section shall include, without necessarily being limited to, the supply of all labour and materials for the installation of steel reinforcement in all structures as detailed.
All works to conform to the standard unedited version of:
- “RTA QA Specification B80 Concrete Works for Bridges”, edition 5, revision 5, dated January 2010, and
The most stringent requirement will be applied when two or more standards specify conflicting requirements.

E25.1.2 RESPONSIBILITIES

General
General: Provide concrete reinforcement and include the following:
- Supply.
- Fixing in place.
- Maintain position during concreting.

E25.1.3 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Concrete in situ.

E25.1.4 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Cores and embedments fixed in place.
- Reinforcement fixed in place, with formwork completed.

E25.1.5 CONSTRUCTION

Dowels
Fixing: If a dowel has an unpainted half, embed this in the concrete placed first.
Tolerances:
- Alignment: 2 mm in 300 mm.
- Location: ± half the diameter of the dowel.
Grade: 250 N.

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

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

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

Projecting reinforcement
General: If 'starter' or other bars project beyond reinforcement mats or cages, through formwork or from cast concrete, provide a plastic protective cap to each bar until it is incorporated into subsequent work.

Tying
General: Secure the reinforcement against displacement by tying at intersections with either wire ties, or clips. Bend the ends of wire ties away from nearby faces of forms so that the ties do not project into the concrete cover.
Beams: Tie stirrups to bars in each corner of each stirrup. Fix other longitudinal bars to stirrups at 1 m maximum intervals.
Bundled bars: Tie bundled bars together so that the bars are in closest possible contact. Provide tie wire at least 2.5 mm diameter at centres ≤ 24 times the diameter of the smallest bar in the bundle.
Columns: Secure longitudinal column reinforcement to all ties at every intersection.
Mats: For bar reinforcement in the form of a mat, secure each bar at alternate intersections.

Cleaning
General: Remove all debris from the formed space.

E25.1.6 CERTIFICATION
General
All requested certification within structural specification to be issued by qualified Structural Engineer with NPER.

E25.1.7 COMPLETION
Unencased reinforcement
General: If 'starter bars' and other items project from cast concrete for future additions and are exposed to the weather, provide details of protection.
E26 CONCRETE IN SITU

E26.1 GENERAL

E26.1.1 SCOPE OF WORK

General
Work in this section shall include, without necessarily being limited to, the supply of all labour and materials for the placement and finish of concrete into forms following placement of reinforcement. All works to conform to the standard unedited version of:
- "RTA QA Specification B80 Concrete Works for Bridges", edition 5, revision 5, dated January 2010,
The most stringent requirement will be applied when two or more standards specify conflicting requirements.

E26.1.2 RESPONSIBILITIES

General
Provide concrete in situ that:
- Conforms to design details.
- Satisfies quality and inspection requirements.
- Conforms to the Selections.

E26.1.3 CROSS REFERENCES

General requirements
Requirement: Conform to the following:
- General requirements.
- Concrete formwork.
- Concrete reinforcement.
- Concrete finishes.

E26.1.4 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Base or subgrade before covering.
- Membrane or film underlay installed on the base or subgrade.
- Completed formwork, and reinforcement, cores, fixings and embedded items fixed in place.
- Surfaces or elements to be concealed in the final work before covering.
- Commencement of concrete placing.

E26.1.5 CONCRETE

Site mixed supply
Do not use.

E26.1.6 PLACING AND COMPACTION

Time between adjacent placements
General: Conform to the Minimum time delay schedule.

E26.1.7 CURING

General
Curing of all concrete to be “wet curing” as specified in RTA QA B80.
E26.1.8 CERTIFICATION

General
All requested certification within structural specification to be issued by qualified Structural Engineer with NPER.

E26.1.9 COMPLETION

Loading
Loading: Give notice before loading the concrete structure.

Protection: Protect the concrete from damage due to construction load overstresses, physical and thermal shocks, and excessive vibrations, particularly during the curing period.

Surface protection: Protect finished concrete surfaces and applied finishes from damage.

E26.1.10 SCHEDULES

Properties schedule – performance

<table>
<thead>
<tr>
<th>Location or element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal and special class</td>
</tr>
<tr>
<td>Maximum aggregate size (mm)</td>
</tr>
<tr>
<td>Slump (mm)</td>
</tr>
<tr>
<td>Strength grade/characteristic compressive strength f (Mpa)</td>
</tr>
<tr>
<td>Cement type</td>
</tr>
<tr>
<td>Drying shrinkage</td>
</tr>
<tr>
<td>Water:cement ratio maximum</td>
</tr>
</tbody>
</table>

Minimum time delay schedule

<table>
<thead>
<tr>
<th>Between (pour locations)</th>
<th>Minimum period between adjacent pours (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjacent pours abutting horizontal construction joints in walls or columns</td>
<td>1</td>
</tr>
<tr>
<td>Adjacent pours abutting vertical construction joints in walls</td>
<td>7</td>
</tr>
<tr>
<td>Columns and slabs</td>
<td>1</td>
</tr>
<tr>
<td>Floor slab construction joints</td>
<td>1</td>
</tr>
<tr>
<td>'Pour strips’ and adjacent concrete</td>
<td>56</td>
</tr>
<tr>
<td>Retaining wall construction joints</td>
<td>1</td>
</tr>
</tbody>
</table>
E27 CONCRETE FINISHES

E27.1 GENERAL

E27.1.1 SCOPE OF WORKS

General
Work in this section shall include, without necessarily being limited to, the supply of all labour and materials for the finishing of concrete placed as specified before. All works to conform to the standard unedited version of:
- "RTA QA Specification B80 Concrete Works for Bridges", edition 5, revision 5, dated January 2010, and
- "TfNSW Engineering Specification – SPC301 Structures Construction" version 1.0, dated July 2010. The most stringent requirement will be applied when two or more standards specify conflicting requirements.

E27.1.2 RESPONSIBILITIES

General
Provide finishes to formed and unformed concrete surfaces as follows:
- Appropriate to the importance (visual or physical) of the concrete elements.
- Compatible with following trades and finishes.

E27.1.3 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Concrete formwork.
- Concrete in situ.

E27.1.4 STANDARDS

General
Formed surfaces: To AS 3610.1.

E27.1.5 INTERPRETATIONS

Definitions
General: For the purposes of this worksection, the following definition applies:
- Green concrete: Concrete which has set but not appreciably hardened.

E27.1.6 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Evaluation of the off-form finishes to formwork.

E27.1.7 SUBMISSIONS

Execution documentation
Shop drawings: Submit formwork shop drawings including details of proposed form linings, form bolt positions, form facings, release agents and, where applicable, reuse of formwork.

E27.1.8 TOLERANCES

Surface quality
Formed surfaces: Confirm conformance with the surface finish requirements of AS 3610.1 for the surface class nominated in the Formed surface finishes schedule.

Flatness
Unformed surfaces: Confirm conformance with the Flatness tolerance classes table for the class of finish nominated using a straight edge placed anywhere on the surface in any direction.
Concrete finishes

Flatness tolerance class table

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

E27.1.9 SURFACE TREATMENT

General
Range: Do not proceed with the related work until the acceptable range of surface treatments has been determined.

E27.2 PRODUCTS

E27.2.1 MATERIALS

Surface hardeners, sealants and protectors
Supply: If required by the project documentation, provide proprietary products.

E27.3 EXECUTION

E27.3.1 SURFACE MODIFIERS

General
Application: Apply to clean surfaces in accordance with the manufacturer's requirements.

E27.3.2 FORMED SURFACES

General
General: Provide formed concrete finishes in conformance with the Formed surface finishes schedule.
Damage: Do not damage concrete works through premature removal of formwork.
Curing
General: If forms are stripped when concrete is at an age less than the minimum curing period, commence curing exposed faces as soon as the stripping is completed.
Evaluation of formed surfaces
General: If evaluation of formed surface tolerance or colour is required, complete the evaluation before surface treatment.
Finishing methods
General: If soffits of concrete elements or faces of concrete columns are to have a finish other than off the form, provide details of proposed procedures.
Blasted finishes:
- Abrasive: Blast the cured surface using hard, sharp graded abrasive particles until the coarse aggregate is in uniform relief.
- Light abrasive: Blast the cured surface using hard, sharp graded abrasive particles to provide a uniform matt finish without exposing the coarse aggregate.
Bush hammered finish: Remove the minimum matrix using bush hammering to expose the coarse aggregate, recessing the matrix no deeper than half the aggregate size, to give a uniform texture.
Exposed aggregate finish: Remove the vertical face forms while the concrete is green. Wet the surface and scrub using stiff fibre or wire brushes, using clean water freely, until the surface film of mortar is mechanically removed, and the aggregate uniformly exposed. Do not use acid etching. Rinse the surface with clean water.
Floated finishes:
- Sand floated finish: Remove the vertical face forms while the concrete is green. Wet the surface and rub using a wood float. Rub fine sand into the surface until a uniform colour and texture are produced.

Contract No
Cardiff Railway Station Easy Access Upgrade

Tender Issue
February 2012
Concrete finishes

- Grout floated finish: Remove the forms while the concrete is green. Dampen the surface and spread a slurry, using hessian pads or sponge rubber floats. Remove surplus slurry and work until a uniform colour and texture are produced.

Smooth rubbed finish: Remove the vertical face forms while the concrete is green. Wet the surface and rub using a carborundum or similar abrasive brick until a uniform colour and texture are produced.

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

E27.3.3 UNFORMED SURFACES

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

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

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

Finishing methods – primary finish
Machine float finish:
- After levelling, consolidate the surface using a machine float.
- Cut and fill and refloat immediately to a uniform, smooth, granular texture.
- Hand float in locations inaccessible to the machine float.
Steel trowel finish: After machine floating finish as follows:
- Use power or handsteel trowels to produce a smooth surface relatively free from defects.
- When the surface has hardened sufficiently, retrowel to produce the final consolidated finish free of trowel marks and uniform in texture and appearance.
Burnished finish: Continue steel trowelling until the concrete surface attains a polished or glossy appearance, uniform in texture, appearance and free of trowel marks and defects.
Wood float finish: After machine floating use wood or plastic hand floats to produce the final consolidated finish free of float marks and uniform in texture and appearance.
Broom finish: After machine floating and steel trowelling draw a broom or hessian belt across the surface to produce a coarse even-textured transverse-scored surface.
Scored or scratch finish: After screeding, give the surface a coarse scored texture using a stiff brush or rake drawn across the surface before final set.
Sponge finish: After machine floating and steel trowelling, produce an even textured sand finish by wiping the surface using a damp sponge.

Finishing methods – supplementary finish
Abrasive blast: After steel trowelling, abrasive blast the cured surface to provide texture or to form patterns without exposing the coarse aggregate using hard, sharp graded abrasive particles.
Exposed aggregate: After steel trowelling, grind the cured surface of the concrete to expose the coarse aggregate.

E27.4 SELECTIONS

E27.4.1 SCHEDULES

Formed surface finishes schedule

<table>
<thead>
<tr>
<th>Property</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>All exposed surfaces</td>
<td>Unexposed surfaces</td>
</tr>
<tr>
<td>Location</td>
<td>Retaining walls, slab and stair soffits</td>
<td>Concealed surfaces generally</td>
</tr>
<tr>
<td>Surface finish class to AS 3610.1</td>
<td>Class 2</td>
<td>Class 4</td>
</tr>
<tr>
<td>Form lining type</td>
<td>New Ply</td>
<td>Ply</td>
</tr>
<tr>
<td>Colour control</td>
<td>Class 2</td>
<td>-</td>
</tr>
</tbody>
</table>
Concrete finishes

<table>
<thead>
<tr>
<th>Property</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolt hole filling</td>
<td>Required</td>
<td>-</td>
</tr>
<tr>
<td>Surface finish type</td>
<td>Class 2</td>
<td>-</td>
</tr>
<tr>
<td>Special requirements</td>
<td>Concrete surface of retaining walls shall incorporate 100mm wide x 30mm deep grooves as shown on drawings.</td>
<td>-</td>
</tr>
</tbody>
</table>

Unformed surface finishes schedule

<table>
<thead>
<tr>
<th>Property</th>
<th>Type</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Exposed surface</td>
<td>Surfaces to be covered by vinyl or carpet</td>
<td>Unexposed surfaces</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Stairs, ramps, platforms</td>
<td>Various areas as scheduled</td>
<td>Concealed surfaces</td>
<td></td>
</tr>
<tr>
<td>Flatness tolerance class</td>
<td>A</td>
<td>A</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Primary finish</td>
<td>Steel trowel</td>
<td>Steel trowel</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Supplementary finish</td>
<td>Light broom</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Slip resistance class to AS/NZS 4663:</td>
<td>Wet pendulum / V</td>
<td>Wet pendulum / V</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>- Wet pendulum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Dry floor friction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Contract No
Cardiff Railway Station Easy Access Upgrade
166 of 301
Tender Issue
February 2012
E28 STRUCTURAL STEEL

E28.1 GENERAL

E28.1.1 SCOPE OF WORKS

General
Work in this section shall include, without necessarily being limited to, the supply of all labour and materials for the fabrication and erection of structural steel as detailed.
All works to conform to the standard unedited version of:
- "RTA QA Specification B240 Supply of Bolts, Nuts, Screws and Washers", edition 4, revision 0, dated August 2008,
- "RTA QA Specification B241 Manufacture and Supply of Minor Steel Items", edition 4, revision 0, dated December 2008, and
Steelwork surface treatment:
The most stringent requirement will be applied when two or more standards specify conflicting requirements.

E28.1.2 RESPONSIBILITIES

General
General: Provide structural steelwork that is integrated into the building construction.

E28.1.3 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Steel – hot-dip galvanized coatings.

E28.1.4 STANDARDS

General
Materials, construction, fabrication and erection: To AS 4100.
Cold-formed steel: AS/NZS 4600.

E28.1.5 INSPECTION

Notice – off site
Inspection: Give notice so that inspection may be made of the following:
- Before placement of root runs of complete penetration butt welds.
- Completion of fabrication before surface preparation.
- Surface preparation before shop painting.
- Completion of protective coating before delivery to site.

Notice – on site
Inspection: Give notice so that inspection may be made of the following:
- Anchor bolts in position before casting in.
- Steelwork and column bases erected on site, before grouting, encasing, site painting or cladding.
- Tensioning of bolts in categories 8.8/TB and 8.8/TF.
- Reinforcement and formwork in place prior to any encasement.
- After any grouting, encasement, fire protection or site painting is completed.
E28.1.6 TESTS

Non destructive weld examination

Standard: To AS/NZS 1554.1.

Methods: Inspect welds in conformance with the Non-destructive weld examination (NDE) table.

Radiographic and ultrasonic inspection: Have the examination performed by an independent testing authority.

Repairs: Repair welds revealed as faulty by non-destructive examination and repeat the examination.

**Non-destructive weld examination (NDE) table**

<table>
<thead>
<tr>
<th>Type of weld and category</th>
<th>Examination method</th>
<th>Extent (% of total length of weld type)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shop fillet welds</td>
<td>Visual means</td>
<td>100</td>
</tr>
<tr>
<td>Site fillet welds</td>
<td>Visual means</td>
<td>100</td>
</tr>
<tr>
<td>Butt welds, GP</td>
<td>Visual means</td>
<td>100</td>
</tr>
<tr>
<td>Butt welds, SP</td>
<td>Visual means</td>
<td>100</td>
</tr>
<tr>
<td>Fillet and butt welds, SP</td>
<td>Radiographic or ultrasonic inspection</td>
<td>10</td>
</tr>
</tbody>
</table>

E28.1.7 SUBMISSIONS

**Origin of steel**

Requirement: If it is proposed to use steel not of Australian origin, submit documentation which demonstrates that the steel complies and is suitable for fabrication to Australian standards.

**Bolts**

Compliance: Submit a manufacturer’s compliance/test certificate from an accredited testing organization confirming compliance with AS/NZS 1252.

Independent certification: If bolts manufactured from outside Australia, provide a local NATA-accredited laboratory independent compliance certificate based on appropriate testing and verification.

**Subcontractors**

General: Submit names and contact details of proposed fabricator and installer.

**Shop drawings**

General: Submit shop drawings showing the following information:
- Relevant details of each assembly, component and connection.
- Information relative to fabrication, surface treatment, transport and erection.

Particular: Include the following information:
- Marking plans.
- Identification.
- Steel type and grade.
- Dimensions of items.
- Required camber, where applicable.
- Fabrication methods including, where applicable, hot or cold forming and post weld heat treatment.
- Location, type and size of welds and/or bolts and bolt holes.
- Weld categories and bolting categories.
- Orientation of members.
- Surface preparation methods and coating system if shop applied.
- Best practice details in relation to application of protective coatings.
- Breather holes for hollow sections (with seal plates) being hot-dip galvanized.
- Procedures necessary for shop and site assembly, and erection.
- Location of and preparation for site welds.
- Temporary works such as lifting lugs, support points, temporary cleats and bracing which are required for transport and erection of the structural steelwork, and the procedure for final removal.
- Required fixings for adjoining building elements.
Substitution: If alternative sections or connections are proposed, provide details.

Purlins and girts: If it is proposed to support other than cladding on or from purlins and girts, provide details.

Splices: If variations to documented splice locations or if additional splices are proposed, submit details.

Record drawings
General: Supply as-built structural and shop drawings.

Tests
Steel: Submit evidence that the steel used in the work complies with the cited material standards.
Acceptable evidence: Certified mill test reports, or test certificates issued by the mill.
Alternative: Have the steel tested by an independent testing authority for compliance with the chemical composition and mechanical test requirements of the cited material standard.

Materials and components
Concrete or masonry anchors: If masonry anchors other than as shown on the drawings are required or proposed for the support or fixing of structural steel, submit evidence of the anchor capacity to carry the load.

Execution
Anchor bolts: If anchor bolts do not meet specified location tolerances, submit proposals that will allow steel erection to proceed.
Splicing: If splicing of structural members is intended, submit proposals.
Welding procedures: Submit details of proposed welding procedures, using the WPS form in Appendix C of AS/NZS 1554.1.
Identification marks: If members and/or connections are to be exposed to view submit details of proposed marking.
Distortions: Submit proposals for preventing or minimising distortion or galvanized components, welded components or welded and galvanized components; and proposals for restoration to design shape.

E28.2 EXECUTION

E28.2.1 FABRICATION AND ERECTION

General
Care: Shop detail and fabricate members so that they can be properly erected.
Substitution: If substitution of members is proposed, provide details.

Beam camber
General: If beam members have a natural camber within the straightness tolerance, fabricate and erect them with the camber up.

Straightening
Care: If correcting distorted members, conform to the submitted procedures and avoid damage.

Work exposed to view
Welds: Grind smooth but do not reduce the weld below its nominal size.
Corners and edges: Grind fair those corners and edges, which are sharp, marred, or roughened.

Site work
General: Other than work shown on the shop drawings as site work, do not fabricate, modify or weld structural steel on site.

Identification marks
General: Provide marks or other means of identifying each member compatible with the finish, for the setting out, location, erection and connection of the steelwork in accordance with the marking plans.
High strength bolting: If the work includes more than one bolting category, mark high-strength structural bolted connections with a 75 mm wide flash of colour, clear of holes.
Cold formed members: Clearly mark material thickness.
Monorail beams: Identify and mark rated capacity in accordance with AS 1418.18 clause 5.12.6.
Tolerances
Measurement: Tolerances are to be checked by measurement after fabrication when corrosion protection has been applied.
Conformance: To AS 4100 clause 14.4.

E28.2.2 ERECTION

General
Standard: To AS 3828.
Execution: Ensure that every part of the structure has sufficient design capacity and is stable under construction loads produced by the construction procedure or as a result of construction loads, which are applied.
Calculations: If required to justify the adequacy of the structure to sustain any loads and/or procedures, which may be imposed, provide calculations.

Temporary work
General: Provide all necessary temporary bracing or propping.
Temporary connections: If required cleats are not shown on shop drawings, submit details.
Temporary members: If temporary members are required, fix so as not to weaken or deface permanent steelwork.
Hand flame cutting
General: Do not hand flame cut bolt holes.

Movements
General: Allow for thermal movements during erection.

Site welds
Completion: Weld only when correct alignment and preset or camber have been achieved.
Overhead welding: If overhead welding is required, submit proposals.

Clearances
End clearances at connections (mm): 2mm

Anchor bolts
General: For each group of anchor bolts provide a template with setting out lines clearly marked for positioning the bolts when casting in.

Grouting at supports
Preparation: Before grouting steelwork to be supported by concrete or masonry, set steelwork on packing or wedges.
- Permanent packing or wedges: Form with solid steel or grout of similar strength to the permanent grout.
- Temporary packing or wedges: Remove before completion of grouting.
Timing: Grout at supports before the construction of any supported floors, walls, roofing, wall cladding or precast.
Temperature: Do not grout if the temperature of the base plate or the footing surface exceeds 35°C.
Method: Dry pack with stiff cement mortar
Type: High strength non-shrink grout
Minimum compressive strength (MPa): 40MPa
Minimum thickness (mm): 10
Maximum thickness (mm): 30

Handling
Care: Handle members or components without overstressing or deforming them.
Protection: Wrap or otherwise protect members or components to prevent damage to surface finishes during handling and erection.

Drifting
Limitation: Use drifting only to bring members into position, without enlarging holes or distorting components.
E28.2.3 REPAIRS

General
General: Repair finishes to ensure the full integrity of each phase and each coating.

E28.2.4 COMPLETION

Tolerances
Compliance: After erection is complete confirm compliance with AS 4100 clause 15.3.

Temporary connections
General: Remove temporary cleats on completion and restore the surface.
E29 STEEL – PROTECTIVE PAINT COATINGS

E29.1 GENERAL

E29.1.1 RESPONSIBILITIES
General
General: Provide protective paint coatings that control corrosion to structural steelwork and steel products in the time to first scheduled maintenance as documented.

E29.1.2 CROSS REFERENCES
General
Requirement: Conform to the following:
- General requirements.
- Painting

E29.1.3 STANDARDS
General
Surface preparation and coating: Conform to the recommendations of AS/NZS 2312.

Site testing of protective coatings
Test methods: To AS 3894.

E29.1.4 INTERPRETATIONS
Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
DFT: Dry Film Thickness.
ITP: Inspection and Test Plan.
μm: micron (10⁻⁶m).

Definitions
General: For the purposes of this worksection the definitions given in AS/NZS 2310 and those below apply.
- Coating contractor: The protective coatings application contractor conducting the on or off site coating application works.
- Coating manufacturer: The supplier and/or manufacturer of the protective coating materials used.
- ITP: A series of formal Inspection and Test Plans, prepared by the coating contractor to reflect the specific inspection and testing that will be carried out on the surface preparation, coating application and the record keeping tasks to be undertaken.
- MSDS: The formal Material Safety Data Sheet, prepared in accordance with Worksafe Australia’s requirements and distributed by the coating manufacturer to provide information on the safe handling, storage, personal protective equipment requirements, use and disposal of a coating product.

E29.1.5 INSPECTION
Notice
Inspection: Give notice so that inspection may be made of the following:
- Items after fabrication before commencing surface cleaning and preparation.
- Surfaces after preparation before application of first coating.
- Coating stages:
  - After application of primer or seal coats.
  - After application of each subsequent coat.
E29.1.6 SUBMISSIONS

Licence
Requirement: Submit proof of currency of the applicator's Environmental Operating Licence.

Detailing of structural steelwork
General: If design and fabrication features of the items to be coated may lead to difficulties, advise before commencing surface preparation.

Quality
ITPs: Submit for each proposed coating system.
Quality supervisor: Submit the name and the experience record of the person nominated to oversee the implementation of the ITPs.

Removal of deleterious materials
General: Submit advice on suitability of marking paints, and removal of materials deleterious to coating processes such as grease, oil and paint.

Repair of coating damage
General: If the protective coating is damaged, submit a repair coating proposal, based on the coating manufacturer's technical data sheet, that will ensure that the full corrosion protection ability of the system is reinstated.

Reinstatement
Final coat reinstatement: If required due to variance, submit proposals for reinstatement of the visible final coating system to match the original coating system samples.

Records
General: Prepare and maintain records of all surface preparation and coating application works as follows:
- Reference the relevant parts of the ITPs, and record conformance.

Maintenance paint coating systems
Existing systems: Itemise areas of corrosion, damage, and other degradation.
Recoating systems: Supply coating systems for maintenance painting of previously coated items and structural elements, including surface preparation, to the Protective paint coating schedule.

Warranties
General: Submit details of the proposed warranty terms, form and period. If separate warranties are offered by the manufacturer and the applicator, ensure they are interlocking.

E29.1.7 SAMPLES

Painting and coating colour
General: Submit a sample of the finished product for each different coating system.
Size of each sample: 400 x 400 mm.
Retention: Retain half of each sample for comparison during coating application.

E29.1.8 TESTING

General
Conformance: All areas of any item must meet the required cleanliness standard.

Abrasive blast cleaning
Assessment: To AS 1627.4 and ISO 8501-1.

Power tool cleaning
Assessment: To AS 1627.2 and ISO 8501-2.
- Class 2.5.

Hand tool cleaning
- Class 2.5.

Surface profile
General: To AS 3894.5.
Profile grade: To AS 3894.5 Method A.

**Surface dust from abrasion**

General: To AS 3894.6 Method C.

**Chloride level testing**

Test: To AS 3894.6 Method A.

Maximum allowable chloride levels: 50 mg/m².

Conformance: If this level is exceeded, rewash the affected surface area using fresh water until the chloride level is within acceptable limits. There are chloride neutralizing solutions commercially available. Jetwashing or steamcleaning is also acceptable before retesting and re-abrasive blasting.

Timing of testing: early in the blasting work so that removal procedures can be initiated before the blasting is completed.

**Wet film thickness**

Method of measurement: To AS 3894.3, Appendix C using an approved wet film gauge continuously during application.

**Dry film thickness**

Method of measurement: To AS 3894.3, clause 10.

Extent: All surfaces at the completion of each of the prime, intermediate and finish coats, in particular include areas of the structure which are difficult to paint, are masked by structure, or areas where double coating or light coating is likely due to the shape of the substrate.

Number of measurements: Perform a sufficient number of readings to ensure a representative account for the DFT compliance of the coated areas tested.

Deduction: If testing the DFT of coatings 150 µm and less, deduct the effect of the measured surface profile from all DFT readings.

Single readings: Single reading requirements are as follows:

- Check any single reading that is less than 80% of the specified DFT with three additional readings within 50 mm of the original reading. If these three readings average not less than 90% of the specified DFT, take the averaged readings to be the "point reading". If less than 90%, reject the DFT in that area.

- Check any single reading that is greater than 150% of the specified DFT with three additional readings within 50 mm of the original reading. If these three readings average not greater than 150% of the specified DFT, take the averaged readings to be the "point reading". If greater than 150%, reject the DFT in that area.

Rectification: Re-work areas rejected, using surface preparation and coatings in the same manner and order as the original work.

Defects including underthickness and overthickness: Mark with school grade chalk, adhesive inspection labels or masking tape. Do not use crayon, paint or spirit based ink pens.

---

**E29.2 PRODUCTS**

**E29.2.1 GENERAL**

**General**

Care: Handle, store, mix and apply all protective coatings strictly in accordance with the manufacturer’s instructions.

Original containers: Provide coating products in unopened containers bearing the brand name and name of the manufacturer with a clearly legible batch number.

Ambient temperature range for storage: 15°C to 25°C.

Use-by-date: Use products with limited shelf life before their use-by-date unless written authorisation from the coating manufacturer’s technical services section is provided.

**Proprietary products**

Requirement: Provide all products in the Protective paint coating schedule from the one manufacturer’s supply.

**Material safety data sheets (MSDS)**

Requirement: Keep on site copies of all relevant MSDSs.
E29.3 EXECUTION

E29.3.1 GENERAL

General
Product warnings: Conform to the requirements and recommendations of product MSDS.

E29.3.2 PROTECTION

Surroundings
Protection: Prevent the release of abrasive, overspray or paint waste debris to air, ground or to any watercourse. Repair or clean affected surrounding areas.
Damage: Prevent damage to other assets, services or equipment.

Contamination
Coating contamination: Prevent contamination of coatings contaminated from abrasive or other foreign matter.
Surfaces: Prevent contamination of coated surfaces which are not yet dry from blasting dust, abrasive or surface preparation debris.

On site storage
General: Deliver coatings to site in the original unopened containers coatings and store in a cool shady place.
Sunlight: Protect coating materials from direct sunlight before mixing or adding the converter (catalyst).

Post application care
General: Provide protection to the coating against physical, chemical, or atmospheric damage until all components are fully cured.
Care: Stack and handle all coated items using fabric slings or padded chains. Adopt soft packaging, carpet strips or other deformable materials between all coated items.
Water ponding: Stack coated items to prevent water ponding.

E29.3.3 SURFACE PREPARATION

General
Defects: Remove all surface defects, including cracks, laminations, deep pitting, weld spatter slag, burrs, fins, sharp edges and other defects before the preparation of the surface to be coated.
Temporary welds: Grind flush temporary welds.
Site welding: Where possible avoid site welding.
Porous, skip or stitch welds: Not acceptable.
Edges: De-burr and round all edges to a 2 mm radius.
Surface contaminants: Remove surface contaminants such as oil, grease, dirt and loose particles, using an alkaline oil emulsifier/degreaser to AS 1627.1.
Surface preparation: Prepare surfaces to the required finish to AS 1627.1, AS 1627.2, AS 1627.4, AS 1627.5, AS 1627.6 and AS 1627.9.
Surface cleaning: Remove spent abrasive from the surface by blowing with clean, dry air and/or by vacuum cleaning.
Bolts: Provide washers at heads and nuts at replacement bolts.

Surface preparation for atmospheric steel
General: Comply to the following requirements:
- Wash and degrease all surfaces to be coated in accordance with AS 1627.1 with a free-rinsing, alkaline detergent, in strict accordance with the manufacturer’s written instructions and all safety warnings.
- Wash with fresh potable water and ensure that all soluble salts are removed in accordance with AS 3894.6 Methods A and D.
- Grind all sharp edges with a power tool to a minimum radius of 2 mm.
- Power tool clean welds to AS 1627.2 Class 2 to remove roughness. Remove filings, preferably by vacuum or compressed air.
- Abrasive blast clean all steel surfaces to be painted in accordance with AS 1627.4 to visual standard AS 1627.9 Class 2.5 (equivalent to ISO 8501-1, Sa 2.5: Very Thorough Blast-Cleaning). Use a non-metallic medium that will generate a surface profile of 35 to 65 microns (as tested to AS 3694.5 Method A.).
- Commence application within 4 hours of abrasive blast cleaning or before surface becomes contaminated, otherwise repeat abrasive blasting step.
- Stripe coat welds, bolts, boltholes and all edges with primer before application of full primer coat nominated in the PROTECTIVE PAINT COATING SYSTEMS.
- Before application, ensure that the surface is free of contaminants including oil, grease, dirt, dust, salt and any other deleterious materials that will interfere with coating performance.

**Treatment of on-site welding**

On-site welding: If on site welding is performed, adopt the following procedures:
- Remove weld spatter.
- Power tool clean welds to AS 1627.2 Class 2 to remove roughness. Remove filings, preferably by vacuum or compressed air.
- Prime welds immediately with the nominated primer before contamination can reoccur. Ensure that the primer overlaps the sound adjacent coating by between 25 mm and 50 mm.
- Apply intermediate and topcoats over the primed welds to match the surrounding coating system, overlapping the sound adjacent coating by between 25 mm and 50 mm.

**Preparing galvanized and aluminium surfaces**

Remove grease, oil and other solvent-soluble contaminants by wiping with mineral turpentine or white spirit. Finally wipe with a clean solvent. Allow to dry and proceed with the next operation immediately. Abrade surfaces to a medium coarse type finish to provide an adhesion key.

**Primed zinc primed surfaces**

If present, remove zinc salts from zinc primers. Remove grease, oil and other solvent-soluble contaminants by wiping with mineral turpentine or white spirit. Finally wipe with a clean solvent. Allow to dry and proceed with the next operation immediately.

**Shop priming**

Dust off and apply a coat of primer, according to the technical specification.

**Site coating**

General: High pressure fresh water wash down all surfaces. Lightly sand down primer/intermediate coats, which have been shop applied, before site application of next coat.

**E29.3.4 MIXING**

**General**

Mixing: Mix coatings thoroughly. Mix package sizes larger than 4 litres using powered agitators driven by air motors.

Multi-component coatings: Combine multi-component coatings as whole pack units. If partial mixing is proposed, submit details.

Thinners: If addition of thinners is proposed, conform to the Coating Manufacturers Technical Data Sheet for the specified product.

Colour consistency: If colour consistency is required, before the addition of the curing agent or converter and before coating application, pre-mix the components of coating products that have been tinted to ensure colour uniformity.

**E29.3.5 COATING APPLICATION**

**General**

General: Conform to the Product Data Sheets.

Painting and coating colour: Verify all project finish colours with the retained samples.

**Final surface preparation or coating application**

Limits: If the following climatic/substrate conditions are present do not apply coating:
- The relative humidity is above 85%.
- The substrate temperature is less than 3°C above the dewpoint.
- The ambient air temperature is below 5°C or above 40°C.
- The substrate temperature is below 10°C or above 45°C.
- The surface to be coated is wet or damp.
- Where the full prime coat application cannot be carried out before the specified cleanliness of the surface deteriorates.
- For external or site applied coatings:
  - The weather is clearly deteriorating or unfavourable for application or curing.
  - High wind conditions.
- The surface preparation standard has not been achieved.
- The time between surface blast cleaning and the commencement of coating exceed 4 hours.
- Visual tarnishing or black spots develop on the surface of the metal.

Exception: Preliminary blast or other surface preparations may be performed in conditions that are outside the limits, providing the final surface preparation and all coating applications are undertaken under the limit conditions.

Prior coating: Before the spray application of each coating stripe coat by brush method all edges, welds, seams, rivets bolts and boltholes (including slots). Prime the underlying surfaces of replacement bolting, washers and nuts before installation.

Procedure: Conform to the order shown in the PROTECTIVE PAINT COATING SYSTEMS.

Timing: Conform to the minimum and maximum recoat intervals and curing times.

Detail: Stripe coat all welds, bolt holes, corners and difficult to spray areas by brushing in with the prime coat and intermediate coat material before the full coating application.

Subsequent coats: Ensure that before any subsequent coating layer is applied, the surface condition of the preceding coat is complete and correct in all respects, including its DFT achievement, cleanliness, freedom from defects.

Correction: Correct any defect in a coating layer before the subsequent coating layer is applied.

Protection

General: Perform all painting under cover and/or protected from rain, condensation, dew, excessive wind, overspray or wind-blown dust.

Period: Continue protection where any of these conditions exist before the coating has cured to a sufficient degree so as to be unaffected.

E29.3.6 COATING REPAIR

Repair of coating damage

Preparation: ‘Feather back’ by hand or machine sanding all leading edges of intact coating adjacent to the repair, to remove any sharp edge.

Surface contamination: Remove by dusting or blowing down before applying the first coat of paint.

Sequence: Apply the repair coating in the same sequence and manner as the original coating.

Areas damaged without exposing the primer: Wash with a proprietary detergent solution and rinse with fresh water, followed by abrading and ensuring that edges of sound paint are feathered. Then coat the area with the appropriate intermediate and finishing coat materials.

Areas damaged to the primer or steel surface: Blast clean to the original standard. Prepare at least 50 mm into the sound coating and to a further feathering zone of approximately 50 mm. Recoit with the specified system to restore the film thickness and integrity over the whole prepared surface including the feathered zone.

Aesthetic reinstatement: If required, repaint to a physical or discernable boundary line.

Defects: If corrosion pitting or areas of significant metal loss and defects are exposed by the blasting process, advise for inspection and have areas passed "fit for service" before proceeding with the coating system.

Timing: Apply the Protective Coating system within 4 hours of blast cleaning or in any case before visual tarnishing of the steel occurs.

E29.3.7 COMPLETION

General

Joints: On completion, seal all joints and mating surfaces with a compatible polyurethane sealant.
Warranty
General: Provide the approved warranty.

E29.4 SELECTIONS

E29.4.1 PROTECTIVE PAINT COATING SYSTEMS

Polyurethane – AS/NZS 2312 Category A and B table

<table>
<thead>
<tr>
<th>Location</th>
<th>Primer</th>
<th>Second Coat</th>
<th>Third Coat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior non-decorative</td>
<td>75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Internal decorative</td>
<td>75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13</td>
<td>50 µm High Solids Polyurethane Conforming to AS/NZS 3750.6</td>
<td>Nil</td>
</tr>
<tr>
<td>External non-decorative</td>
<td>75 µm Epoxy Zinc phosphate conforming to AS/NZS 3750.13</td>
<td>50 µm High Solids Polyurethane Conforming to AS/NZS 3750.6</td>
<td>Nil</td>
</tr>
<tr>
<td>to AS/NZS 2312 PUR2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External decorative</td>
<td>75 µm Epoxy zinc phosphate conforming to AS/NZS 3750.13</td>
<td>50 µm High Solids Polyurethane Conforming to AS/NZS 3750.6</td>
<td>Nil</td>
</tr>
<tr>
<td>to AS/NZS 2312 PUR2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Polyurethane – AS/NZS 2312 Category C, D and E table

<table>
<thead>
<tr>
<th>Location</th>
<th>Primer</th>
<th>Second Coat</th>
<th>Third Coat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior non-decorative</td>
<td>75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Internal decorative</td>
<td>75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2</td>
<td>75 µm High Solids Polyurethane Conforming to AS/NZS 3750.6</td>
<td>Nil</td>
</tr>
<tr>
<td>External non-decorative</td>
<td>75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2</td>
<td>200 µm High-Build Epoxy MIO Conforming to AS/NZS 3750.14</td>
<td>Nil</td>
</tr>
<tr>
<td>to AS/NZS 2312 EH84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External decorative</td>
<td>75 µm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2</td>
<td>200 µm High-Build Epoxy MIO Conforming to AS/NZS 3750.14</td>
<td>75 µm High Solids Polyurethane Conforming to AS/NZS 3750.6</td>
</tr>
<tr>
<td>to AS/NZS 2312 PUR 5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Micaceous Iron Oxide – AS/NZS 2312 Category A and B table

<table>
<thead>
<tr>
<th>Location</th>
<th>Primer</th>
<th>Second Coat</th>
<th>Third Coat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior non-decorative</td>
<td>75 µm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Internal decorative</td>
<td>75 µm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2</td>
<td>50 µm Alkyd MIO finish Conforming to AS/NZS 3750.12</td>
<td>Nil</td>
</tr>
<tr>
<td>External non-decorative</td>
<td>75 µm Alkyd zinc phosphate containing</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>conforming</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Primer</td>
<td>Second Coat</td>
<td>Third Coat</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>-------------</td>
<td>------------</td>
</tr>
<tr>
<td>to AS/NZS 2312 ALK2</td>
<td>MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>External decorative conforming to AS/NZS 2312 ALK6</td>
<td>75 μm Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 type 2</td>
<td>40 μm Alkyd MIO finish Conforming to AS/NZS 3750.12</td>
<td>40 μm Alkyd MIO finish Conforming to AS/NZS 3750.12</td>
</tr>
</tbody>
</table>

**Micaceous Iron Oxide – AS/NZS 2312 Category C, D and E table**

<table>
<thead>
<tr>
<th>Location</th>
<th>Primer</th>
<th>Second Coat</th>
<th>Third Coat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior non-decorative</td>
<td>75 μm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Internal decorative</td>
<td>75 μm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2</td>
<td>75 μm Epoxy MIO Conforming to AS/NZS 3750.14</td>
<td>Nil</td>
</tr>
<tr>
<td>External non-decorative conforming to AS/NZS 2312 EHB4</td>
<td>75 μm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2</td>
<td>200 μm High-Build Epoxy MIO Conforming to AS/NZS 3750.14</td>
<td>Nil</td>
</tr>
<tr>
<td>External decorative conforming to AS/NZS 2312 EHB8</td>
<td>75 μm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2</td>
<td>125 μm Epoxy MIO Conforming to AS/NZS 3750.14</td>
<td>125 μm Epoxy MIO Conforming to AS/NZS 3750.14</td>
</tr>
</tbody>
</table>

**Epoxy Acrylic – AS/NZS 2312 Category A and B table**

<table>
<thead>
<tr>
<th>Location</th>
<th>Primer</th>
<th>Second Coat</th>
<th>Third Coat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior non-decorative</td>
<td>75 μm Epoxy zinc phosphate conforming to AS/NZS 3750.13</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Internal decorative</td>
<td>75 μm Epoxy zinc phosphate conforming to AS/NZS 3750.13</td>
<td>50 μm Epoxy Acrylic Conforming to AS/NZS 3750.5</td>
<td>Nil</td>
</tr>
<tr>
<td>External non-decorative conforming to AS/NZS 2312 ACC2</td>
<td>75 μm Epoxy zinc phosphate conforming to AS/NZS 3750.13</td>
<td>50 μm Epoxy Acrylic Conforming to AS/NZS 3750.5</td>
<td>Nil</td>
</tr>
<tr>
<td>External decorative conforming to AS/NZS 2312 ACC2</td>
<td>75 μm Epoxy zinc phosphate conforming to AS/NZS 3750.13</td>
<td>50 μm Epoxy Acrylic Conforming to AS/NZS 3750.5</td>
<td>Nil</td>
</tr>
</tbody>
</table>

**Epoxy Acrylic – AS/NZS 2312 Category C, D and E table**

<table>
<thead>
<tr>
<th>Location</th>
<th>Primer</th>
<th>Second Coat</th>
<th>Third Coat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior non-decorative</td>
<td>75 μm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Internal decorative</td>
<td>75 μm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2</td>
<td>50 μm Epoxy Acrylic Conforming to AS/NZS 3750.5</td>
<td>Nil</td>
</tr>
<tr>
<td>External non-decorative conforming to AS/NZS 2312 EHB4</td>
<td>75 μm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2</td>
<td>200 μm High-Build Epoxy MIO Conforming to AS/NZS 3750.14</td>
<td>Nil</td>
</tr>
<tr>
<td>External decorative conforming to AS/NZS 2312 ACC6</td>
<td>75 μm Zinc rich epoxy conforming to AS/NZS 3750.9 Type 2</td>
<td>200 μm High-Build Epoxy MIO Conforming to AS/NZS 3750.14</td>
<td>50 μm Epoxy Acrylic Conforming to AS/NZS 3750.5</td>
</tr>
</tbody>
</table>
Steel protection and decoration for green buildings - AS/NZS 2312 Category A and B table

<table>
<thead>
<tr>
<th>Location</th>
<th>Primer</th>
<th>Second Coat</th>
<th>Third Coat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior non-decorative</td>
<td>50 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC &lt; 15 g/L</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Internal decorative</td>
<td>50 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC &lt; 15 g/L</td>
<td>40 µm waterborne acrylic Conforming to AS/NZS 3750.16 VOC &lt; 75 g/L</td>
<td>Nil</td>
</tr>
<tr>
<td>External non-decorative conforming to AS/NZS 2312 IZS2</td>
<td>75 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC &lt; 15 g/L</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>External decorative exceeding AS/NZS 2312 IZS2</td>
<td>75 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC &lt; 15 g/L</td>
<td>40 µm waterborne Acrylic Conforming to AS/NZS 3750.16 VOC &lt; 75 g/L</td>
<td>Nil</td>
</tr>
</tbody>
</table>

Steel protection and decoration for ‘green buildings’ – AS/NZS 2312 Category C, D and E table

<table>
<thead>
<tr>
<th>Location</th>
<th>Primer</th>
<th>Second Coat</th>
<th>Third Coat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior non-decorative</td>
<td>50 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC &lt; 15 g/L</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Internal decorative</td>
<td>50 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC &lt; 15 g/L</td>
<td>40 µm waterborne Acrylic Conforming to AS/NZS 3750.16 VOC &lt; 75 g/L</td>
<td>Nil</td>
</tr>
<tr>
<td>External non-decorative conforming to AS/NZS 2312 IZS2</td>
<td>75 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC &lt; 15 g/L</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>External decorative exceeding AS/NZS 2312 IZS2</td>
<td>75 µm waterborne inorganic zinc conforming to AS/NZS 3750.15 Type 3 VOC &lt; 15 g/L</td>
<td>50 µm waterborne epoxy Conforming to AS/NZS 3750.13 VOC &lt; 20 g/L</td>
<td>40 µm waterborne Acrylic Conforming to AS/NZS 3750.16 VOC &lt; 75 g/L</td>
</tr>
</tbody>
</table>

Industrial silicone enamel - AS/NZS 2312 Category A and B table

<table>
<thead>
<tr>
<th>Location</th>
<th>Primer</th>
<th>Second Coat</th>
<th>Third Coat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior non-decorative</td>
<td>75 µm Alkyd zinc phosphate containing</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Location</td>
<td>Primer</td>
<td>Second Coat</td>
<td>Third Coat</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>--------------------------------------------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>Internal decorative</td>
<td>MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2</td>
<td>75 (\mu)m Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2</td>
<td>50 (\mu)m Silicone Enamel Conforming to AS/NZS 3750.22 Nil</td>
</tr>
<tr>
<td>External non-decorative conforming to AS/NZS 2312 ALK2</td>
<td>75 (\mu)m Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>External decorative conforming to AS/NZS 2312 ALK4</td>
<td>75 (\mu)m Alkyd zinc phosphate containing MIO and Aluminium pigment conforming to AS/NZS 3750.19 Type 2</td>
<td>50 (\mu)m Silicone Enamel Conforming to AS/NZS 3750.22</td>
<td>Nil</td>
</tr>
</tbody>
</table>
### E30.1 GENERAL

#### E30.1.1 RESPONSIBILITIES

**General**

General: Provide hot-dip galvanized coatings that control corrosion to structural steelwork or steel products in the time to first maintenance.

All works to conform to the standard unedited version of:

The most stringent requirement will be applied when two or more standards specify conflicting requirements.

#### E30.1.2 CROSS REFERENCES

**General**

Requirement: Conform to the following:
- General requirements.
- Structural steel.

#### E30.1.3 STANDARDS

**General**

Coating: Comply with the requirements of AS/NZS 4680.

Durability: Conform to the requirements of AS 2309.

**Metal finishing**

Methods: To AS 1627.

#### E30.1.4 INSPECTION

**Notice**

Inspection: Give notice so that inspection may be made of the following:
- Coating integrity, at the galvanizing plant.

#### E30.1.5 SUBMISSIONS

**Holes and lifting lugs**

General: If holes and lifting lugs are required to facilitate handling, filling, venting and draining during galvanizing, submit details on size and location.

**Detailing features**

General: If design and fabrication features of the articles to be galvanized may lead to difficulties during galvanizing, identify these and submit details for improvement.
E31 LIGHT STEEL FRAMING

E31.1 GENERAL

E31.1.1 RESPONSIBILITIES

General
General: Provide light steel floor, wall and roof framing that is:
- In conformance with the performance criteria documented.
- Integrated into the building.
- Suitable for the fixing to it of flooring, linings cladding and roofing.
- Independently designed and documented.
- Independently certified by a professional engineer for the design and the erected framing.

E31.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Structural steel
- Sundry items
- Lining

E31.1.3 STANDARDS

General
Design, materials and protection: To AS/NZS 4600.
Residential and low-rise steel framing: To NASH-1 (National Association of Steel Housing) Standard.

E31.1.4 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of steel framing erected on site before lining or cladding.

E31.1.5 SUBMISSIONS

Design
General: Where the structural drawings define performance criteria, submit independent design, documentation and certification from a professional engineer including for the erected work.
Reactions: Provide location and magnitude of reactions to be accommodated by the support structure.
Floor and wall frame member sizes: Submit a schedule of proposed member sizes, certified as meeting stated project and AS/NZS 4600 requirements for span, spacings and loadings.

Shop drawings
General: Submit shop detail drawings certified by a professional engineer stating that the design has been carried out in accordance with documented project and AS/NZS 4600 requirements for the configurations and loadings.
Roof beams: Prepare drawings to show:
- On a plan, the beam layout.
- On elevations, the arrangement of members allowing for the accommodation of in-roof services and the size and section type of each member.
- The method of assembly, connection, holding down and bracing.

Wall frames: If wall framing is to be pre-fabricated, prepare drawings to show:
- On plan, the wall layout.
- On elevations, the arrangement of members, and the size and section type of each member.
- The method of assembly, connection, holding down and bracing.
E31.1.6 TOLERANCES

General
Manufacturing and assembly tolerances: To NASH-1 Standard, Appendix D.
Installation tolerances for attachments to supporting structures, walls, trusses, rafters, ceiling joists and floor members: To NASH-1 Standard, Appendix D.

E31.2 PRODUCTS

E31.2.1 COMPONENTS

Cold-formed steel framing
Cold-form sections from metallic-coated steel to AS 1397.
Corrosion protection: To BCA 3.4.2.2.
Framing members
Cold-formed steel framing: For a proprietary system, comply with NASH-1.
Fascias and barge boards
Refer to Roofing.

E31.3 EXECUTION

E31.3.1 CONSTRUCTION GENERALLY

Fabrication
Length: Cut members accurately to length so that they fit firmly against abutting members.
Service holes: Form holes by drilling or punching.
Bushes: Provide plastic bushes or grommets to site cut holes.
- Swarf: Remove swarf and other debris from cold-formed steel framing immediately.
Site work: Do not fabricate on site where welded connections are required.
Fastening
Type: Select from the following:
- Bolting.
- Self-drilling, self-tapping screws.
- Blind rivets.
- Proprietary clinching system.
- Structural adhesives.
- Welding.
Welding
Avoid procedures that result in greater than localised ‘burning’ of the sheets or framing members.
Prefabricated frames
General: Protect frames from damage or distortion during storage, transport and erection.
Metal separation
General: Install lagging to separate non-ferrous service pipes and accessories from the framing.
Unseasoned or CCA treated timber
General: Do not fix in contact with framing without fully painting the timber and/or the steel.
Earthing
Permanent earthing: Required.
Temporary earthing: Provide temporary earthing during erection until the permanent earthing is installed.
Protection
General: Restore coatings which have been damaged by welding or other causes. Thoroughly clean affected areas to base metal and coat with zinc rich organic primer.
Grommets: Provide grommets to isolate piping and wiring from cold-formed steel framing.
Light steel framing

Swarf: Remove swarf and other debris from cold-formed steel framing immediately.

Certification
General: For components for which independent design certification has been required, provide independent certification for the erected components confirming compliance with the design intent.

E31.3.2 WALL FRAMING

Wall studs
General: Provide studs in single lengths without splices. Place a stud under, or within 40 mm from, each structural load point from roof or ceiling (except for openings). Provide multiple studs at points of concentrated load.
Maximum stud spacing: 600 mm.

Heads to openings
General: Provide lintels appropriate to load and span.

Additional support
General: Provide additional support in the form of noggings, trimmers and studs for support and fixing of lining, cladding, hardware, accessories, fixtures and fittings including grab rails in Toilets.

Vermin barriers
General: Provide vermin barriers as follows:
- Brick veneer barrier: Close nail 10 mm steel wire mesh to the underside of the bottom plate of external stud walls, extending across the cavity for building into brickwork.

Damp-proof course
General: Provide damp-proof courses under the bottom plate of stud walls built off slabs or masonry dwarf walls, as follows:
- External walls (not masonry veneer): Turn up at least 75 mm on the inside and tack. Project 10 mm beyond the external slab edge or dwarf wall and turn down at 45°.
- Walls of bathrooms, shower rooms and laundries: Turn up at least 150 mm on the 'wet' side and tack to studs.
Installation: Lay in long lengths. Lap full width at angles and intersections and at least 150 mm at joints.
Junctions: Preserve continuity of damp-proofing at junctions of damp-proof courses, sarking and waterproof membranes.

Flashings
Location: Provide flashings to external openings sufficient to prevent the entry of moisture. Form trays at the ends of sill flashings.
Masonry veneer construction: Extend across cavities and build into brickwork.

E31.3.3 ROOF FRAMING

General
Refer to structural engineer's drawings.

Beam framing
General: Construct framing for 'flat' or pitched roofs where the ceiling follows the roof line, consisting of rafters or purlins supporting both ceiling and roof covering.

Antiponding
Requirement: Fix appropriate members to the tops of framing at the rear of fascias, to prevent sagging of and ponding on the sarking.

Additional support
Provide a frame member behind every joint in fibre cement or plasterboard sheeting or lining.

Battens
Requirement: Supply and fix battens suitable for span, spacing and roofing.

E31.3.4 ROOF TRIM

Fascia, valley gutter and barge boards
Requirement: Supply and fix fascia, valley gutter and barge boards in accordance with the manufacturer's requirements.
E31.3.5 COMPLETION

Cleaning
General: On completion of framing remove debris from any gaps between members.
E32 WATERPROOFING – EXTERNAL AND TANKING

E32.1 GENERAL

E32.1.1 RESPONSIBILITIES

General
General: Provide roof and deck waterproofing systems to substrates, which are:
- Waterproof under five minutes duration rainfall intensity, which has an average recurrence interval of 100 years.
- Graded to falls to dispose of stormwater without ponding above the depth of lapped seams.
- Able to accommodate anticipated building movements.
- Able to accommodate its own shrinkage over the warranty life of the roofing system.
Selections: Conform to Selections as documented.

E32.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.

E32.1.3 STANDARDS

Membrane materials
Standard: To AS 4654.1.
Membrane design and installation
Standard: To AS 4654.2.
Stormwater drainage
Standard: To AS/NZS 3500.3.

E32.1.4 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions given in AS 4654.1 and AS 4654.2 and the following apply:
- Acrylic - liquid applied: Water based formulations which air dry to form plastic membranes.
- Bitumen: A viscous material from the distillation of crude oil comprising complex hydrocarbons, which is soluble in carbon disulphide, softens when it is heated, is waterproof and has good powers of adhesion. It is produced as a refined by-product of oil.
- SBS bitumen: Bitumen modified with Styrene Butadiene Styrene, a thermoplastic rubber that undergoes a phase inversion at elevated temperature and converts to an elastomeric material. The membrane is reinforced with fibreglass or non-woven polyester (NWP).
- APP bitumen: Bitumen modified with Atactic (meaning non-crystalline or amorphous) polypropylene wax to form a plastomeric sheet. The membrane is reinforced with fibreglass or non-woven polyester (NWP).
- Bond breakers: A system preventing a membrane bonding to the substrate, bedding or lining.
- Double detail joint: A joint formed by turning up and bonding the horizontal membrane to a vertical substrate and adding an overflashing of membrane material bonded to the vertical substrate and folded over and bonded to the horizontal membrane. In certain situations the 'double detail' can be achieved by bonding an angle profile of membrane material to the junction prior to laying the membrane.
- Elastomer: A polymer having elastic properties similar to rubber.
- Plasticised PVC: Rigid PVC made flexible with plasticisers to form a plastic sheet membrane (vinyl).
- Polyurethane - liquid applied: solvent based formulations which moisture cure to form an elastic rubber membrane.
- Seamless membranes: Membranes applied in liquid or gel form and air cured to form a seamless film.
- Slip sheets: Are used to isolate the membrane system from the supporting substrate or from the topping or mortar bedding above, are sometimes referred to as cleavage membranes, and are similar to bond breakers. The most common material is polyethylene sheeting.
- Substrate: The surface to which a material or product is applied.

**E32.1.5 INSPECTION**

**Notice**
Inspection: Give notice so that inspection may be made as follows:
- Substrate preparation completed.
- Secondary layers preparation completed.
- Before membranes are covered up or concealed.
- Underflashings complete before installation of overflashings.
- After flood testing.

**E32.1.6 SUBMISSIONS**

**Execution records**
Placing records: Photographically record the application of membranes and label with the following information:
- Date.
- Portion of work.
- Substrate preparation.
- Weather during application and curing.
- Protection provided from traffic and weather.

**Products documentation**
General: Submit copies of product manufacturer’s:
- Product technical data sheets.
- Material safety data sheets (MSDS).
- Preventative maintenance procedures.
- Instructions and procedures for the repair of the membrane.

**E32.2 PRODUCTS**

**E32.2.1 MEMBRANES**

**Membrane systems**
Requirement: Provide a proprietary membrane systems certified as suitable for the intended external waterproofing by the following:

**E32.2.2 ACCESSORIES**

**Control joint covers**
Corners, crossovers, tees and bends: Factory mitred, welded and provided with 500 mm legs. End closures: Factory folded and sealed to match joint cover profile.

**E32.2.3 DRAINAGE CELL PANELS**

**Walls**
Material: Atlantis 30mm wall panel with Atlantis 52mm Drainage Log.
Cell panel protection: [complete/delete]
Filter: Geotextile Fabric
Location:
- Behind walls of lift pits.
Behind retaining walls

E32.2.4 PROTECTION

Protection board
Description: Provide protection board to membrane behind retaining walls.
Type: As recommended by the membrane manufacturer.

E32.3 EXECUTION

E32.3.1 PREPARATION

General
Substrates: Prepare substrates as follows:
- Fill all cracks in substrates wider than 1.5 mm with a filler compatible with the membrane system.
- Fill voids and hollows in concrete substrates with a concrete mix not stronger than the substrate.
- Remove projections.
- Remove deleterious and loose material.
- Remove all traces of a concrete curing compound if used.
Leave the surface free of contaminants, clean and dust free.

Moisture content
Concrete substrates: Cure for > 21 days.
Moisture content: Verify that the moisture content of the substrate is compatible with the water vapour transmission rate of the membrane system by testing to AS/NZS 2455.1 Appendix B.
Test type: select from the following:
- Hygrometer test: Seal a hygrometer to the substrate for > 16 hours and measure the relative humidity of the air between the instrument and the slab.

Falls
Verify that falls in substrates are >1.5%.

Joints and fillets
Internal corners: Provide 45° fillets 50 x 50 mm.
Fillet Material: Cement
External corners: Round or arris edges.
Control joints: Prepare all substrate joints to suit the membrane system.

Priming
Compatibility: If required, prime the substrates with compatible primers to ensure adhesion of membrane systems.

E32.3.2 APPLICATION

Protection during installation
Damage: Protect membrane from damage during installation and for the period after installation until the membrane achieves its service characteristics that resist damage.

Drains
General: Prevent moisture from tracking under the membranes at drainage locations.
Drains and cages: Provide removable grates or cages to prevent blockage from debris. If the finished surface is above the level of the membrane provide a slotted extension piece to bring the grate up to the level of the finished surface.
Overflows: Apply a bond breaker to the perimeter of the overflow outlet at its junction with the surface to which the membrane will be fixed. Turn the membranes into the overflow to prevent moisture from tracking behind the membrane.

Sheet joints
Orientation of laps: Lap sheets on the upslope side of the roof fall over sheets on the downslope side.
End laps generally: Stagger end lap joints.

Bituminous sheet membranes:
- Side laps: 75 mm.
- End laps: 100 mm.

Synthetic rubber membranes:
- Factory-vulcanized laps > 40 mm.
- Field side laps > 50 mm for side laps.
- Field end-laps > 100 mm for end laps.

Plasticised PVC (Polyvinyl chloride) membranes:
- Factory welded laps > 30 mm.
- Field-welded laps:
  - If used over insulation boards > 100 mm.
  - Other instances > 75 mm overlaps.

**Curing of liquid applied systems**

General: To the manufacturers' instructions.

**Control of movement**

General: Provide control joints located over control joints in the substructure.

Fillets and bond breakers: Adequately size to allow the membrane to accommodate movement.

Control joint covers: Install after fixing hobs and membranes.

Bonded membranes: Carry control joints in the substrate through to and into the surface finish.

**Membrane terminations**

Membrane upturns: Provide upturns above the maximum water level expected from the exposure conditions of rainfall intensity and wind.
- Height: > 150 mm.
- Anchoring: Secure sheet membranes along the top edge.
- Edge protection: Protect edges of the membrane.
- Waterproofing above terminations: Waterproof the structure above the termination to prevent moisture entry behind the membrane using cavity flashings, capping, waterproof membranes or waterproof coatings.

Horizontal terminations: Do not provide.

**Overlaying finishes on membranes**

Compatibility: If a membrane is to be overlayed with another system such as tiles, pavers, ballast, insulation or soil, provide an overlaying system that is compatible with and will not cause damage to the membrane.

Bonded or partially bonded systems: If the topping or bedding mortar requires to be bonded to the membrane, provide sufficient control joints in the topping or bedding mortar to reduce the movement over the membrane.

Slip sheet: If the topping or bedding mortar is structurally sufficient not to require bonding to the substrate, lay a double slip sheet over the membrane to separate it from the topping or bedding mortar.

Paint coatings: If maintenance pathways are indicated by a paving paint, ensure compatibility with the membrane.

**E32.3.3 FLOOD TEST**

**General**

Application: Perform a flood test before the installation of surface finishes.

Set-up:
- Measure for dryness the wall/floor junction of adjacent spaces to the slab soffit below using electrical resistance testing to AS/NZS 2455.1 Appendix B.
- Record the result for each area.
- Dam the access openings and seal drainage outlets to allow 50 mm water level but no higher than 25 mm below the weir level of the perimeter flashings.
Provide temporary overflows of the same capacity as the roof outlets to maintain the flood level.
- Fill space with clean water and leave overnight.

Evaluation:
- Make a visual inspection of the wall/floor junction of adjacent spaces and of the slab soffit below for obvious water or moisture.
- Test the same areas for dryness using a moisture meter, and compare the results to the measurements taken before flooding.

Compliance:
- Evidence of water from the visual test: Failure.
- No visual evidence of water: Proceed with the moisture meter test.
- Increase in test results before and after flooding: Failure.

Records: Submit records of all flood tests.

E32.3.4 COMPLETION

Protection
General: Keep traffic off membrane surfaces until bonding has set or for 24 hours after laying, whichever period is the longer.

Reinstatement: Repair or replace faulty or damaged work. If the work cannot be repaired satisfactorily, replace the whole area affected.

Warranty
Waterproofing: Cover materials and workmanship in the terms of the warranty in the form of interlocking warranties from the supplier and the applicator.
- Form: Against failure of materials and execution under normal environment and use conditions.
- Period: As offered by the supplier, with a minimum of 15 years.

E32.4 SELECTIONS

E32.4.1 EXTERNAL WATERPROOFING SCHEDULES

Lift pits
Supply and install a two component waterproofing coating to walls of lift pits.

Description: A flexible waterproof coating against positive and negative pressure, suitable for application on concrete and masonry.

Proprietary item: Maxseal Flex or approved equivalent.

Preparation: In accordance with the manufacturer’s printed instructions

Application: In accordance with the manufacturer’s printed instructions.

Retaining walls
Supply and install Tremco TREMproof 3300 self-adhering cold applied sheet waterproofing membrane to all retaining walls.

Prepare substrates and apply membrane in accordance with the instructions of the manufacturer.
Provide protection board and drainage cells behind all membranes.
**E33 ROOFING**

**E33.1 GENERAL**

**E33.1.1 RESPONSIBILITIES**

General
General: Provide a roofing system and associated work which:
- Satisfies the product performance requirements.

**E33.1.2 CROSS REFERENCES**

General
Requirement: Conform to the following:
- General requirements.
- Light steel framing
- Roof access system

**E33.1.3 PERFORMANCE CRITERIA**

Ambient climatic conditions
Design rainfall intensity (mm/h) to AS/NZS 3500.3.

Bushfire prone areas
Level of construction to AS 3959.

Roof access
Type: Normal roof maintenance.

**E33.1.4 INSPECTION**

Notice
Inspection: Give notice so that inspection may be made of:
- Roof supports.
- Those parts of the roofing, sarking, vapour barrier, insulation and roof plumbing installation which will be covered up or concealed.

**E33.1.5 SUBMISSIONS**

Tests
Submit results of type tests as follows:
- Metal roofing general tests: Roof sheeting and fastenings to AS 1562.1 for resistance to concentrated load and to wind pressure.
- Metal roofing in cyclonic regions AS/NZS 1170.2: Roof sheeting and fastenings to AS 1562.1 clause 5.6.

Internal downpipes: Submit results of site tests to each stack hydrostatically in stages 2 storeys high for two hours. Remedy defects and retest if necessary.

Samples
Submit samples of:
- Sheet metal finishes.
- Custom profiled flashings and cappings.

**E33.2 PRODUCTS**

**E33.2.1 COMPONENTS**

Fasteners
Finish: Prefinish exposed fasteners with an oven baked polymer coating to match the roofing material.
Fastenings to timber battens: Provide fastenings just long enough to penetrate the thickness of the batten without piercing the underside.
Roofing

Profiled fillers
Provide: Purpose-made closed cell polyethylene foam profiled to match the roofing profile.
Locate profiled fillers under flashings to:
- Ridges.
- Eaves.
- Lapped joints in roof sheeting.

Safety mesh
Standard: To AS/NZS 4389.

E33.2.2 SHEET METAL ROOFING

Standards
Design and installation: To AS 1562.1.
Prepainted and organic film/metal laminate products: To AS/NZS 2728.

Roofing product
Location:
- New Platform Building
- New Lift shafts
- New canopies

Product brand: Ritek Roof Systems
Description: Roofing panels comprising Custom Orb Colorbond sheeting bonded on both sides of EPS insulation.

Panel thickness:
- New Platform Building: 140mm
- New Lift shafts: 75mm
- New canopies: 100mm

Insulation rating
- New Platform Building: R3.2 minimum

Colour of sheeting: Colorbond shale grey.

E33.2.3 ROOF PLUMBING

General
Standard: To AS/NZS 3500.3.
Requirement: Provide the flashings, cappings, gutters, rainwater heads, outlets and downpipes necessary to complete the roof system.

Materials
Metal rainwater goods: To AS/NZS 2179.1.
Metal: To match roofing panels
PVC rainwater goods and accessories: To AS/NZS 3500.3.

Proprietary flashings and cappings
Standard: To AS/NZS 2904.
Material and colour: Match roof sheeting.
Rib notching: Match roof sheeting.

Proprietary ridge and barge cappings
Material and colour: Match roof sheeting.

Eaves gutters
Product: Steel gutter
Type: Half round
Material and colour: Match roof sheeting.

Matching fascia/barge: If the selected eaves gutter is a proprietary high front pattern forming part of a combined system of gutter, fascia and barge, provide the matching proprietary fascias and barge cappings to roof verges and edges.
Roofing

Downpipes
Material: Colorbond steel
Colour: To match roofing
Profile: Circular
Size: 100mm diameter

Gratings
Gratings: Provide removable gratings over rainwater heads and sumps:

Leaf screens
Product: Leaf stopper or other approved equal.
Location: All outlets.

E33.3 EXECUTION

E33.3.1 INSTALLATION

Protection
General: Keep the roofing and rainwater system free of debris and loose material during construction, and leave them clean and unobstructed on completion. Repair damage to the roofing and rainwater system.
Touch up: If it is necessary to touch up minor damage to prepainted metal roofing, do not overspray onto undamaged surfaces.

Thermal movement
Requirement: Provide for thermal movement in the roof installation and the structure, including movement in joints and fastenings.

Pan type sheets
Removal: Capable of being de-indexed and removed without damage.
Curved corrugated sheet
General: Form by rolling from material recommended for curving or bullnosing. Minimise crimping or creasing across the face of the sheet. Trim off crimped or creased edges and ends.

Metal separation
Requirement: Prevent direct contact between incompatible metals, and between green hardwood or chemically treated timber and aluminium or coated steel, by either:
- Applying an anti-corrosion, low moisture transmission coating to contact surfaces.
- Inserting a separation layer.

Tolerances
Requirement: Conform to the Tolerances table.

Tolerances table

<table>
<thead>
<tr>
<th>Property</th>
<th>Tolerance criteria: Permitted deviation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spacing of supporting members</td>
<td>± 5 mm on the nominated support member spacing</td>
</tr>
<tr>
<td>Vertical or horizontal misalignment at the abutting ends of sheets</td>
<td>≤ 2 mm</td>
</tr>
<tr>
<td>Tops of supporting members in a plane parallel to the nominated roof slope</td>
<td>≤ 7 mm smooth deviation per metre length of supporting member</td>
</tr>
</tbody>
</table>

E33.3.2 PANEL ROOFING

Installation
Install roofing panels in accordance with the printed instructions of the manufacturer to achieve a complete watertight construction. Provide all screws and other fixing accessories.

Accessories: Provide material with the same finish as roofing sheets.

E33.3.3 BUILDING ELEMENTS

Ridges and eaves
Treat ends of sheets as follows:
- Project sheets 50 mm into gutters.
- Close off ribs at bottom of sheets using mechanical means or with purpose-made fillers or end caps.
- Turn pans of sheets up at tops and down into gutters by mechanical means.
- Provide pre-cut notched eaves flashing and birdproofing where necessary.
- Close off ridges with purpose-made ridge fillers of closed cell polyethylene.

**Ridge and barge**
Capping: Finish off along ridge and verge lines with purpose-made ridge capping or barge rolls.
End laps
Panels are to be in single lengths without end laps.

**E33.3.4 ROOF PLUMBING**

**Jointing sheet metal rainwater goods**
Butt joints: Make joints over a backing strip of the same material.
Soldered joints: Do not solder aluminium or aluminium/zinc-coated steel.
Sealing: Seal fasteners and mechanically fastened joints. Fill the holes of blind rivets with silicone sealant.

**Flashings**
Installation: Flash roof junctions, upstands, abutments and projections through the roof. Preform to required shapes where possible. Notch, scribe, flute or dress down as necessary to follow the profile of adjacent surfaces. Mitre angles and lap joints 150 mm in running lengths. Provide matching expansion joints at 6 m maximum intervals.
Upstands: Flash projections above or through the roof with two part flashings, consisting of a base flashing and a cover flashing, with at least 100 mm vertical overlap. Provide for independent movement between the roof and the projection.
Large penetrations: To low pitch roofs extend the base flashing over the roofing ribs to the ridge to prevent ponding behind the penetrating element.
Wall abutments: Provide overflashings where roofs abut walls, stepped to the roof slope in masonry and planked cladding, otherwise raking and as follows:
- In masonry: Build into the full width of the outer leaf. Turn up within cavity, sloping inward across the cavity and fixed to or built in to the inner leaf at least 75 mm above.
- In concrete: Turn 25 mm into joints or grooves, wedge at 200 mm centres with compatible material and point up.
Fixing to masonry or concrete: Step in courses to the roof slope. Interleave with damp proof course, if any.
Fixing to pipes: Solder, or seal with neutral cured silicone rubber and either of the following:
  - Secure with a clamping ring.
  - Provide a proprietary flexible clamping shoe with attached metal surround flashing.

**Gutters**
Gutter and sump support: Provide framing and lining to support valley gutters, box gutters and sumps. Line the whole area under the gutters and sumps.

**Downpipes**
General: Prefabricate downpipes to the required section and shape where possible. Connect heads to gutter outlets and, if applicable, connect feet to rainwater drains.
Access cover: Provide a removable watertight access cover at the foot of each downpipe stack.
Downpipe support: Provide supports and fixings for downpipes.

**Rainwater disposal**
System: Connect new downpipes to existing rainwater disposal system.

**E33.3.5 COMPLETION**

**Warranties**
Roofing materials: Submit the manufacturer's published product warranties.
Maintenance manual

On completion: Submit a manual of recommendations from the roof manufacturer or supplier for the maintenance of the roofing system including, frequency of inspection and recommended methods of access, inspection, cleaning, repair and replacement.
E34 CLADDING

E34.1 GENERAL

E34.1.1 RESPONSIBILITIES

General
General: Provide lightweight external wall cladding and associated work which is as follows:
- Satisfies the product performance requirements.

E34.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Light Steel framing

E34.1.3 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
- EIFS: External insulated finishing system.
- AAC: Autoclaved aerated concrete.

E34.1.4 INSPECTION

Notice
Inspection: Give sufficient notice so that the framing, sarking, vapour barrier and insulation may be inspected before they are covered up or concealed.

E34.1.5 SUBMISSIONS

Samples
Finish: Submit samples of the cladding material showing the range of variation available.

Installation

Tests
Submit results of type tests as follows:
- Metal cladding general tests: Sheeting and fastenings to AS 1562.1 for resistance to wind pressure.
- Metal cladding in cyclonic regions AS/NZS 1170.2: Metal cladding and fastenings to AS 1562.1 clause 5.6.
- Fibre cement cladding: Type test the wall sheeting and fixings to AS/NZS 1562.2 for resistance to wind forces.

E34.2 PRODUCTS

E34.2.1 SHEET METAL CLADDING

Standards
Design and installation: To AS 1562.1.
Prepainted and organic film/metal laminate products: To AS/NZS 2728.

E34.2.2 FIBRE CEMENT CLADDING

Fibre cement
Standard: To AS/NZS 2908.2.
Soffit linings: Type A Category 3 (modulus of rupture ≥ 7 MPa).
Compressed cladding: Type A Category 5 (modulus of rupture ≥ 18 MPa).
- Edges: Square.
Sheet cladding
General: Provide a proprietary system of single faced fibre cement sheets.
Arrangement: Set out in even panels with joints coinciding with framing.
Sheet thickness: 6 mm.
Joints, corners and edges: UPVC extrusion.

Soffit lining
Sheets: Single faced fibre cement.
Sheet thickness: 4.5 mm.
Joints: UPVC extrusion.

Compressed fibre cement cladding
Location: Storage Cupboard and TVM recess in Platform Building.
Sheet thickness: 9 mm
Joints, corners and edges: Set.
Junctions with other cladding materials: As shown on drawings.
Fixings: as recommended by the sheet manufacturer.

E34.2.3 PROPRIETARY SYSTEMS

Cladding product
Location:
- Lift shaft walls
- Platform Building
Product brand: HH Robertson or approved equivalent
Product material type: Vitreous enameled panel
Standard: The panels shall be in accordance with the current edition of the Specification "Architectural vitreous enamel on steel for exterior use PEI: S100 of the Porcelain Enamel Institute Inc, Washington DC, USA"
Material: 1.6mm thick steel sheet, manufactured to the shapes and sizes to withstand all loads as specified and to comply with the tolerances regarding thickness, straightness, finishing and flatness. All steel shall be decarburised (maximum carbon content (0.006%) suitable for coating on both sides
Backing material: 12mm thick calcium silicate board bonded to steel panel with a high performance epoxy resin compatible with the backing material to meet specified performance criteria.
Size of panels: Panels to be of varying sizes as shown on drawings
Colour: Range of 4 colours as detailed in the Finishes Schedule.
Pattern: Panels of different colours to be set out in the patterns shown on drawings.
Joints: Non-hardening sealant as recommended by the cladding system manufacturer.

E34.2.4 COMPONENTS

Flashings
Standard: To AS/NZS 2904.
Material: Colorbond steel
Colour: To match cladding

E34.3 EXECUTION

E34.3.1 TOLERANCES

Tolerances
Requirement: Conform to the Tolerances table.

<table>
<thead>
<tr>
<th>Property</th>
<th>Tolerance criteria: Permitted deviation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spacing of supporting members</td>
<td>± 5 mm on the nominated support member spacing</td>
</tr>
</tbody>
</table>
Cladding

<table>
<thead>
<tr>
<th>Property</th>
<th>Tolerance criteria: Permitted deviation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical or horizontal misalignment at the abutting ends of cladding</td>
<td>≤ 2 mm</td>
</tr>
</tbody>
</table>

E34.3.2 CONSTRUCTION GENERALLY

Substrates or framing
Requirement: Before fixing cladding check and, if necessary, adjust the alignment of substrates or framing.
Fixing
Method: Nail to timber framing, screw to steel framing.
Accessories and trim
Requirement: Provide accessories and trim necessary to complete the installation.
Fixing eaves and soffit lining
Nailing: 150 mm centres to bearers at maximum 450 mm centres.

Metal separation
Requirement: Prevent direct contact between incompatible metals, and between green hardwood or chemically treated timber and aluminium or coated steel, by either:
- Applying an anti-corrosion, low moisture transmission coating to contact surfaces.
- Inserting a separation layer.

E34.3.3 PROPRIETARY SYSTEMS OR PRODUCTS

Installation
Product fixings: Fix the following proprietary systems in accordance with the current written recommendations and instructions of the manufacturer or supplier:
- Complete cladding systems.
- Aluminium sandwich panel cladding systems.
- EIFS cladding systems.

E34.3.4 SHEET METAL CLADDING

Cladding sheet installation
Install panels of various colours in the layout shown on drawings.
Fixing: Concealed fixing with silicone joints.
Swarf: Remove swarf and other debris as soon as it is deposited.
Accessories: Provide material with the same finish as cladding sheets.
Expansion joints: Provide in accordance with the recommendations of the manufacturer.
Corner flashing
Requirement: Finish off at corners with purpose-made folded flashing strips.

E34.3.5 COMPLETION

Warranties
Cladding materials: Submit the manufacturer’s published product warranties.
E35 WINDOWS

E35.1 GENERAL

E35.1.1 RESPONSIBILITIES

General
General: Conform to the Selections.

Maintenance
Product design: Provide windows with sashes capable of being opened to satisfy the documented maintenance requirements.

E35.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.

E35.1.3 STANDARDS

General
Selection and installation: To AS 2047.
- Building classification: Class 9B and Class 5.

Glazing
Glass type and thickness: To AS 1288, where no glass type or thickness is nominated.
Materials and installation: To AS 1288.
Quality requirements for cut-to-size and processed glass: To AS/NZS 4667.
Terminology for work on glass: To AS/NZS 4668.

E35.1.4 INTERPRETATION

Definitions
General: For the purposes of this worksection the following definitions apply:
- Louvres:
  . Horizontal: Louvres that span between frames stiles, mullions or vertical supports.
  . Continuous horizontal: Louvres that run continuously past, and are supported by, concealed framing or brackets.
  . Vertical: Louvres that span between frame heads and sills, or horizontal supports.
- Window: The term 'window' used in this worksection also means 'louvre grille' where the grille forms part of the window assembly.
- U-value: Total U-Value as defined by BCA and determined in accordance with NFRC 100.
- SHGC: Solar heat gain coefficient as defined by BCA and determined in accordance with NFRC 200.

E35.1.5 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Openings prepared to receive windows (where windows are to be installed in prepared openings).
- Fabricated window assemblies at the factory ready for delivery to the site.
- Fabricated window assemblies delivered to the site, before installation.
- Commencement of window installation.

E35.1.6 SUBMISSIONS

Samples
Submit samples of window and door framing as follows:
- Accessory and hardware items documented descriptively or by performance (i.e. not documented as proprietary items) including locks, latches, handles, catches, sash operators, anchor brackets and attachments, masonry anchors and weather seals (pile or extruded).

- Colour samples of prefinished production material (e.g. anodised or organic coated extrusions and sheet) showing the limits of the range of variation in the selected colour.

- Joints made by proposed techniques.

- Sections proposed to be used for frames, sashes, louvres and slats.

- Label each sample, giving the Series code reference and date of manufacture.

Submit samples of glazing materials, each at least 200 x 200 mm, showing documented visual properties and the range of variation, if any, for each of the following types of glass or glazing plastics:

- Tinted or coloured glass or glazing plastics.

- Surface modified or surface coated glass.

- Patterned or obscured glass or glazing plastics.

- Mirror glass.

Sealant compatibility

Compatibility statements: Submit statements from all parties to the installation that certify the compatibility of sealants and glazing systems to all substrates.

Samples in prototypes: Required samples may form part of prototypes.

Shop drawings

Submit shop drawings to a scale that best describes the detail, showing the following information:

- Full size sections of members.

- Hardware, fittings and accessories including fixing details.

- Junctions and trim to adjoining surfaces.

- Layout (sectional plan and elevation) of the window assembly.

- Lubrication requirements.

- Methods of assembly.

- Methods of installation, including fixing, caulking and flashing.

- Provision for vertical and horizontal expansion.

- Method of glazing, including the following:

  - Rebate depth.

  - Edge restraint.

  - Clearances and tolerances.

  - Glazing gaskets and sealant beads.

Certification: Submit an engineers' certificate confirming compliance with AS 2047.

Subcontractors

General: Submit names and contact details of proposed manufacturers and installers. Have windows and glazed doors installed by their manufacturer or by a subcontractor recommended by the manufacturer.

E35.2 PRODUCTS

E35.2.1 GENERAL

Standards

Flashings: To AS/NZS 2904.

Aluminium extrusions: To AS/NZS 1866.

E35.2.2 GLASS

Glass types and quality

Standard: To AS/NZS 4667.
Glazing plastics
General: Free from surface abrasions, and warranted by the manufacturer for 10 years against yellowing or other colour change, loss of strength and impact resistance, and general deterioration.

Bullet-resistant glazing panels
Standard: To AS/NZS 2343.
Classification: Class G2
Panel materials: Glass
Panel opacity: Transparent

Safety glasses
Standard: To AS/NZS 2208.
Certification: Required.
Certification provider: An organisation accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).
Type: Grade A.

Unacceptable blemishes in heat-treated flat glass (including tinted and coated glass)
Standard: To AS/NZS 4667.

E35.2.3 GLAZING MATERIALS

General
Glazing materials (including putty, glazing compounds, sealants, gaskets, glazing tapes, spacing strips, spacing tapes, spacers, setting blocks and compression wedges): Appropriate for the conditions of application and the required performance.

Jointing materials
Requirement: Provide recommended jointing and pointing materials which are compatible with each other and with the contact surfaces and non staining to finished surfaces. Do not provide bituminous materials on absorbent surfaces.

Priming
Application: Apply the recommended primer to the surfaces in contact with sealant materials.

Control joints
Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.
Foamed materials (in compressible fillers and backing rods): Closed-cell or impregnated types which do not absorb water.
Bond breaking: Provide backing rods, and other back-up materials for sealants, which do not adhere to the sealant.

E35.2.4 GLASS IDENTIFICATION

Safety glazing materials
Identification: Identify each piece or panel, to AS 1288.

Bullet-resistant panels
Marking: To AS/NZS 2343.

E35.2.5 LOUVRE WINDOW ASSEMBLIES

General
General: Provide louvre blades mounted in a metal surround frame or subframe and able to withstand the permissible-stress-design wind pressure for that location without failure or permanent distortion of members, and without blade flutter.

Framing
Framing to Louvre assemblies shall be similar to window framing and installed as for metal window installations.

LOUVRE
Screens
Requirement: Provide metallic-coated steel wire or UPVC mesh screens behind louvres to prevent the entry of vermin, birds, rodents and wind blown leaves and papers.
E35.2.6 ALUMINIUM FRAME FINISHES

Powder coatings
Standard: To AS 3715.
Grade: Architectural coating.
Anodised
Standard: To AS 1231.
Thickness: ≥ 15 microns to 20 microns.
Colour: Natural

E35.2.7 GLAZING FILM

Materials
Anti-blast film to inside of glazing
Anti graffiti film on inside.
Installation
Adhesive fix in accordance with the manufacturer’s recommendations.

E35.2.8 ANCILLARY MATERIALS

Trims
Timber: Solid timber at least 19 mm thick, mitred at corners.

Extruded gaskets and seals
General: Provide seals to the Window and glazed door seal schedule.
Materials: Non cellular (solid) elastopressive seals as follows:
  - Flexible polyvinyl chloride (PVC): To BS 2571, 100% solids with high consistency, ultra-violet stabilised.
  - Rubber products (neoprene, ethylene propylene diene monomer (EPDM) or silicone rubber): To BS 4255-1.

Flashings
General: Corrosion resistant, compatible with the other materials in the installation, and coated with a non-staining compound where necessary.
Standard: To AS/NZS 2904.

Jointing materials
General: Compatible with each other and with the contact surfaces and non staining to finished surfaces. Do not provide bituminous materials on absorbent surfaces.

Nylon brush seals
General: Dense nylon bristles locked into galvanized steel strips and fixed in a groove in the edge of the door or in purpose-made anodised aluminium holders fixed to the door with double sided PVC foam tape.

Pile weather strips
General: Polypropylene or equivalent pile and backing, low friction silicone treated, ultra-violet stabilised.
Standard: To AAMA 701/702.

Weather bars
General: Provide a weather bar under hinged external doors, locate under the centres of closed doors.

E35.2.9 MIRRORS

General
Type: Silver layer deposited on glass or glazing plastic.
Protective coatings: Electrolytic copper coating at least 5μm thick and 2 coats of mirror backing and edge sealing paint having a total dry film thickness of at least 50μm.
E35.3 EXECUTION

E35.3.1 GLASS PROCESSING

General
Processing: Perform required processes on glass, including cutting, obscuring, silvering and bending. Form necessary holes, including for fixings, equipment, access openings and speaking holes. Process exposed glass edges to a finish not inferior to ground arised.

E35.3.2 INSTALLATION

Glazing
General: Install the glass so that:
- Each piece is held firmly in place by permanent means which enable it to withstand the normal loadings and ambient conditions at its location without distortion or damage to glass and glazing materials.
- Building movements are not transferred to the glass.
- External glazing is watertight and airtight.
Temporary marking: Use a method which does not harm the glass. Remove marking on completion.
Toughened glass: Do not cut, work, or permanently mark after toughening. Use installation methods which prevent the glass making direct contact with metals or other non-resilient materials.
Heat absorbing glass: In locations exposed to direct sunlight, provide wheel cut edges free from damage or blemishes, with minimum feather.

Preglazing
Window assemblies and glazed doors: Supply inclusive of glazing, shop preglazed.

Windows
General: Install windows so that the frames:
- Are plumb, level, straight and true within acceptable building tolerances.
- Are fixed or anchored to the building structure in conformance with the wind action loading requirements.
- Will not carry any building loads, including loads caused by structural deflection or shortening.
- Allow for thermal movement.

Weatherproofing
Flashings and weatherings: Install flashings, weather bars, drips, storm moulds, caulking and pointing so that water is prevented from penetrating the building between the window frame and the building structure under the prevailing service conditions, including normal structural movement of the building.

Fixing
Fasteners and fastener spacing: Conform to the recommendations of the manufacturer.
Fasteners: Conceal fasteners.
Packing: Pack behind fixing points with durable full width packing.
Prepared masonry openings: If fixing of timber windows to prepared anchorages needs fastening from the frame face, sink the fastener heads below the surface and fill the sinking flush with a material compatible with the surface finish.

Joints
General: Make accurately fitted tight joints so that neither fasteners nor fixing devices such as pins, screws, adhesives and pressure indentations are visible on exposed surfaces.
Sealants: If priming is recommended, prime surfaces in contact with jointing materials. If frames are powder coated apply a neutral cure sealant.

Operation
General: Ensure moving parts operate freely and smoothly, without binding or sticking, at correct tensions or operating forces and are lubricated.

Protection
Removal: Remove temporary protection measures from the following:
- Contact mating surfaces before joining up.
- Exposed surfaces.

**In situ touch up**
Polyester or fluoropolymer coatings: Contact supplier for approval to apply touch up products otherwise replace damaged material.

**Trim**
General: Provide mouldings, architraves, reveal linings, and other internal trim using materials and finishes matching the window frames. Install to make neat and clean junctions between frames and the adjoining building surfaces.

**E35.3.3 LOUVRE ASSEMBLIES**

**Installation**
General: Screw fix stiles and mullions to the building structure. Provide weather strips to heads and sills.

**Metal louvres**
General: Provide metal louvre blades mounted in a metal surround frame or subframe, installed as for metal window installations.

**E35.3.4 COMPLETION**

**Trade clean**
Method: Clean with soft clean cloths and clean water, finishing with a clean squeegee. Do not use abrasive or alkaline materials.

**Extent:** All frames and glass surfaces inside and out.

**Maintenance manual**
General: Submit the window and glazed door manufacturer's published instructions for operation, care and maintenance.

**Warranties**
Window and door assemblies: Submit the manufacturer's published product warranties.

**E35.4 SELECTIONS**

**E35.4.1 WINDOWS AND GLAZED DOORS**

Window construction schedule

<table>
<thead>
<tr>
<th>Location</th>
<th>Description</th>
<th>Value/description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New Platform Building</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A - Windows</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product name</td>
<td>G James 475 series frames or approved equivalent</td>
<td></td>
</tr>
<tr>
<td>Frame size</td>
<td>100mm, with 35mm rebates as required by TINSW</td>
<td></td>
</tr>
<tr>
<td>Suite description</td>
<td>Fixed glazing and fixed glazing combined with louvres</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>Aluminium</td>
<td></td>
</tr>
<tr>
<td>Finish</td>
<td>Anodised</td>
<td></td>
</tr>
<tr>
<td>Glazing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Manufacturer</td>
<td>Viridian New World Glass</td>
<td></td>
</tr>
<tr>
<td>- Type</td>
<td>&quot;VFloat&quot; Laminated annealed safety glass</td>
<td></td>
</tr>
<tr>
<td>- Colour</td>
<td>Super Green</td>
<td></td>
</tr>
<tr>
<td>- Thickness</td>
<td>10.38mm</td>
<td></td>
</tr>
<tr>
<td>- Film</td>
<td>Anti-blast film on inside and anti-graffiti film on the outside</td>
<td></td>
</tr>
<tr>
<td>B - Louvres</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Description</td>
<td>Value/description</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>New Platform Building</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Supplier</td>
<td>Architectural Louvre Products and Services (ALPS)</td>
<td></td>
</tr>
<tr>
<td>- Frame</td>
<td>As for glazing</td>
<td></td>
</tr>
<tr>
<td>- Type</td>
<td>Aluminium Double Bank Louvres, Type 2UL/SH, with insect and vermin proofing</td>
<td></td>
</tr>
<tr>
<td>- Blade material</td>
<td>Aluminium</td>
<td></td>
</tr>
<tr>
<td>- Finish</td>
<td>Anodised</td>
<td></td>
</tr>
<tr>
<td>- Ventilation</td>
<td>50% open area in accordance with the mechanical services drawings</td>
<td></td>
</tr>
<tr>
<td><strong>Lift Shafts</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A - Windows</td>
<td>G James 475 series frames or approved equivalent</td>
<td></td>
</tr>
<tr>
<td>Product name</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frame size</td>
<td>100mm, with 35mm rebates as required by TfNSW</td>
<td></td>
</tr>
<tr>
<td>Suite description</td>
<td>Fixed glazing and louvres</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>Aluminium</td>
<td></td>
</tr>
<tr>
<td>Finish</td>
<td>Anodised</td>
<td></td>
</tr>
<tr>
<td>Glazing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Manufacturer</td>
<td>Viridian New World Glass</td>
<td></td>
</tr>
<tr>
<td>- Type</td>
<td>“VFloat” Laminated annealed safety glass</td>
<td></td>
</tr>
<tr>
<td>- Colour</td>
<td>Super Green</td>
<td></td>
</tr>
<tr>
<td>- Thickness</td>
<td>10.38mm</td>
<td></td>
</tr>
<tr>
<td>- Film</td>
<td>Anti-blast film on inside and anti-graffiti film on the outside</td>
<td></td>
</tr>
<tr>
<td>B - Louvres</td>
<td>Architectural Louvre Products and Services (ALPS)</td>
<td></td>
</tr>
<tr>
<td>- Supplier</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Frame</td>
<td>As for glazing</td>
<td></td>
</tr>
<tr>
<td>- Type</td>
<td>Aluminium Double Bank Louvres, Type 2UL/SH, with insect and vermin proofing</td>
<td></td>
</tr>
<tr>
<td>- Blade material</td>
<td>Aluminium</td>
<td></td>
</tr>
<tr>
<td>- Finish</td>
<td>Anodised</td>
<td></td>
</tr>
<tr>
<td>- Ventilation</td>
<td>50% open area in accordance with the mechanical services drawings</td>
<td></td>
</tr>
<tr>
<td>- U Value</td>
<td>5.8</td>
<td></td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td><strong>Description</strong></td>
<td><strong>Value/description</strong></td>
</tr>
<tr>
<td><strong>New Platform Building</strong></td>
<td>Ticket window</td>
<td>Refer to Metalwork</td>
</tr>
<tr>
<td><strong>Ticket Office</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Louvre screens</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td><strong>Description</strong></td>
<td><strong>Value/description</strong></td>
</tr>
<tr>
<td><strong>Screens at Lift landings</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Louvre screens</td>
<td>Each screen is to be consist of 9 panels</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Description</td>
<td>Value/description</td>
</tr>
<tr>
<td>----------------</td>
<td>--------------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>- Supplier</td>
<td>CS Group</td>
<td>-</td>
</tr>
<tr>
<td>- Frame</td>
<td>As for glazing</td>
<td>-</td>
</tr>
<tr>
<td>- Type</td>
<td>Z shaped louvres, set vertically or</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>horizontally as shown on drawings</td>
<td>-</td>
</tr>
<tr>
<td>- Blade material</td>
<td>Aluminium</td>
<td>-</td>
</tr>
<tr>
<td>- Finish</td>
<td>Anodised</td>
<td>-</td>
</tr>
</tbody>
</table>

### E35.4.2 MIRRORS

#### Mirror schedule

**Location:** Family Access Toilet

- **Type:** Wall mounted frameless mirror extending from skirting tile to ceiling
- **Size:** Refer to drawings
- **Fixing:** Screw fixed to walls

**Location:** Staff Toilet

- **Type:** One wall mounted frameless mirror extending from skirting tile to ceiling, and one wall mounted frameless mirror above basin.
- **Size:** Refer to drawings
- **Fixing:** Screw fixed to walls
E25 DOORS

E25.1 GENERAL

E25.1.1 RESPONSIBILITIES

General
General: Provide doors, frames, doorsets, security screen doors and fire doorsets as documented.

E25.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Door hardware

E25.1.3 INTERPRETATION

Definitions
General: For the purposes of this worksection the following definitions apply:
- Balanced construction: A construction of flush doors in which the facings on one side of the core are essentially equal in thickness, grain direction, properties and arrangement to those on the other side of the core. It is such that uniformly distributed changes in moisture content will not cause warpage.
- Door frame: Includes jamb linings.
- Doorset: An assembly comprising a door or doors and supporting frame, guides and tracks including the hardware and accessories necessary for operation.
  - Fire-doorset: A doorset which retains its integrity, provides insulation and limits, if required, the transmittance of radiation in a fire.
  - Smoke-doorset: A doorset which restricts the passage of smoke.
- Flush door: A door leaf having two plane faces which entirely cover and conceal its structure. It includes doors with intermediate rail, cellular, blockboard and particleboard cores.
  - Solid core door: A flush door with a solid core continuous between stiles and rails or edge strips and fully bonded to the faces.
- Joinery door: A door leaf having either stiles and rails, or stiles, rails and muntins, framed together. A joinery door may also incorporate glazing bars.
  - Louvred door: A joinery door in which the panel spaces are filled in with louvre blades.
  - Panelled door: A joinery door with spaces filled in with panels including glass.

E25.1.4 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Door frames in place before building in to masonry.
- Door frames installed before fixing trim.

E25.1.5 SUBMISSIONS

General
General: Submit 2 samples as follows:
- Colour range samples from prefinished production material (e.g. anodised or organic coated extrusions and sheet). When the colour selection has been made, submit 5 sets of samples showing the colour range.
- Door manufacturer's standard hardware items.
- Finishes to prepared surfaces.
- Joints made using proposed techniques.
- Sections proposed to be used for frames, louvres and slats.
Type tests
General: Submit type-test certification complying with the following standards to verify conformance with the Doorsets performance schedule:
- Fire and smoke doors: To AS 1905.1 and BCA Spec C3.4.
- Weighted sound reduction index ($R_0$): To AS/NZS 1276.1, ISO 717-1 or AS/NZS ISO 717.1.

Maintenance documentation
Recommendations: Submit manufacturer's published recommendations for service use.

E25.2 PRODUCTS

E25.2.1 FRAMES

Steel frames
General: Continuously welded from metallic-coated steel sheet sections, including necessary accessories such as buffers, strike plates, spreaders, mortar guards, switch boxes, fixing ties or brackets, and cavity flashing with suitable provision for fixing hardware and electronic security assemblies, and prefinished with a protective coating.

Finish: Grind the welds smooth, cold galvanize the welded joints and shop prime.

Hardware and accessories: Provide for fixing hardware including hinges and closers, using 4 mm backplates and lugs. Screw fix the hinges into tapped holes in the back plates.

Base metal thickness:
- General: $\geq 1.1$ mm.
- Fire rated doorsets: $\geq 1.4$ mm.
- Security doorsets: $\geq 1.6$ mm.

Metallic-coated steel sheet: To AS 1397.
- Coating class interior: Z275.
- Coating class exterior: Z450.

E25.2.2 DOORS

Standards
Materials: To the following:
- Decorative laminated sheets: To AS/NZS 2924.1.
- Wet processed fibreboard (including hardboard): To AS/NZS 1859.4.
- Dry processed fibreboard (including medium density fibreboard): To AS/NZS 1859.2.
- Particleboard: To AS/NZS 1859.1.
- Plywood and blockboard for interior use: To AS/NZS 2270.
- Plywood and blockboard for exterior use: To AS/NZS 2271.
- Seasoned cypress pine: To AS 1810.
- Timber - hardwood: To AS 2796.1.
- Timber - softwood: To AS 4785.1.

Certification
General: Brand panels under the authority of a recognised certification program applicable to the product. Locate the brand on faces or edges which will be concealed in the works.

General
Doors: Proprietary products manufactured for interior or exterior applications and for the finish required.

Flush doors
General: Of balanced construction.

Cellular core and intermediate rail core flush doors:
- Provide a subframe of 25 mm minimum width timber around openings for louvres and glazing.
- Provide additional material to take hardware, fastenings and grooves.
- Cut outs: If openings are required in flush doors (e.g. for louvres or glazing) make the cut outs not closer than the width of the styles at the edges of the doors.

Solid core: Solid flush doors as follows:
- Flush door with blockboard: Core plate of timber strips laid edge to edge, fully bonded to each other and to facings each side of no less than two sheets of timber veneer.
- Single thickness of moisture resistant general purpose medium density fibreboard.

Smoke doors: Solid core ≥ 35 mm thick.

**Construction**

**Adhesives:**
- Internal: To AS/NZS 2270.
- External: To AS/NZS 2271.

Door thickness:
- General: 35 mm.
- External doors and doors over 900 mm wide: 40 mm.

Edge strips: Fix to stiles. Minimum thickness 10 mm. Increase overall thickness to > 15 mm to accommodate the full depth of the rebate in rebated doors. Form rebates to suit standard rebated hardware. Bevel square edged doors as necessary to prevent binding between the leaves.

Louver grilles: Construct by inserting the louvre blades into a louvre frame, and fix the frame into the door.

**Tolerance**

Squareness: The difference between the lengths of diagonals of a door: ≤ 3 mm.

Twist: The difference between perpendicular measurements taken from diagonal corners: ≤ 3 mm.

Nominal size (mm):
- Height: +0, -2.
- Width: +0, -2.

**E25.2.3 DOORSETS**

**Duct access panels**
General: Proprietary products comprising metal-faced doors side hung to steel door frames, inclusive of the necessary hardware and accessories including hinges and lock and lugs or other suitable means for installation.

**Fire-resistant doorsets**
Standard: To AS 1905.1 and BCA Spec C3.4.

**E25.2.4 ANCILLARY MATERIALS**

**Trims**
Timber: Solid timber at least 19 mm thick, mitred at corners.

**Extruded gaskets and seals**
General: Provide seals to the Door seal schedule.

Materials: Non cellular (solid) elastopressive seals as follows:
- Flexible polyvinyl chloride (PVC): To BS 2571, 100% solids with high consistency, ultra-violet stabilised.
- Rubber products (neoprene, ethylene propylene diene monomer (EPDM) or silicone rubber): To BS 4255-1.

**Flashings**
General: Corrosion resistant, compatible with the other materials in the installation, and coated with a non-staining compound where necessary.

Standard: To AS/NZS 2904.

**Jointing materials**
General: Compatible with each other and with the contact surfaces and non staining to finished surfaces. Do not provide bituminous materials on absorbent surfaces.
Nylon brush seals
General: Dense nylon bristles locked into galvanized steel strips and fixed in a groove in the edge of the door or in purpose-made anodised aluminium holders fixed to the door with double sided PVC foam tape.

Pile weather strips
General: Polypropylene or equivalent pile and backing, low friction silicone treated, ultra-violet stabilised.
Standard: To AAMA 701/702.

Weather bars
General: Provide a weather bar under hinged external doors, locate under the centres of closed doors.

E25.3 EXECUTION

E25.3.1 FRAMES

General
Frames: Install so that the frames are as follows:
- Plumb, level, straight and true.
- Fixed or anchored to the building structure.
- Will not carry any building loads, including loads caused by structural deflection or shortening.

Frame fixing
Brackets: Metallic-coated steel:
- Width: ≥ 25 mm.
- Thickness: ≥ 1.5 mm.
Depth of fixing for building into masonry:
- Brackets: ≥ 200 mm.
- Expansion anchors: ≥ 50 mm.
- Plugs: ≥ 50 mm.
- Rods: ≥ 60 mm.
Heads of fasteners: Conceal where possible, otherwise sink the head below the surface and fill the sinking flush with a material compatible with the surface finish.
Jamb fixing centres: ≤ 600 mm.

Joints
General: Make accurately fitted joints so that no fasteners, pins, screws, adhesives and pressure indentations are visible on exposed surfaces.

Steel frames
Building in to masonry: Attach galvanized steel rods to jambs, build in and grout up.
Fixing to masonry openings: Build in hairpin anchors and install locking bars, or use proprietary expansion anchors and screw twice through jambs at each fixing.
Fixing to stud frame openings: Attach galvanized steel brackets to jambs and screw twice to studs at each fixing.

Weatherproofing
Flashings and weatherings: Install flashings, weather bars, drips, storm moulds, caulking and pointing to prevent water from penetrating the building between the door frame and the building structure under the prevailing service conditions, including normal structural movement of the building.

Finishing
Trim: Provide mouldings, architraves, reveal linings, and other internal trim using materials and finishes matching the door frames. Install to make neat and clean junctions between the frame and the adjoining building surfaces.

E25.3.2 DOORS

Priming
General: Prime timber door leaves on top and bottom edges before installation.
E25.3.3 COMPLETION

Operation
General: Make sure moving parts operate freely and smoothly, without binding or sticking, at correct tensions or operating forces and that they are lubricated where appropriate.

Protection
Temporary coating: On or before completion of the works, or before joining up to other surfaces, remove all traces of temporary coatings used as a means of protection.

E25.4 SELECTIONS

E25.4.1 DOOR SCHEDULE

<table>
<thead>
<tr>
<th>Door No</th>
<th>Door Location</th>
<th>Door Type</th>
<th>Leaf Size H x W x T</th>
<th>Leaf finish</th>
<th>Frame Type</th>
<th>Frame Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.01</td>
<td>Station Building Entry</td>
<td>External, single leaf, solid core with metal lining</td>
<td>2040 x 920 x 40</td>
<td>Paint</td>
<td>Steel Double rebate</td>
<td>Paint</td>
</tr>
<tr>
<td>D.02</td>
<td>Station Building Ticket Office</td>
<td>Internal, single leaf, solid core with plywood lining</td>
<td>2040 x 920 x 40</td>
<td>Paint</td>
<td>Steel Double rebate</td>
<td>Paint</td>
</tr>
<tr>
<td>D.03</td>
<td>Station Building Cleaners Room</td>
<td>Internal, single leaf, solid core with plywood lining</td>
<td>2040 x 920 x 40</td>
<td>Paint</td>
<td>Steel Double rebate</td>
<td>Paint</td>
</tr>
<tr>
<td>D.04</td>
<td>Station Building Staff Toilet</td>
<td>Internal, single leaf, solid core with plywood lining</td>
<td>2040 x 920 x 40</td>
<td>Paint</td>
<td>Steel Double rebate</td>
<td>Paint</td>
</tr>
<tr>
<td>D.05</td>
<td>Station Building Family Accessible Toilet</td>
<td>External, single leaf, solid core with metal lining</td>
<td>2040 x 920 x 40</td>
<td>Paint</td>
<td>Steel Double rebate</td>
<td>Paint</td>
</tr>
<tr>
<td>D.06</td>
<td>Storage Area</td>
<td>External, double leaf, solid core with metal lining</td>
<td>2040 x 1260 x 40</td>
<td>Paint</td>
<td>Steel Double rebate</td>
<td>Paint</td>
</tr>
</tbody>
</table>
E26 OVERHEAD DOORS

E26.1 GENERAL

E26.1.1 RESPONSIBILITIES

General
General: Provide overhead doorsets as scheduled in Selections.

E26.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.

E26.1.3 STANDARDS

General
Garage doors: To AS/NZS 4505.
Bushfire screens and seals: To AS 3959.

E26.1.4 INSPECTION

Notice
Inspection: Give sufficient notice so that inspection may be made of the following:
- Tracks and guides installed before doors or shutters are hung.

E26.2 PRODUCTS

E26.2.1 WINDOW SHUTTER

Types
Window shutter: Proprietary system comprising a flexible continuous curtain sliding between vertical guides, raised or lowered by rolling or unrolling around a horizontal drum (barrel) mounted above the opening, inclusive of the manufacturer’s standard operating gear, hardware, and accessories necessary for satisfactory performance.

Wind actions
General: Install so that the shutter, in its closed position, withstands pressure on the surface without impairment of its ability to function.

Curtain
Continuous curtain: A single metal sheet pressed to a horizontal ribbed profile.
Slatted curtain: A curtain of horizontal interlocking slats, incorporating interlocking hinges extending the full width of the curtain.
Bottom curtain rail: A stiffening member interlocking with the bottom edge or lowest slat of the curtain, extending between the inner faces of the vertical guides, formed or adapted where necessary to follow the contour of a sloping floor or threshold. The rail may also be adapted to house the locking device.

Drum
Maximum drum deflection: 1/360th of the span.
Springs: Helical torsion springs housed in the drum and arranged to counterbalance the curtain weight without exceeding the safe working stress of the spring material.

Operation
Method of raising and lowering the curtain: Motorised

Motorised operation
General: Provide electric motor incorporating limit switches, manual safety stop and reversing mechanism, and overload cutout, operated by a battery-powered radio remote controller (supplied as part of the system), and also by a direct push-button or key switch. Provide a motorised system which is capable of manual operation in the event of power failure. Locate operating switch 1500 mm above floor level.
E26.3 EXECUTION

E26.3.1 FRAMES

General
Frames: Install so that the frames are as follows:
- Plumb, level, straight and true.
- Fixed or anchored to the building structure.
- Will not carry any building loads, including loads caused by structural deflection or shortening.

E26.3.2 COMPLETION

Operation
General: Ensure moving parts operate freely and smoothly, without binding or sticking, at correct tensions or operating forces and that they are lubricated where appropriate.

Protection
Temporary coating: On or before completion of the works, or before joining up to other surfaces, remove all traces of temporary coatings used as a means of protection.

Maintenance manual
General: Submit the overhead door manufacturer's published instructions for operation, care and maintenance.

Warranties
Roller shutters: Submit the manufacturer's published product warranties.

E26.4 SELECTIONS

E26.4.1 SCHEDULES

Sectional overhead doors schedule

<table>
<thead>
<tr>
<th>Location</th>
<th>Ticket Office window</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Security shutter</td>
</tr>
<tr>
<td>Size</td>
<td>As shown on drawings</td>
</tr>
<tr>
<td>Type</td>
<td>8/50 industrial slat</td>
</tr>
<tr>
<td>Slats</td>
<td>50mm wide x 0.8mm thick</td>
</tr>
<tr>
<td>Manufacturer</td>
<td>B&amp;D or equivalent</td>
</tr>
<tr>
<td>Finish</td>
<td>Powdercoat</td>
</tr>
</tbody>
</table>
E27.1 GENERAL

E27.1.1 RESPONSIBILITIES

General
General: Provide door hardware as documented.
Handing: Before supply, verify on site, the correct handing of hardware items.
Hardware specified generically: Provide hardware of sufficient strength and quality to perform its function, appropriate to the intended conditions of use, suitable for use with associated hardware, and fabricated with fixed parts firmly joined.
Operation: Ensure working parts are accurately fitted to smooth close bearings, without binding or sticking, free from rattle or excessive play, lubricated where appropriate.

Supply
Delivery: Deliver door hardware items, ready for installation, in individual complete sets for each door, as follows:
- Clearly labelled to show the intended location.
- In a separate dust and moisture proof package.
- Including the necessary templates, fixings and fixing instructions.

E27.1.2 REPLACEMENT ITEMS

Door hardware: Match items being replaced with existing unless documented otherwise. Upgrade hinges as necessary to conform to Hinges table A and Hinges table B.

E27.1.3 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Doors
- Overhead doors

E27.1.4 INTERPRETATION

Abbreviations
General: To AS 4145.1 Appendix D.
Definitions
Glossary of terms: To AS 4145.1 Section 2.
Lock functions: To AS 4145.1 Appendix E.

E27.1.5 SUBMISSIONS

Door-by-door schedule
General: Submit a door-by-door hardware schedule.
Information sources: This worksection and the contract drawings.

Samples
Generic items: Submit samples of hardware items offered as meeting the description of items not specified as proprietary items.
Refurbished items: Submit samples of hardware items offered as meeting the standard of cleaning, repair and testing of recovered items.

Key control System
New works: Submit details of the proprietary key control security system proposed by the lock manufacturer for locks required to accept a group key (master, grandmaster).
Alterations and additions: Submit details to extend the existing key control security system for locks required to accept a group key.
**Door Hardware**

**Record Documents**
Door hardware schedule: Submit an amended schedule, prepared by the door hardware supplier, showing changes to the contract door hardware schedule caused as follows:
- By the approval of a hardware sample.
- By the acceptance of an equivalent to a specified proprietary item.
- By a contract variation to a door hardware requirement.

**Keys**
Key codes: Submit the lock manufacturer's record of the key coding system showing each lock type, number and type of key supplied, key number for re-ordering, and name of supplier.
Keys: For locks keyed to differ and locks keyed alike, verify quantities against key records, and deliver to the Principal's Representative at practical completion.

**E27.2 Products**

**E27.2.1 Locks and Latches**

*Standard General:* To AS 4145.2.

*Padlocks*
Standard: To AS 4145.4.

**E27.2.2 Hinges**

**Butt hinge sizes**
Size for door types: Conform to tables as follows:
- Timber doors in timber or metal frames: *Hinge table A.*

*Measurement: Length (l) is the dimension along the knuckles, not including hinge tips, if any, and width (w) is the dimension across both hinge leaves when opened flat.*

**Butt hinge materials**
Timber doors in timber or steel frames:
- Material: Refer to hardware Schedule.
- Product: Refer to Hardware Schedule.

Doors fitted with closers: Provide low friction ball bearing hinges.
Fire doors: To AS 1905.1.

Power transfer hinges: Ensure they do not assume any load and are installed with other compatible hinges.

**E27.2.3 Hinge Tables**

**Hinge table A**
Application: Solid core doors. The table can be used to determine the quantity of hinges required for the nominated door leaf sizes and weights only. For door leaf sizes not specified or with applied finishes use the weight of the door to determine the quantity of hinges required. For door leafs over 80 kg, nominate pivot hinges.

The size of the hinge is determined by the door leaf thickness:
- 35 - 43 mm thick door: 100 x 75 mm # butt hinges with a minimum thickness of 2.5 mm.
- 44 - 55 mm thick door: 100 x 100 mm # butt hinges with a minimum thickness of 2.5 mm.
- > 55 mm thick door: Refer to the door by door hardware schedule.

Hinge pin: The symbol # refers to the pin type. Supply fixed pins to doors opening out or designated as a security doors.

Wide throw: If necessary, provide wide throw hinges to achieve the required door swings in the presence of obstacles such as nubs, deep reveals and architraves.

**Hinge table A**

<table>
<thead>
<tr>
<th>Nominal door leaf size (H x W x T) (mm)</th>
<th>Door leaf weight (kg - approx)</th>
<th>Number of hinges</th>
</tr>
</thead>
</table>
Door hardware

<table>
<thead>
<tr>
<th>Nominal door leaf size (H x W x T) (mm)</th>
<th>Door leaf weight (kg - approx)</th>
<th>Number of hinges</th>
</tr>
</thead>
<tbody>
<tr>
<td>2040 x 400 x 35</td>
<td>≤ 19</td>
<td>2</td>
</tr>
<tr>
<td>2040 x 600 x 35</td>
<td>≤ 29</td>
<td>2</td>
</tr>
<tr>
<td>2040 x 720 x 35</td>
<td>≤ 35</td>
<td>3</td>
</tr>
<tr>
<td>2040 x 820 x 35</td>
<td>≤ 39</td>
<td>3</td>
</tr>
<tr>
<td>2040 x 920 x 35</td>
<td>≤ 44</td>
<td>3</td>
</tr>
<tr>
<td>2040 x 1020 x 35</td>
<td>≤ 49</td>
<td>4</td>
</tr>
<tr>
<td>2040 x 720 x 40</td>
<td>≤ 37</td>
<td>3</td>
</tr>
<tr>
<td>2040 x 820 x 40</td>
<td>≤ 42</td>
<td>3</td>
</tr>
<tr>
<td>2040 x 920 x 40</td>
<td>≤ 48</td>
<td>3</td>
</tr>
<tr>
<td>2040 x 1020 x 40</td>
<td>≤ 52</td>
<td>4</td>
</tr>
<tr>
<td>2040 x 720 x 50</td>
<td>≤ 45</td>
<td>3</td>
</tr>
<tr>
<td>2040 x 820 x 50</td>
<td>≤ 50</td>
<td>3</td>
</tr>
<tr>
<td>2040 x 920 x 50</td>
<td>≤ 57</td>
<td>3</td>
</tr>
<tr>
<td>2040 x 1020 x 50</td>
<td>≤ 68</td>
<td>4</td>
</tr>
<tr>
<td>2400 x 720 x 40</td>
<td>≤ 50</td>
<td>4</td>
</tr>
<tr>
<td>2400 x 820 x 40</td>
<td>≤ 52</td>
<td>4</td>
</tr>
<tr>
<td>2400 x 920 x 40</td>
<td>≤ 55</td>
<td>4</td>
</tr>
<tr>
<td>2400 x 1020 x 40</td>
<td>≤ 60</td>
<td>4</td>
</tr>
<tr>
<td>2400 x 1220 x 50</td>
<td>≤ 72</td>
<td>5</td>
</tr>
<tr>
<td>2040 x 920 x 70</td>
<td>≤ 88</td>
<td>Nominate pivot hinges</td>
</tr>
</tbody>
</table>

E27.2.4 KEYING

Temporary construction keys and cylinders
Requirement: Provide one of the following:
- Loan cylinder: Install for construction locks and replace at practical completion.
- Construction keyed master key cylinder: Keep up-to-date records of keys issued including recipient's name, company and contact details, date issued and date returned.

Delivery of keys
Great grandmaster, grandmaster and master keys: Arrange for the manufacturer or supplier to deliver direct to the principal.

Number of keys: Conform to the Number of keys table.

Group keying
Keying system: Provide a group keying system in conformance with the requirements of TfNSW.
Existing system: Obtain the details of existing group or master key systems to which a new system is required to be an extension.
Future extensions: Provide master and grandmaster group keying systems which are capable of accommodating future extensions.
Keying control security system: If cylinder or pin-tumbler locks accept a group key (e.g. master key, maison key) provide to those locks a proprietary keying control security system.
Stamping: Stamp keys and lock cylinders to show the key codes and/or door number as scheduled.

Identification
Labelling: Supply each key with a purpose-made plastic or stamped metal label legibly marked to identify the key, attached to the key by a metal ring.

Key material
Lever locks: Malleable cast iron or mild steel.
Pin tumbler locks: Nickel alloy, not brass.
**Number of keys table**

<table>
<thead>
<tr>
<th>Code</th>
<th>Key type</th>
<th>Minimum number of keys</th>
</tr>
</thead>
<tbody>
<tr>
<td>GG MK</td>
<td>Great grandmaster keys</td>
<td>2</td>
</tr>
<tr>
<td>GMK</td>
<td>Grandmaster keys</td>
<td>2</td>
</tr>
<tr>
<td>MK</td>
<td>Master keys</td>
<td>2 per code group</td>
</tr>
<tr>
<td>KD</td>
<td>Locks keyed to differ</td>
<td>2 per lock</td>
</tr>
<tr>
<td>KA</td>
<td>Locks keyed alike:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 locks in code group</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>3 to 10 locks in code group</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>11 to 40 locks in code group</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>41 and over locks in code group</td>
<td>1 per 4 locks or part thereof</td>
</tr>
</tbody>
</table>

**E27.3 EXECUTION**

**E27.3.1 INSTALLATION**

**Mounting height**
Locks and latches: Centreline of the door knob or lever spindle above finished floor: Generally 1050mm above finished floor level.

**Door stops**
Fixing: Fix on the floor, skirting or wall, as appropriate, to prevent the door or door furniture striking the wall or other surface.

**Fasteners**
Materials: Provide materials compatible with the item being fixed, and of sufficient strength, size and quality to perform their function.
- Conformed fixings: Provide a corrosion resistant finish to conformed fixings.
- Exposed fixings: Match exposed fixings to the material being fixed.

**Security**: Locate exposed fixings to lock furniture on the inside faces of external doors and on the inside faces of internal doors to lockable rooms.

**Support**: Provide appropriate back support (for example lock stiles, blocking, wall noggings and backing plates) for hardware fixings.
- Hollow metal sections: Provide backing plates drilled and tapped for screw fixing, or provide rivet nuts with machine thread screws. Do not use self tapping screws or blind rivets.

**Floor springs**
General: Form a recess in the floor slab for the floor spring box and grout the box in place so that the cover plate is flush with the finished floor.

**Hinges**
Metal frames: Fix hinges using metal thread screws.
Timber doorsets: Install butt hinges in housings equal in depth to the thickness of the hinge leaf (except for hinges designed for mounting without housing), and fix with countersunk screws.

**E27.3.2 COMPLETION**

**Adjustment**
General: Leave the hardware properly adjusted with working parts in working order, and clean, undamaged, properly adjusted, and lubricated where appropriate.

Automatic door operators: Maintain and adjust the system throughout the defects liability period.

**Keys**
Contractor's keys: Immediately before practical completion, replace or reset cylinders to which the contractor has had key access during construction and ensure the exclusion of the contractor's keys.

**Maintenance**
Automatic door operators: Submit the installer's proposal for continuing maintenance after completion on an annual renewal basis.
Manual: Submit the manufacturer's published recommendations for use, care and maintenance of the hardware provided.
Product warranties
Warranty: Cover materials and workmanship in the terms of the warranty in the form of interlocking warranties from the manufacturer or distributor and the applicator.
Automatic door operators: Submit a warranty (or interlocking warranties) from the supplier and installer for the system and its installation, for a period of at least twelve months from the date of practical completion.

E27.4 SELECTIONS

Door hardware schedule
Refer to the Door Hardware Schedule prepared by Fusion 2 Hardware Specifier.
**E28 INSULATION AND SARKING MEMBRANES**

**E28.1 GENERAL**

**E28.1.1 RESPONSIBILITIES**

General
General: Provide insulation and sarking membrane systems:
- Complete for their function.
- Conforming to the detail and location drawings.
- Firmly fixed in position.
- Maintain their performance for the life of the building.

**E28.1.2 CROSS REFERENCES**

General
Requirement: Conform to the following:
- General requirements.
- Lining
- Suspended ceilings

**E28.1.3 STANDARDS**

Installation of mineral wool insulation
Comply with the ICANZ Industry Code of Practice for the Safe Use of Glass Wool and Rock Wool Insulation.
Marking: Deliver mineral wool products to site in packaging labelled FBS1 BIOSOLUBLE INSULATION.

**E28.1.4 INTERPRETATION**

Definitions
General: For the purposes of this worksection the following definitions apply:
- Terminology: To AS/NZS 4859.1.
- Fire hazard properties: To BCA A2.4.
- Sarking membrane: Flexible membrane material normally used for waterproofing, vapour proofing or thermal reflectance.
- FBS-1 Glass wool: Spun fibres of molten glass, utilizing up to 60% recycled waste glass, thermally bonded to form batts, blankets and sheets for thermal and acoustic insulation.
- FBS-1 Rock wool: Spun fibres of molten rock thermally bonded to form batts and blankets for thermal and acoustic insulation.
- Polyester insulation: Polyester fibres thermally bonded to form batts and blankets.
- Vapour barrier: A material or system that adequately impedes the transmission of water vapour under specified conditions.
- Breathable (vapour permeable) membrane: A flexible membrane material normally used for secondary waterproofing that allows for the transmission of water vapour.

**E28.1.5 INSPECTION**

Notice
Inspection: Give notice so that inspection may be made of the sarking, vapour barrier and insulation before they are covered up or concealed.

**E28.1.6 SUBMISSIONS**

Fire hazard properties
General: Submit evidence of conformance with the following:
Insulation and sarking membranes

- Fire hazard indices for all materials when tested in conformance with AS/NZS 1530.3, including, if the material has a reflective facing, scoring and blackening to AS/NZS 1530.3 clause A6:
  - Spread of flame index: 0.
  - Smoke developed index: ≤ 3.
- Facing materials: Flammability index < 5 when tested in conformance with AS/NZS 1530.2.

**Thermal properties**
General: Submit evidence of conformance with AS/NZS 4859.1.

**E28.2 PRODUCTS**

**E28.2.1 INSULATION MATERIALS**

**Fire hazard properties**
General: Fire hazard indices for all materials when tested in conformance with AS/NZS 1530.3:
- Spread of flame index: 0.
- Smoke developed index: ≤ 3.
- Materials with reflective facing: Test to AS/NZS 1530.3 clause A6.

Facing materials: Flammability index < 5 when tested in conformance with AS/NZS 1530.2.

**Bulk and reflective insulation**
Cellulosic fibre (loose fill): To AS/NZS 4859.1 Section 5.
Mineral wool blankets and cut pieces: To AS/NZS 4859.1 Section 8.
Polyester: To AS/NZS 4859.1 Section 7.
Polyisocyanurate (rigid cellular sheets RC/PIR): To AS 1366.2.
Polystyrene (extruded rigid cellular sheets RC/PS-E): To AS 1366.4.
Polystyrene (moulded rigid cellular sheets): To AS 1366.3.
Polyurethane (rigid cellular sheets): To AS 1366.1.
Polyurethane (sprayed): To ASTM D6694.
Reflective insulation: To AS/NZS 4859.1 Section 9.
Wet processed fibreboard (including softboard): To AS/NZS 1859.4.
Wool: To AS/NZS 4859.1 Section 6.
Certification: Required.
Certification provider: An organisation accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

**Sarking membranes**
Standard: To AS/NZS 4200.1.
Thermal performance: To AS/NZS 4859.1 Section 9.
Breathable (vapour permeable) membrane: Vapour resistance of not more than 0.5 MNs/g when tested to AS/NZS 4200.1.

**Fasteners and supports**
General: Metallic-coated steel.

**Mesh support to roof insulation**
Metallic-coated steel wire netting: To AS 2423 Section 4.
- Size: 45 mm mesh x 1 mm diameter.
Welded safety mesh: To AS/NZS 4389.

**E28.3 EXECUTION**

**E28.3.1 GENERAL**

Framed wall thermal break strips
Product type: Proprietary item.
Application: To steel or timber framing with lightweight external cladding.
Insulation and sarking membranes

R-value: \( \geq 0.2 \).
Screw fixing: Button head screws at 1 m centres.
Adhesive fixing: Wallboard adhesive ‘walnuts’ at 1 m centres.

**Bulk insulation**
Installation: To AS 3999 and BCA J1.2.
General: Ensure batts or blankets are firmly butted with no gaps except as follows:
- Access openings and vents: Do not obstruct.
- Light fittings: To AS/NZS 3000 clause 4.5.
- Electrical cables: Prevent contact with polystyrene insulation by wrapping the cable with foil tape.

**Sarking membrane**
Standard: To AS/NZS 4200.2.

**E28.3.2 WALL INSULATION**
Bulk insulation to framed walls
Product type: Fibre batts.
Batts: Friction fit between framing members. If support is not otherwise provided, staple nylon twine to the framing and stretch tight.

**E28.3.3 ROOF INSULATION**
Roof insulation
Insulation to roofs of new Platform Building and the lift shafts is comprised in the roof panel system specified in roofing.

**E28.3.4 COMPLETION**
Warranties
Insulation: Submit the manufacturer's published product warranties.

**E28.4 SELECTIONS**

**E28.4.1 WALL INSULATION**
Bulk thermal insulation to 90 mm framing
Product: Bradford insulation batts
R-value: 2.5
Location: External walls of new Platform Building
E29 LINING

E29.1 GENERAL

E29.1.1 RESPONSIBILITIES

General
General: Provide internal lining systems to the Selections.

E29.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Light steel framing
- Cladding
- Suspended ceilings

E29.1.3 INSPECTION

Notice
Inspection: Give sufficient notice so that inspection may be made of substrate or framing before installation of linings.

E29.1.4 TOLERANCES

Surface
Flatness, twist, winding and bow: ≤ 1.5 mm deviation from a 1.5 m straightedge placed in any position.

E29.1.5 SUBMISSIONS

Type-test reports
General: Submit type-test reports to verify conformance with the Partition performance schedule and as follows:
- Fire hazard properties:
  - Average specific extinction area (non-sprinklered buildings): < 250 m³/kg to AS/NZS 3837.
  - Group number: To AS/NZS 3837 and BCA Spec A2.4, or AS ISO 9705.
  - Smoke growth rate index (non-sprinklered buildings): < 100 to AS ISO 9705 and BCA Spec A2.4.
- Fire resistance level: To AS 1530.4.

E29.2 PRODUCTS

E29.2.1 MATERIALS AND COMPONENTS

Plasterboard
Standard: To AS/NZS 2588.
Location: Refer to drawings and Finishes Schedule.
Grade:
- Standard
- Impact resistant
- Fire resistant

Fibre cement
Standard: To AS/NZS 2908.2.
Wall and ceiling linings: Type B category 2.
Minimum thickness: 4.5 mm.
Location: Refer to drawings and Finishes Schedule.
Thickness (mm): 9mm
Coated steel
Standard: To AS 1397.
- Coating class interior: Z275.
- Coating class exterior: Z450.

Fasteners
Steel nails: Hot dip galvanized.

Adhesives
For wallboards: Gunnable synthetic rubber/resin based mastic contact adhesive formulated for bonding flooring and wallboards to a variety of substrates.

Sealants
Fire rated sealant: Non-hardening sealant compatible with the materials to be sealed and having a fire rating equal to that of the partition it seals.
Acoustic sealant: Non-hardening sealant compatible with the materials to be sealed and having a specific gravity of not less than 1.5 gm/cubic centimetre and of 100% polyurethane mastic.

E29.3 EXECUTION

E29.3.1 CONSTRUCTION GENERALLY

Conditions
Commencement: Do not commence lining work until such time as the building or zone in question is enclosed and weathertight and all wet trades have been completed.

Substrates or framing
General: Before fixing linings check and, if necessary, adjust the alignment of substrates or framing.

Battens
General: Fix at each crossing with structural framing members, or direct to solid walls or ceilings.
Provide wall plugs in solid backgrounds.

Ceiling linings
General: Do not install until at least 14 days after the timber roof structure is fully loaded.

Accessories and trim
General: Provide accessories and trim necessary to complete the installation.

Adhesives
General: Provide adhesives of types appropriate to their purpose, and apply them so that they transmit the loads imposed, without causing discolouration of finished surfaces.

E29.3.2 PLASTERBOARD LINING

Supports
General: Install timber battens or proprietary cold-formed galvanized steel furring channels as follows:
- Where framing member spacing exceeds the recommended spacing,
- Where direct fixing of the plasterboard is not possible due to the arrangement or alignment of the framing or substrate.
- Where the lining is the substrate for tiled finishes.

Transverse walls: Locate noggings as follows:
- At least 150 mm from the horizontal joint.
- Ensure that noggings do not protrude beyond the face of studs.

Installation
Gypsum plasterboard and fibre reinforced gypsum lining: To AS/NZS 2589.

Multiple sheet layers
Application: Fire rated and acoustic rated walls.

Joints: Fill and flush up all joints and fixings in each layer and caulk up perimeters and penetrations before commencing succeeding layers. Stagger all sheet joints by minimum 200 mm.

Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.
Butt joints: Make joints over framing members or otherwise provide back blocking.
External corner joints: Make joints over metallic-coated steel corner beads.
Dry joints: Provide square edged sheet and finish with a UPVC joining section.
Control joints: Provide purpose-made metallic-coated control joint beads at not more than 12 m centres in walls and ceilings and to coincide with structural control joints.
Wet areas: Install additional supports, flashings, trim and sealants as required.
Joints in tiled areas: Do not apply a topping coat after bedding perforated paper tape in bedding compound.

E29.3.3 FIBRE CEMENT LINING

Supports
General: Install timber battens or proprietary cold-formed galvanized steel furring channels as follows:
- Where framing member spacing exceeds the recommended spacing.
- Where direct fixing of the fibre cement is not possible due to the arrangement or alignment of the framing or substrate.
- Where the lining is the substrate for tiled finishes.

Installation
General: Run sheets across the framing members. In flush jointed applications, stagger end joints in a brick pattern and locate them on framing members, away from the corners of large openings. Provide supports at edges and joints.
Timber framed construction: Nail only or combined with adhesive.
Steel framed construction: Screw only or combined with adhesive.
Wall framing:
- Do not fix to top and bottom plates or noggings.
- In tiled areas: Provide an extra row of noggings immediately above wall-to-floor flashings. Fix sheet at 150 mm centres to each stud and around the perimeter of the sheet.
Masonry wall construction:
- Fix using adhesive direct to masonry, but do not fix direct to masonry as a substrate for tiled finish.
- Fix to furring channels using screw or screw and adhesive.
Ceilings: Fix using screw or screw and adhesive to ceiling furring members. Do not fix sheets to the bottom chords of trusses.
Wet areas: Do not use adhesive fixing alone.

Multiple sheet layers
Application: Fire rated and acoustic rated walls.
Joints: Fill and flush up all joints and fixings in each layer and caulk up perimeters and penetrations before commencing succeeding layers. Stagger all sheet joints by minimum 200 mm.

Joints
Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.
External corner joints: Make joints over metallic-coated steel corner beads.
Dry joints: Provide square edged sheet and finish with a UPVC joining section.
Control joints: Provide control joints to coincide with structural control joints and as follows:
- Walls: ≤ 7.2 m centres.
- Ceilings: To divide into bays not larger than 10.8 x 7.2 m.
- Soffit linings: To divide into bays not larger than 4.2 x 4.2 m or 5.6 x 3.6 m.
- Control joint beads: Purpose-made metallic coated.
- Support: Provide framing parallel to the joint on each side. Do not fix the lining to abutting building surfaces.
Wet areas: Provide additional supports, flashings, trim and sealants as required.
Joints in tiled areas: Bed perforated paper tape in bedding compound. Do not apply a topping coat.
- Control joints: Space to suit joints required in tiling.
- Internal corners: Reinforce with metallic-coated steel angles. In corners subject to continuous moisture, flash over the angle and under the sheeting with continuous bitumen coated aluminium flashing.

E29.3.4 TRIM AND ACCESSORIES

General
General: Provide trim such as beads, mouldings and stops to make neat junctions between lining components, finishes and adjacent surfaces.
Proprietary items: Provide complete with installation accessories.

Timber trim
Hardwood: AS 2796.1.
Cypress pine: AS 1810.
Softwood: To AS 4785.1.
- Grade: To AS 4785.2.

E29.4 SELECTIONS

E29.4.1 SHEET LINING

<table>
<thead>
<tr>
<th>Location</th>
<th>Platform Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supporting System:</td>
<td>Steel framing as specified in Light Steel Framing</td>
</tr>
<tr>
<td>Lining (internal)</td>
<td></td>
</tr>
<tr>
<td>- Material</td>
<td>Generally: Impact resistant plasterboard</td>
</tr>
<tr>
<td></td>
<td>Wet Areas: Water resistant plasterboard</td>
</tr>
<tr>
<td>- Proprietary item</td>
<td>N/A</td>
</tr>
<tr>
<td>- Thickness</td>
<td>13mm</td>
</tr>
<tr>
<td>- Joints</td>
<td>Flush</td>
</tr>
<tr>
<td>- Edge Type</td>
<td>Recessed edge</td>
</tr>
<tr>
<td>- Finish</td>
<td>Generally: Paint</td>
</tr>
<tr>
<td></td>
<td>Wet Areas: Ceramic tiles</td>
</tr>
<tr>
<td>Lining (external)</td>
<td>Refer to Cladding Section</td>
</tr>
<tr>
<td>Trim</td>
<td></td>
</tr>
<tr>
<td>- At junctions with ceilings</td>
<td>Rondo P50 Shadowline</td>
</tr>
<tr>
<td>- Skirting</td>
<td>Generally: 150mm high timber fixed to finish flush with plasterboard lining and with Rondo P50 Shadowline joint between skirting and wall lining</td>
</tr>
<tr>
<td></td>
<td>Wet Areas: Coved ceramic tiles</td>
</tr>
<tr>
<td>- Other</td>
<td>Steel lining to ticket office to achieve G2 security rating as specified in Metalwork.</td>
</tr>
</tbody>
</table>
E30 SUSPENDED CEILINGS

E30.1 GENERAL

E30.1.1 RESPONSIBILITIES

General
General: Provide suspended ceilings to the Selections and as follows.
- Consistent in finish treatment.

E30.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Light steel framing
- Lining
- Cladding

E30.1.3 STANDARDS

General
Suspended ceilings: To AS/NZS 2785.

E30.1.4 INSPECTION

Notice
Inspection: Give notice so that inspection may be made:
- Of the suspension system before the installation of lining.
- Of the completed ceiling before site painting.

E30.1.5 SUBMISSIONS

Samples
General: Submit samples as follows:
- Suspension system: Sections proposed for the suspension system, including wall angles and trim.
- Accessories including access panels and wall trims.

Type tests
General: Submit type-test reports to verify conformance with the Suspended ceilings performance schedule and as follows:
- Fire hazard properties:
  . Average specific extinction area (non-sprinklered buildings): < 250 m²/kg to AS/NZS 3837.
  . Group number: To AS/NZS 3837 and BCA Spec A2.4, or AS ISO 9705.
  . Smoke growth rate index (non-sprinklered buildings): < 100 to AS ISO 9705 and BCA Spec A2.4.
- Fire resistance level: To AS 1530.4.
- Weighted suspended ceiling normalized level difference: To AS/NZS 1276.1, ISO 717-1 or AS/NZS ISO 717.1.
- Weighted sound absorption coefficient: To AS ISO 11654.

E30.2 PRODUCTS

E30.2.1 SUSPENSION SYSTEM

Proprietary system
General: Provide in conformance with the Proprietary suspended system schedule.
Protective coatings for steel components: To AS/NZS 2785 Table F1.
E30.2.2 LININGS

Plasterboard
Standard: To AS/NZS 2588.

Fibre cement
Standard: To AS/NZS 2908.2.
Wall and ceiling linings: Type B category 2.
Minimum thickness: 4.5 mm.

Sealants
Fire rated sealant: Non-hardening sealant compatible with the materials to be sealed and having a fire rating equal to that of the partition it seals.
Acoustic sealant: Non-hardening sealant compatible with the materials to be sealed and rated to Rₚₖ 65.

E30.2.3 CORNICE

Plasterboard cornices
Fixing: Adhesive fix with the supplier’s cornice cement. Pin in place at cornice edges until adhesive sets, remove pins and fill holes.

Fibrous plaster cornices and roses
Accessible ceiling spaces: Pin or prop in place and fix with wet plaster of Paris and scrim straps over framing members.

Fire rated walls
Seal to soffit with sealant of matching fire rated level before fixing decorative cornices.

E30.3 EXECUTION

E30.3.1 SUSPENSION SYSTEM

Alterations
General: Dismantle and re-use ceiling suspension system members and supplement them with compatible members as required.

Suspension system
Failure: Provide a ceiling system such that failure of any one suspension point does not cause a progressive failure of the ceiling.
Height adjustment: Provide height adjustment by means of a length adjustment device at each suspension point, permitting length variation of at least 50 mm.
Grid members: If required, notch grid members at the junction with the perimeter trim to ensure the panels lie flat on the perimeter trim.
Restriction: Do not attach the suspension system to the lip of purlins.

Services
Support: Space the support members as required by the loads on the system and the type of ceiling, and allow for the installation of services and accessories, including ductwork, light fittings and diffusers. Provide additional back support or suspension members for the fixing of such items to ensure that distortion, overloading or excessive vertical deflection is prevented. Do not fix suspension members to services (e.g. ductwork) unless the service has been designed to accept the ceiling load. In locations where services obstruct the ceiling supports, provide bridging and suspension on each side of the services. Do not support services terminals on ceiling tiles or panels.

Partitions
General: If partitions are attached to the underside of the ceiling systems include the partition mass in the seismic mass of the ceiling.

Protection
General: Protect existing work from damage during the installation.

Stability
General: Install the ceilings level; and fix so that under normal conditions there is no looseness or rattling of ceiling components.
Suspended ceilings

Structure-borne sound
General: Provide a ceiling system which does not amplify structure-borne sound. Provide suitable proprietary products or systems for reducing contact vibrations between structure and ceiling.

Bracing
General: Provide bracing to prevent lateral movement and to resist the imposed horizontal seismic force.

Bulkheads
General: Construct bulkheads and other similar ceiling formations as an integral part of the ceiling structure. Brace bulkheads to prevent lateral movement. If the ceiling is terminated at a bulkhead, provide for seismic requirements.

External suspended soffits
General: Support external suspended soffits on rigid members capable of carrying the loads from imposed actions. Install members to minimise any eccentricity, and ensure that the upward and downward loads from wind actions are carried through to the supporting structure.

Fasteners
General: Install fasteners so that they are not visible in the finished ceiling. Do not use screw fasteners in materials supporting hangers less than 3 mm thick.

Control of movement
Abutments: Install the ceiling to allow for differential movement at abutting surfaces.
Alignment: Install the ceiling with control joints to correspond in location and direction to the structural control joints. Do not bridge any structural control joint.

Tolerance
Suspension system bearing surface: To AS/NZS 2589 Table 4.2.2.

Prefinishes
General: Repair damaged prefinishes by recoating.

E30.3.2 PLASTERBOARD LINING
Installation
Gypsum plasterboard and fibre reinforced gypsum plaster: To AS/NZS 2589
Suspended flush ceilings: Fix using screw or screw and adhesive to ceiling members or support frame.

Multiple sheet layers
Application: Fire rated and acoustic rated walls.
Joints: Fill and flush up all joints and fixings in each layer and caulk up perimeters and penetrations before commencing succeeding layers. Stagger all sheet joints by minimum 200 mm.

Joints
Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.
Butt joints: Make joints over framing members or otherwise provide back blocking.
External corner joints: Make joints over metallic-coated steel corner beads.
Control joints: Provide purpose-made metallic-coated control joint beads at not more than 12 m centres in ceilings and to coincide with structural control joints.
Wet areas: Install additional supports, flashings, trim and sealants as required.

E30.3.3 FIBRE CEMENT LINING
Installation
General: Run sheets across the framing members. In flush jointed applications, stagger end joints in a brick pattern and locate them on framing members, away from the corners of large openings. Provide supports at edges and joints.
Suspended flush ceilings: Fix using screw or screw and adhesive to ceiling members or support frame.

Multiple sheet layers
Application: Fire rated and acoustic rated walls.
Joints: Fill and flush up all joints and fixings in each layer and caulk up perimeters and penetrations before commencing succeeding layers. Stagger all sheet joints by minimum 200 mm.
Suspended ceilings

Joints
Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.
External corner joints: Make joints over metallic-coated steel corner beads.
Dry joints: Provide square edged sheet and finish with a PVC-U joining section.
Control joints: Provide control joints to coincide with structural control joints and as follows:
- Ceilings: To divide into bays not larger than 10.8 x 7.2 m.
- Soffit linings: To divide into bays not larger than 4.2 x 4.2 m or 5.6 x 3.6 m.
- Control joint beads: Purpose-made metallic coated.
- Support: Provide framing parallel to the joint on each side. Do not fix the lining to abutting building surfaces.
Wet areas: Provide additional supports, flashings, trim and sealants as required.

E30.3.4 ACCESS PANELS

Finish
General: Match the access panels to the ceiling in appearance and performance.
Identification
General: Provide each access panel with an identification mark.

Non-demountable ceilings
General: Provide access panels supported and anchored to permit ready removal and refixing.

Reinforcement
General: Reinforce the back of the access panel to prevent warping and facilitate handling.

E30.3.5 TRIM

General
General: Provide trim such as beads, mouldings and stops to make neat junctions between lining components, finishes and adjacent surfaces.

E30.4 SELECTIONS

E30.4.1 SUSPENDED CEILINGS

<table>
<thead>
<tr>
<th>Location</th>
<th>New Platform Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supporting System:</td>
<td>Concealed</td>
</tr>
<tr>
<td>- Type</td>
<td>Concealed</td>
</tr>
<tr>
<td>- Material</td>
<td>Pressed steel</td>
</tr>
<tr>
<td>- Proprietary item</td>
<td>Rondo screw-up ceiling suspension system</td>
</tr>
<tr>
<td>Lining</td>
<td>Generally: Standard grade plasterboard</td>
</tr>
<tr>
<td>- Material</td>
<td>Wet Areas: Water resistant plasterboard</td>
</tr>
<tr>
<td>- Proprietary item</td>
<td>N/A</td>
</tr>
<tr>
<td>- Thickness</td>
<td>13mm</td>
</tr>
<tr>
<td>- Joints</td>
<td>Flush</td>
</tr>
<tr>
<td>- Edge Type</td>
<td>Recessed edge</td>
</tr>
<tr>
<td>- Finish</td>
<td>Paint</td>
</tr>
<tr>
<td>Trim</td>
<td>Rondo P50 Shadowline</td>
</tr>
</tbody>
</table>
E31 JOINERY

E31.1 GENERAL

E31.1.1 RESPONSIBILITIES

General

General: Fabricate and install joinery items to backgrounds undamaged, plumb, level, straight and free of distortion and to the Tolerances table.

Tolerances table

<table>
<thead>
<tr>
<th>Property</th>
<th>Tolerance criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plumb and level</td>
<td>1 mm in 800 mm</td>
</tr>
<tr>
<td>Offsets in flush adjoining surfaces</td>
<td>&lt; 0.5 mm</td>
</tr>
<tr>
<td>Offsets in revealed adjoining surfaces</td>
<td>&lt; 2 mm</td>
</tr>
<tr>
<td>Alignment of adjoining doors</td>
<td>&lt; 0.5 mm</td>
</tr>
<tr>
<td>Difference in scribe thickness for joinery items centred between walls</td>
<td>&lt; 2 mm</td>
</tr>
<tr>
<td>Doors centred in openings</td>
<td>zero</td>
</tr>
<tr>
<td>Joints in finished surfaces</td>
<td>zero</td>
</tr>
</tbody>
</table>

E31.1.2 CROSS REFERENCES

General

Requirement: Conform to the following:
- General requirements.

E31.1.3 INSPECTION

Notice

Inspection: Give sufficient notice so that inspection may be made of the following:
- Shop fabricated or assembled items ready for delivery to the site.
- Openings prepared to receive assemblies.
- Site erected assemblies on completion of erection, before covering up by cladding and encasing.
- Surfaces prepared for, and immediately before, site applied finishes.
- Completion of installation.

E31.1.4 SUBMISSIONS

Samples generally

General: Submit samples to the Sample table.

Sample table

<table>
<thead>
<tr>
<th>Description</th>
<th>No. of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each type of board to be used complete with finish and edge stripping</td>
<td>2</td>
</tr>
<tr>
<td>Each type of joint</td>
<td>2</td>
</tr>
<tr>
<td>Typical item of hardware indicating each finish</td>
<td>2</td>
</tr>
<tr>
<td>Samples of the selected stone cladding showing the maximum expected variation</td>
<td>2 x 3 variants</td>
</tr>
<tr>
<td>Samples of the selected timber veneer showing the maximum expected variation</td>
<td>2 x 3 variants</td>
</tr>
<tr>
<td>Patch of each nominated fabric</td>
<td>2</td>
</tr>
<tr>
<td>The finish to all stainless steel items</td>
<td>2</td>
</tr>
<tr>
<td>Complete timber bench cupboards, including hardware</td>
<td>1</td>
</tr>
<tr>
<td>Complete drawer front, including hardware</td>
<td>1</td>
</tr>
</tbody>
</table>
Clear finished samples
Initial submission:
- Veneered board: Three samples each 600 x 600 mm for each species.
- Solid timber: Three samples each 40 x 19 x 600 mm for each species.
Control sample: The approved selection from the initial submission.
Finished sample: Cut the control sample in half and apply the finish to half the remaining area.

Shop drawings
General: Submit shop drawings to a scale that best describes the detail, showing the following:
- Overall dimensions.
- Materials, thicknesses and finishes of elements including doors, divisions, shelves and benches.
- Type of construction including mitre joints and junctions of members.
- Hardware type and location.
- Temporary bracing, if required.
- Procedures for shop and site assembly and fixing.
- Locations of benchtop joints.
- Stone benchtop layout including joint arrangement and penetrations.
- Locations of sanitary fixtures, stoves, ovens, sinks, and other items to be installed in the units.
- Relationship of fixture to adjacent building elements.
- Proposals for the break-up of large items as required for delivery to the site.
- Proposed method of joining the modules of large items.
Timing: Before fabrication.

E31.2 PRODUCTS

E31.2.1 JOINERY MATERIALS AND COMPONENTS

Visible work
Clear finished timber and veneer: Ensure all visible surfaces are free of branding, crayon or chalk marks and of blemishes caused by handling.

Joinery timber
Hardwood: To AS 2796.3.
Seasoned cypress pine: To AS 1810.
Softwood: To AS 4785.3.
Finished sizes: For milled timbers actual dimensions which are at least the required dimensions, except for dimensions qualified by a term such as ‘nominal’ or ‘out of’ to which industry standards for finished sizes apply.

Plywood
Interior use generally: To AS/NZS 2270.
Interior use, exposed to moisture: To AS/NZS 2271.
Visible surface with a clear finish: Veneer quality A.
Other visible surfaces: Veneer quality C or D.

Non-structural glued laminated timber
Standard: AS 5067.

Wet processed fibreboard (including hardboard)
Standard: To AS/NZS 1859.4.

Particleboard
Standard: To AS/NZS 1859.1.
Melamine overlaid particleboard: Particleboard overlaid on both sides with low pressure melamine.

Dry-processed fibreboard (including medium density fibreboard)
Standard: To AS/NZS 1859.2.
Melamine overlaid medium density fibreboard: Medium density fibreboard (STD MDF) overlaid on both sides with low pressure melamine.

Decorative overlaid wood panels
Standard: To AS/NZS 1859.3.

Certification
General: Brand panels under the authority of a recognised certification program applicable to the product. Locate the brand on faces or edges which will be concealed in the works.

High-pressure decorative laminate sheets
Standard: To AS/NZS 2924.1.

<table>
<thead>
<tr>
<th>Class</th>
<th>Definition</th>
<th>Typical applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>CG (S or F)</td>
<td>Compact general purpose</td>
<td>High performance, self supporting vertical or horizontal surfaces</td>
</tr>
<tr>
<td>HD (S or F)</td>
<td>Horizontal heavy duty</td>
<td>High performance horizontal surfaces</td>
</tr>
<tr>
<td>HG (S, or P)</td>
<td>Horizontal general purpose</td>
<td>General horizontal surfaces and high performance vertical surfaces</td>
</tr>
<tr>
<td>VG (S, or P)</td>
<td>Vertical general purpose</td>
<td>General vertical surfaces and light duty horizontal surfaces</td>
</tr>
<tr>
<td>VL (S)</td>
<td>Vertical light duty</td>
<td>Light duty vertical surfaces</td>
</tr>
</tbody>
</table>

Thickness (minimum):
- For horizontal surfaces fixed to a continuous background: 1.2 mm.
- For vertical surfaces fixed to a continuous background: 0.8 mm.
- For post formed laminate fixed to a continuous background: 0.8 mm.
- For vertical surfaces fixed intermittently (e.g. to studs): 3.0 mm.
- For edge strips: 0.4 mm.

E31.2.2 VENEERS

Timber veneer
Veneer quality: To AS/NZS 2270.

Grades (minimum requirement):
- Select grade, veneer quality A, for visible surfaces to have clear finish or to have no coated finish.
- General purpose grade, veneer quality B, for other visible surfaces.

Requirement: Provide veneers slip matched and flitch batched and falling within the visual range of the approved samples.

E31.2.3 JOINERY ITEMS

General
Refer to documents as follows:
- Drawings: Joinery units and their location, indicative construction details, scribes and trims, materials, dimensions and thicknesses, and finishes.
- Drawings: Confirm on site all dimensions noted, after the completion of partitions.
- Finishes schedules or drawings: Finishes Schedule.

E31.2.4 JOINERY ASSEMBLIES

Standard
General: To AS/NZS 4386.1.

Plinths
Carcasses
Material: Select from the following:
- Overlaid high moisture resistant particleboard.
- Overlaid high moisture resistant medium density fibreboard.

Thickness: 16 mm.

Joints: Select from the following:
- Proprietary mechanical connections.
- Dowels and glue.
- Screws and glue.
- Proprietary joining plates and glue.

Adjustable shelves: Support on proprietary pins in holes bored at equal centres vertically.
- Spacing: 32 mm.

Fasteners: Conceal with finish.

Installation: Secure to walls at not more than 600 mm centres.

**Drawer fronts and doors**

Material: Select from the following:
- Melamine overlaid high moisture resistant particleboard.
- Melamine overlaid high moisture resistant medium density fibreboard.

Thickness: 16 mm.

Maximum door size: 2400 mm high, 900 mm wide, 1.5 m² on face.

Drawer fronts: Rout for drawer bottoms.

**Drawer backs and sides**

Material: PVC film wrapped particleboard.

Thickness: 12 mm.

Colour: White

Installation: Mitre corners leaving outer skin of foil intact, finish with butt joints, glue to form carcass and screw to drawer front. Rout for drawer bottoms.

**Drawer bottoms**

Material: PVC film laminated hardboard.

PVC film faces: One

Thickness: 3 mm.

Colour: White

**Drawer and door hardware**

Hinge types: Concealed metal hinges with the following features:
- Adjustable for height, side and depth location of door.
- Self closing action.
- Hold open function.
- Nickel plated.

Piano hinges: Chrome plated steel, extending full height of doors.

Slides: Metal runners and plastic rollers with the following features:
- 30 kg loading capacity.
- Closure retention.
- White thermoset powder coating or nickel plated.

Pulls: Stainless steel D handles

**E31.2.5 WORKING SURFACES**

Laminated benchtops

Material: HMR MDF

Finish: High-pressure decorative laminated sheet as detailed in the Finishes Schedule.

Exposed edges: Extend laminate over shaped nosing, finishing > 50 mm back on underside. Splay outside corners at 45°.
Balance underside: Extend laminate to the undersides of benchtops.
Installation: Scribe to walls. Fix to carcass at least twice per 600 mm length of benchtop.
Joint sealing: Fill joint with sealant matching finish and clamp with proprietary mechanical connectors.
Balance underside: Laminate undersides of benchtops.

### E31.3 EXECUTION

#### E31.3.1 JOINERY

**General**
Joints: Provide materials in single lengths whenever possible. If joints are necessary make them over supports.
Framing: Frame and trim where necessary for openings, including those required by other trades.
Openings: Provide openings for the following: Kitchen sink, plumbing and other services as required.

**Accessories and trim**
General: Provide accessories and trim necessary to complete the installation.

**Fasteners**
Visibility: Do not provide visible fixings except in the following locations:
- Inside cupboards and drawer units.
- Inside open units in which case provide proprietary caps to conceal fixings.

Visible fixings: Where fastenings are unavoidable on visible joinery faces, sink the heads below the surface and fill the sinking flush with a material compatible with the surface finish. In surfaces which are to have clear or tinted finish provide matching wood plugs showing face (not end) grain. In surfaces which are to have melamine finish provide proprietary screws and caps finished to match.
Fix joinery units to backgrounds as follows:
- Floor mounted units: 600 mm centres max.
- Wall mounted units: To each nogging and/or stud stiffener.
Fixings: Screws with washers into timber or steel framing, or masonry anchors.

**Adhesives**
General: Provide adhesives to transmit the loads imposed and to ensure the rigidity of the assembly, without causing discolouration of finished surfaces.

**Finishing**
Junctions with structure: Scribe, plinths, benchtops, splashbacks, ends of cupboards, kickboards and returns to follow the line of structure.
Joints: Scribe internal and mitre external joints.
Edge strips: Finish exposed edges of sheets with edge strips which match sheet faces.
Matching: For surfaces which are to have clear or tinted finish, arrange adjacent pieces to match the grain and colour.
Hygiene requirements: To all food handling areas and voids at the backs of units to all areas, seal all carcass junctions with walls and floors, and to cable entries, with silicone beads for vermin proofing.
Apply water resistant sealants around all plumbing fixtures and ensure the sealants are fit for purpose.

**Benchtops**
Installation: Fix to carcass at least twice per 600 mm length of benchtop.
Joint sealing: Fill joints with sealant matching the finish colour and clamp with proprietary mechanical connectors.
Edge sealing: Seal to walls and carcasses with a sealant, which matches the finish colour.

**Splash backs**
Glass: Fix with non-acidic silicone adhesive. Apply at the rate recommended by the manufacturer.
Installation: Clean the back of the glass panel and apply ‘wallnuts’ of adhesive together with double sided adhesive tape for temporary support, and affix directly to the substrate.

**Labelling**
General: Permanently mark each unit of furniture with the manufacturer’s name, on an interior surface.
E31.3.2 DELIVERY AND STORAGE

General
General: Deliver joinery units to site in unbroken wrapping or containers and store so that its moisture content is not adversely affected. Do not store in areas of wet plaster. Keep storage to a minimum by delivering items only when required for installation.

Concealed surfaces: Prime surfaces concealed by backgrounds.

Deficiencies: Examine joinery units for completeness and remedy deficiencies.

Acclimatisation
General: Acclimatise the joinery items by stacking it in the in-service conditions with air circulation to all surfaces after the following construction operations are complete:
- Air conditioning operational.
- Lighting operational.
- Site drainage and stormwater works are complete.
- Space fully enclosed and secure.
- Wet work complete and dry.

Background
General: Damp clean and vacuum background surfaces that will be permanently concealed.

E31.3.3 COMPLETION

Maintenance manual
General: Submit manufacturer’s published recommendations for service use.

Cleaning
Temporary coatings: On or before completion of the works, or before joining up to other surfaces, remove all traces of temporary coatings used as a means of protection.

General: Remove all dust, marks and rubbish from all surfaces and internal spaces. Clean and polish all self finished surfaces such as anodised and powdercoated metals, sanitaryware, glass, tiles and laminates.

E31.4 SCHEDULE OF JOINERY ITEMS

<table>
<thead>
<tr>
<th>Schedule</th>
<th>Ticket Office Counter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Ticket Office in New Platform Building</td>
</tr>
<tr>
<td>Description</td>
<td>U shaped desktop with size as shown Mobile drawer unit below desktop. Unit to be 530mm wide by 450mm deep by 800mm high, with 3 drawers all as detailed</td>
</tr>
<tr>
<td>Materials</td>
<td>32mm thick MDF with heavy duty laminate to both surfaces</td>
</tr>
<tr>
<td>Laminate selection</td>
<td>Refer to Finishes Schedule</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Desk top</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Cash Counting area in New Platform Building</td>
</tr>
<tr>
<td>Description</td>
<td>L shaped desktop with size as shown</td>
</tr>
<tr>
<td>Materials</td>
<td>32mm thick MDF with heavy duty laminate to both surfaces</td>
</tr>
<tr>
<td>Laminate selection</td>
<td>Refer to Finishes Schedule</td>
</tr>
</tbody>
</table>
### Joinery

<table>
<thead>
<tr>
<th>Item</th>
<th>Kitchen cupboards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Kitchen in New Platform Building</td>
</tr>
<tr>
<td>Description</td>
<td>Floor cupboard unit with sink, two door cupboard and space for refrigerator. L shaped benchtop. Wall cupboard unit.</td>
</tr>
<tr>
<td>Materials</td>
<td>General: HMR MDF. Carcass: Melamine coated to all exposed surfaces. Doors: Laminated with selected laminate. Benchtop: 32mm thick laminated with selected laminate.</td>
</tr>
<tr>
<td>Laminate selection</td>
<td>Refer to Finishes Schedule</td>
</tr>
<tr>
<td>Fittings</td>
<td>Single bowl stainless steel sink with draining board</td>
</tr>
<tr>
<td>Size</td>
<td>As shown on drawings</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Storage cupboard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Cleaners Room in new Platform Building</td>
</tr>
<tr>
<td>Description</td>
<td>Floor cupboard with raised floor and skirting, two hinged doors, and one shelf at high level. Cupboard to incorporate EDB.</td>
</tr>
<tr>
<td>Materials</td>
<td>Laminated MDF to floor, doors and shelf as previously specified</td>
</tr>
<tr>
<td>Laminate selection</td>
<td>Refer to Finishes Schedule</td>
</tr>
<tr>
<td>Size</td>
<td>Coordinate length, depth and height with the dimensions of the existing metal lockers which are to be re-installed in the new building. Height: 2000mm approx. Width: 1100mm approx. Depth: 500mm approx.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Storage cupboard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Lobby in new Platform Building</td>
</tr>
<tr>
<td>Description</td>
<td>Built in cupboard with raised floor and skirting, one hinged door and one shelf at 1700mm above floor level.</td>
</tr>
<tr>
<td>Materials</td>
<td>Laminated MDF to floor, door and shelf as previously specified</td>
</tr>
<tr>
<td>Laminate selection</td>
<td>Refer to Finishes Schedule</td>
</tr>
<tr>
<td>Size</td>
<td>To fit within recess in wall. Height: 2100mm approx. Width: 400mm approx. Depth: 350mm approx.</td>
</tr>
</tbody>
</table>

| Item | Baby Change Unit and countertop |

---

Contract No  
Cardiff Railway Station Easy Access Upgrade  
Tender Issue  
February 2012
<table>
<thead>
<tr>
<th>Location</th>
<th>Family accessible toilet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Change table comprising countertop and apron (on all four sides) and supported on four steel legs.</td>
</tr>
<tr>
<td>Materials</td>
<td>HMR MDF. Countertop 32mm thick, carcass and apron 18mm thick. All visible surfaces laminated with selected laminate</td>
</tr>
<tr>
<td>Laminate selection</td>
<td>Refer to Finishes Schedule</td>
</tr>
<tr>
<td>Fittings</td>
<td>Baby change unit as specified in Sundry Items</td>
</tr>
<tr>
<td>Size</td>
<td>As shown on drawings</td>
</tr>
</tbody>
</table>
E32 FABRICATED METALWORK

E32.1 GENERAL

E32.1.1 RESPONSIBILITIES

General
General: Provide metal fixtures that are:
- Undamaged, plumb, level and straight.
- Free of surface defects or distortions.

E32.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Metals and prefinishes
- Sundry items
- Structural steel

E32.1.3 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Shop fabricated or assembled items ready for delivery to the site.
- Commencement of shop or site welding.
- Site erected assemblies on completion of erection, before covering up by cladding and encasing.
- Steel surfaces prepared for, and immediately before, site applied finishes.

E32.1.4 SUBMISSIONS

Samples
General: Submit samples of the following:
- Each type of joint.
- Each type of finish.
- Sections for use in fabricated work.

Shop drawings
General: Submit shop drawings showing the following information:
- Details of fabrication and components.
- Details of fabrication involving other trades or components.
- Information necessary for site assembly.
- Proposals for the break-up of large items as required for delivery to the site.
- Proposed method of joining the modules of large items.

Shop drawings are to be provided for the following metalwork items
- Balustrade and handrails
- Anti-throw screens
- End of platform stairs
- Ticket Office window

Shop drawing certification
General: Engage a Professional Engineer and submit certification for the design and installation of:
Balustrades and provide a certificate of conformity with the structural requirements of Building Code of Australia.
Tests
Stainless steel: Before fabrication commences, submit satisfactory evidence that relevant procedure test plates have passed the tests specified in AS/NZS 1554.6.

Materials
Manufacturer’s data: Submit manufacturers published product data including standard drawings and details.
Stainless steel: For each batch of stainless steel supplied to the works, submit the certificate of compliance or test certificate specified in the applicable standard.

Execution
Welding procedures: Submit details of proposed welding procedures before fabrication.
Welding dissimilar metals: Submit the following details:
- Type and thickness of materials to be welded.
- Proposed joint preparation and welding procedures.
- Proposed filler metal.
- Expected dilution (proportion of fused parent metal in the weld metal).
Fastenings to aluminium (including aluminium alloys): Stainless steel or aluminium.

E32.2 PRODUCTS

E32.2.1 MATERIALS AND COMPONENTS

Metals and components
Performance: Provide metals in sections of strength and stiffness suited to their required function, finish and method of fabrication.

E32.2.2 STAINLESS STEEL FINISHES

Sample
General: Provide a finish to match the sample in terms of the mill grade and finish process.

Pre assembly
Mechanically polished and brushed finishes: Apply grit faced belts or fibre brushes that achieve uni-directional finishes with buffing as required to the following:
Bead blasted finish: Provide a uniform non-directional low reflective surface by bead blasting. Do not use sand, iron or carbon steel shot. Blast both sides of austenitic grades of stainless steel to equalise induced stress.

Post assembly pre-treatment
Heat discoloration: Remove by pickling.
Welds: Grind excess material, brush, and polish to match the pre assembly finish.

Completion
Cleaning: Clean and rinse to an acid free condition and allow to dry. Do not use carbon steel abrasives or materials containing chloride.
Protection: Secure packaging or strippable plastic sheet.

E32.3 EXECUTION

E32.3.1 CONSTRUCTION GENERALLY

Aluminium structures
Standard: To AS/NZS 1664.1 or AS/NZS 1664.2.

Metals
Performance: Provide metals so that they transmit the loads imposed and ensure the rigidity of the assembly without causing deflection or distortion of finished surfaces.
Incompatible metals: Separate using concealed layers of suitable materials in appropriate thicknesses.

Fasteners
Performance: Provide non-galvanic corrosion fasteners.
Materials: Provide fasteners in materials of mechanical strength and corrosion resistance at least equal to that of the lowest resistant metal joined.
To copper and copper alloys: Provide copper or copper-alloy fixing devices only.
To aluminium and aluminium alloys: Provide aluminium alloy or non-magnetic stainless steel fixing devices only.
To stainless steel: Provide appropriate stainless steel materials only.

Fabrication
Workshop: Fabricate and pre-assemble items in the workshop wherever practicable.
Edges and surfaces: Keep clean, neat and free from burrs and indentations. Remove sharp edges without excessive radiusing.
Tube bends: Form bends in tube without visibly deforming the cross section.
Colour finished work: Match colours of sheets, extrusions and heads of fasteners.
Thermal movement: Accommodate thermal movement in joints and fastenings.

Fabrication tolerances
Structural work generally: ± 2 mm from design dimensions.

Joints
General: Fit joints to an accuracy appropriate to the class of work. Finish visible joints made by welding, brazing or soldering using grinding, buffing or other methods appropriate to the class of work, before further treatment.
Self-finished metals: Free of surface colour variations, after jointing.
Joints: Fit accurately to a fine hairline.

Marking
General: Provide suitable and sufficient marks or other means for identifying each member of site-erected assemblies, and for their correct setting out, location, erection and connection. Mark bolted connections to show the bolting category. Do not mark stainless steel by notching.

Splicing
General: Provide structural members in single lengths.

E32.3.2 WELDING AND BRAZING

General
Quality: Provide finished welds which are free of surface and internal cracks, slag inclusion, and porosity.
Site welds: Avoid site welding wherever possible. If required locate site welds in positions for down hand welding.
Butt weld quality level: Not inferior to the appropriate level recommended in AS 1665 Appendix A.
Brazing
General: Ensure brazed joints have sufficient lap to provide a mechanically sound joint. Do not use butt joints relying on the filler metal fillet only.

E32.3.3 STAINLESS STEEL FABRICATION

Welding stainless steel
Certification of welders: To AS 1796.

Riveting
General: Riveting may be used only to join stainless steel sheet or strip less than 1 mm thick. Drill (not punch) the rivet hole, and drive the rivet cold. On completion, clean and passivate the riveted assembly.

Soldering
General: Do not solder stainless steel.

E32.3.4 METAL FIXTURES

General
General: Provide metal fixtures noted on drawings as follows:
- Components and their location, indicative construction details, scribes and trims, materials, dimensions and thicknesses, and finishes.
- Confirm on site all dimensions noted on drawings.
- Finishes selections as documented.
- Hardware and equipment.

E32.3.5 PIPE RAIL BALUSTRADES

Fabrication
Method: Welding.
Joints: Produce smooth unbroken surfaces at joints. Scribe the joints between posts and rails. Make end-to-end joints over an internal sleeve.
Bends: Make changes of direction in rails by evenly curved pipe bends.
Free ends: Seal the free ends of pipes with fabricated or purpose-made end caps.

Fixing to structure
General: Provide fabricated predrilled or purpose-made brackets or post bases, and attach the piping to the building structure with fixings, including bolts into masonry anchors, and coach screws or bolts into timber, of metal compatible with the piping.

Galvanizing
General: If possible, complete fabrication before galvanizing; otherwise apply a zinc-rich primer to affected joint surfaces.

E32.3.6 STAIR NOSINGS

Applied nosings
Aluminium: Purpose-made extruded Slip resistant aluminium nosing.
Vinyl: Purpose-made moulded Slip resistant section.
Ceramic: Purpose-made moulded Slip resistant tiles.
Slip resistance classification to AS/NZS 4586:
Dry environment: Pendulum X and Ramp R10
Wet environment: Pendulum W and Ramp B or R11

Tactile indicators
Standard: To AS/NZS 1428.4.1.

E32.3.7 COMPLETION

Maintenance manual
General: Submit manufacturer’s published recommendations for service use.

Cleaning
Temporary coatings: On or before completion of the works, or before joining up to other surfaces, remove all traces of temporary coatings used as a means of protection.

E32.4 SCHEDULE OF METALWORK

E32.4.1 BALUSTRADES

General
Provide balustrades to existing footbridge, existing and new stairs, Lift Lobbies, ramps and miscellaneous areas as shown on drawings.

Finish: All steel members, except stainless steel handrails and brackets, shall be galvanised and painted with epoxy paint as detailed in the Finishes Schedule.

Balustrade Type A
Location
- Open sides of new stairs and landings between the Footbridge Level and Upper Access Way
- Open sides of existing stairs and landings
- Lift lobbies
- Other areas as indicated on drawings

Description: Full balustrade with posts, top and bottom rails and balustrades at 100mm centres

Materials:
- Posts: 75 x 75mm x 3.0mm thick mild steel SHS, with 10mm thick mild steel baseplates located as shown on drawings and at maximum 1500mm centres.
- Top and bottom rails: 75 x 50mm x 3.0mm thick RHS
- Balusters: 20mm diameter mild steel rod
- Handrails: 42mm diameter x 3.2mm thick Grade 316 stainless steel CHS supported on brackets made from 16mm diameter stainless steel rods.

Handrails: Stainless steel handrail on the inner side of the balustrades, and fixed to wall at one side of the lower flights of Stair 1

Balustrade Type B
Location: Centrally in new stairs between Footbridge Level and Upper access Way.
Description: Open balustrade with posts and top and bottom rails.
Materials: Similar to Balustrade Type A.
Handrails: Stainless steel handrail on each side of the balustrade.

Balustrade Type C
Location: At minor changes in levels of Lower Car Park and where nominated on drawings.
Description: Open balustrade with posts and top and bottom rails.
Materials: Similar to Balustrade Type A.
Handrails: Not required

Balustrade Type D
Location: Ramp at Lower Car Park Level.
Description: Full balustrade with posts, top and bottom rails and balustrades at 100mm centres
Materials: Similar to Balustrade Type A.
Handrails: Stainless steel handrail on one side of the balustrade, and another handrail fixed to wall on the other side.

Handrails
Provide handrails to existing and new stairs and landings, Lobbies, footbridge and ramps as shown on drawings. Hand rails shall be made from 42mm diameter x 3.2mm thick Grade 316 stainless steel CHS supported on brackets made from 16mm diameter stainless steel rods.

Installation
- Where handrails are located in conjunction with a balustrade, Types A, b and D, weld handrail brackets to balustrade posts.
- Where handrails are located along concrete or masonry walls provide 60mm diameter by 6mm thick stainless steel plate at the end of each bracket and bolt fix to wall.

E32.4.2 ANTI THROW SCREENS

General
Provide Anti-throw screens to existing Footbridge and new extension as detailed. The screens to the existing footbridge shall be installed above the existing bridge slab, while the screens to the extension shall be fixed above the new concrete balustrade. All screens shall extend to a height of approximately 3000mm from the bridge floor level.

Framing
Construct mild steel framing consisting of curved vertical RHS posts and SHS horizontal rails. Posts shall be welded to mild steel angles bolted to top and side of concrete slab or balustrade wall. Size of members and fixing details shall be in accordance with the structural engineer's drawings.

Screen mesh
Material: Mild steel mesh fixed to steel framing as detailed.
Supplier: Locker Group
Type: Woven wire mesh
Aperture: Maximum 25mm x 25mm
Finish: Galvanised
Fabricated metalwork

**Handrails**
Existing Footbridge: 42mm diameter x 3.2mm thick, Grade 316 stainless steel CHS supported on brackets welded to main framework.
New extension: 42mm diameter x 3.2mm thick Grade 316 stainless steel CHS supported on brackets fixed to concrete balustrade.

**Finish**
Steel framing: Galvanised and painted with epoxy paint as specified in the Finishes Schedule.
Mesh: Galvanised.

**E32.4.3 STAIR NOSINGS**

**General**
Supply and install stair nosings to all existing and new stairs.
Slip resistance: R11 and Pendulum ‘W’

**New stairs**
Proprietary item: SafetyStride stair nosing
Product code: SN-CL4-MBN-TP5
Size: 75 x 26 mm (tread x riser)
Installation: Recessed
Material: Aluminium
Finish: Natural anodised with black inserts

**Existing Stairs**
Proprietary item: SafetyStride stair nosing
Product code: SN-CL4
Size: 104 x 26 mm (tread x riser)
Installation: Surface mounted
Material: Aluminium
Finish: Natural anodised with black inserts

**E32.4.4 TACTILE INDICATORS**

**General**
Provide tactile indicators to the existing and new stairs and other areas as shown on drawings.
Standard: AS1428.4 and TfNSW requirements

**Stairs and ramps**
Extent: 600mm wide x the full width of the stair or ramp landing.
Proprietary Item: Tactile Indicators as supplied by Pathfinder Systems Australia.
Type: Hazard indicators on a 30mm star shaft.
Material: Stainless steel with coloured polyurethane insert.

**E32.4.5 LOCKERS**

**General**
Location: Cleaners Room in new Platform Building.
Installation: Re-install lockers removed from existing Platform Building.

**E32.4.6 TICKET OFFICE WINDOW AND WALL LINING**

**General**
Provide ticket window and security wall lining in accordance with TfNSW’s requirements and details.
The installation must be carried out by an authorised security installer licensed under the NSW Security Protection Act and certification provided to TfNSW.

**Ticket window**
The Ticket window shall include steel frame, counter, money tray, glass panel and all trims and accessories as shown on drawings.
Glass: Bullet proof glass with a G2 rating.
Money Tray: Metal tray as detailed with a G2 rating.

**Wall lining**
Provide security steel wall lining to the front wall of the Ticket Office. The lining shall be fixed to the external side of the wall framing and shall extend the full width of the workstation unit and to the window head height.

The lining shall achieve a G2 rating.

**Security roller shutter**
Provide security roller shutter to Ticket Office window as specified in Overhead doors.

**E32.4.7 ITEMS SPECIFIED IN OTHER SECTIONS**

**General**
The following items are specified in other sections of this specification:
- Toilet Area fittings and Platform seating and bins: Sundry items
- Steel wall framing: Light steel framing
- Fencing: Fences and barriers

**E33 EXTINGUISHERS AND BLANKETS**

**E33.1 GENERAL**

**E33.1.1 RESPONSIBILITIES**

**General**
General: Provide fire extinguishers and fire blankets as documented.

**E33.1.2 CROSS REFERENCES**

**General**
Requirement: Conform to the following:
- General requirements.

**E33.1.3 AUTHORISED PRODUCTS**

**General**
General: Provide equipment listed in the ActivFire Register of Fire Protection Equipment.

**E33.2 PRODUCTS**

**E33.2.1 EXTINGUISHERS**

**Standards**
General: Provide portable fire extinguishers and location signs as follows:
- General requirements: AS/NZS 1841.1.
- Water: AS/NZS 1841.2.
- Wet chemical: AS/NZS 1841.3.
- Foam: AS/NZS 1841.4.
- Powder: AS/NZS 1841.5.
- Carbon dioxide: AS/NZS 1841.6.
- Non-rechargeable: To AS/NZS 1841.8.

Selection and location: To AS 2444

Certification: Required.

Certification provider: An organisation accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).
Extinguishers and blankets

Fire extinguishers schedule

<table>
<thead>
<tr>
<th>Location</th>
<th>Type</th>
<th>Number</th>
<th>Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Platform Building</td>
<td>Tyco or equivalent CO₂</td>
<td>1</td>
<td>Fix to wall where indicated</td>
</tr>
</tbody>
</table>

E33.2.2 BLANKETS

Fire blankets
General: To AS/NZS 3504.
Certification: Required.
Certification provider: An organisation accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).
Selection and location: To AS 2444.

Fire blankets schedule

<table>
<thead>
<tr>
<th>Location</th>
<th>Number</th>
<th>Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Platform Building</td>
<td>1</td>
<td>Fix to wall where indicated</td>
</tr>
</tbody>
</table>

E33.3 EXECUTION

E33.3.1 COMPLETION

Maintenance
Fire extinguishers: To AS 1851.
Fire blankets: To AS 1851.
Cementitious toppings

E34 CEMENTITIOUS TOPPINGS

E34.1 GENERAL

E34.1.1 RESPONSIBILITIES

General
General: Provide cementitious toppings in conformance with Selections and as follows:
- If floating, without edge curl.
- If bonded, without drummy areas.
- Without obvious shrinkage cracks.

E34.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.

E34.1.3 INTERPRETATION

Definitions
General: For the purposes of this worksection the following definitions apply:
- Concrete class: Normal: Concrete which is specified primarily by a standard compressive strength grade and otherwise in accordance with AS 1379 clause 1.5.3.
- Granolithic topping: A topping mix with the coarse aggregate restricted to between 2 mm and 3 mm.
- Substrates: The surface to which a material or product is applied.
- Topping: Mixture of binders, aggregate and water applied to substrates in a plastic state and dried and cured to a hard surface.
- Topping function:
  - Levelling: Topping placed to receive applied floor finishes.
  - Wearing: Topping placed to act as the finished floor.
- Topping method:
  - Bonded or post applied: Topping which is bonded to a hardened substrate from which laitance has been removed and to which a bonding agent has been applied.
  - Floating: Topping which is separated from a hardened substrate by a resilient layer.
  - Monolithic or wet applied: Topping placed on a plastic substrate so that a chemical bond is created between the substrate and the topping.
  - Separated: Topping which is separated from a concrete subfloor by a membrane.

E34.1.4 SUBMISSIONS

Product information
General: Submit product data on the following:
- Admixtures.
- Bonding products.
- Colouring products.
- Curing products.
- Sealant products.
- Slip-resistant products.
- Surface treatment products.

Product samples
General: Submit samples of the following products:
- Colouring products.
- Control joint products.
- Surface treatment products.

**Prototypes**
General: Prepare prototypes of each topping type:
- Size: 1200 x 2400 mm.

**E34.1.5 INSPECTIONS AND TESTS**

**Construction inspections**
General: Give notice to allow inspections as follows:
- Substrates ready for laying of toppings.
- Prototypes ready for inspection.

**Construction tests**
General: Test and assess conformity of construction as follows:
- Flatness: If flatness properties are required:
  - Method: To ASTM E1155.
- In situ crushing resistance/soundness: If a soundness category is required:
  - Method: To BS 8204-1.
- Slip resistance: If a slip resistance classification is required:
  - Method: To AS/NZS 4663.

**E34.1.6 TOLERANCES**

**General**
Thickets: Deviation from the stated thickness:
- Thickness < 15 mm: 2 mm.
- Thickness ≥ 15 < 30 mm: 5 mm.
- Thickness ≥ 30 mm: 10 mm.

Flatness deviation: Measured under a 3000 mm straightedge laid in any direction on a plane surface:
- Class A: < 3 mm.
- Class B: ≥ 3 < 5 mm.

**E34.2 PRODUCTS**

**E34.2.1 PRODUCTS**

**Admixtures**
Standard: To AS 1478.1.

**Aggregates**
Standard: To AS 2758.1.
Coarse aggregate: Nominal single size ≤ 1/3 topping thickness.
Fine aggregate: Fine, sharp, well-graded sand with a low clay content and free from efflorescing salts.

**Bonding products**
General: Provide proprietary products manufactured for bonding cement-based toppings to concrete substrates.

**Cement**
Standard: To AS 3972.
- Type: SL.

**Colouring products**
General: Provide proprietary products manufactured for colouring cement toppings.
Integral pigment proportion: ≤ 10% by mass of cement.

**Concrete**
Standard: To AS 1379.
Unreinforced topping:
- Class: Normal.
  Reinforced topping: Conform to the Reinforced topping table.

Reinforced topping table

<table>
<thead>
<tr>
<th>Exposure location</th>
<th>Strength grade</th>
<th>Cover to reinforcement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal and External &gt; 50 km inland and non-industrial and non-tropical</td>
<td>N25</td>
<td>20 mm</td>
</tr>
<tr>
<td>External &gt; 50 km inland and tropical and External near coastal (&gt; 1 km &lt; 50 km)</td>
<td>N32</td>
<td>30 mm</td>
</tr>
<tr>
<td>External coastal &lt; 1 km but not in the splash zone</td>
<td>N40</td>
<td>35 mm</td>
</tr>
</tbody>
</table>

Reinforcement
  Standard: To AS/NZS 4671.
  Mesh sizes for joint spacing as follows:
  - SL 42: Up to 3 m internal, 2 m external.
  - SL 62: Up to 6 m internal, 4 m external.

Curing products
  General: Provide proprietary products manufactured for use with cement-based toppings and with the floor finish to be laid on the toppings.

Mixes
  General: Provide toppings as follows or select mix proportions to the Mixes table:
  - Air entrainment: ≤ 3%.
  - Nominal coarse aggregate size: ≤ 0.3 x topping thickness.
  - Slump: 80 mm.
  - Standard strength grade: N25.
  Water quantity: The minimum necessary to achieve full compaction and prevent excessive water being brought to the surface during compaction.

Mixes table

<table>
<thead>
<tr>
<th>Mix type</th>
<th>Thickness (mm)</th>
<th>Upper and lower limits of proportion by weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cement</td>
</tr>
<tr>
<td>Bonded – cement and sand</td>
<td>35</td>
<td>1</td>
</tr>
<tr>
<td>Bonded – fine concrete</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td>Floating – fine concrete</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Granolithic</td>
<td>Floors: 25</td>
<td>1</td>
</tr>
<tr>
<td>Separated – fine concrete</td>
<td>70</td>
<td>1</td>
</tr>
</tbody>
</table>

Slip-resistance products
  General: Provide proprietary products manufactured to improve the wet-slip resistance of toppings.
  - Silicon carbide granules:
    - Granule size: ≥ 300 < 600 μm.
  - Silicon carbide two-part resin:
    - Granule size: ≥ 300 μm.

Surface treatment products
  General: Provide proprietary products manufactured for use with cement-based toppings to change the characteristics of the surface of the finished topping.
Cementitious toppings

Water
General: Clean and free from any deleterious matter.

E34.2.2 CONTROL JOINTS

Control joint materials
Control joint strip: A proprietary expansion joint consisting of a neoprene filler sandwiched between plates with lugs or ribs for mechanical keying. Set flush with the finished surface.
Proprietary slide plate divider strip: An arrangement of interlocking metal plates grouted into pockets formed in the concrete joint edges.
Sealant: One-part self-levelling non-hardening mould-resistant, silicone or polyurethane sealant applied over a backing rod. Finish flush with the terrazzo surface.
Floors: Trafficable, shore hardness > 35.
Backin g rod: Compressible closed cell polyethylene foam with a bond-breaking surface.

E34.3 EXECUTION

E34.3.1 PREPARATION

Substrates
General: Provide substrates as follows:
- Clean and free from any deposit which may impair adhesion of monolithic or bonded toppings.
- Remove excessive projections and voids and fill hollows with a mix not stronger than the substrate or weaker than the topping.
- Roughen hardened concrete by scabbling or the like to remove 2 mm of the laitance and expose the aggregate.

Bonded toppings
General: Before laying topping wash the substrate with water and provide a bonding product, or treat as follows:
- Keep wet for 2 hours or more.
- Remove surplus water and brush on neat cement or a clean slurry of cement and water.
- Place the topping while the slurry is wet.

E34.3.2 APPLICATION

Laying
General: Spread the mix and compact. Strike off, consolidate and level surfaces to finished levels.
Monolithic toppings: Lay while concrete subfloor is plastic and the surface water is no longer visible.
Toppings over 50 mm thick:
- Lay in two layers of equal thickness.
- Place a layer of reinforcement between the layers of toppings. Lap reinforcement 200 mm and tie.
  Do not create four way laps.

E34.3.3 SURFACE FINISHES

Finishing methods – primary finish
Machine float finish:
- After levelling, consolidate the surface using a machine float.
- Cut and fill and refloat immediately to a uniform, smooth, granular texture.
- Hand float in locations inaccessible to the machine float.
Steel trowel finish: After machine floating finish as follows:
- Produce a smooth surface relatively free from defects using power tools
- When the surface has hardened sufficiently, use steel hand trowels to produce the final consolidated finish free of trowel marks and uniform in texture and appearance.
Wood float finish: After machine floating, produce the final consolidated finish free of float marks and uniform in texture and appearance using wood or plastic hand floats.
Cementitious toppings

Broom finish: After machine floating draw a broom or hessian belt across the surface to produce a coarse even-textured slip-resistant transverse-scored surface.

Scored or scratch finish: After screeding, give the surface a coarse scored texture using a stiff brush or rake drawn across the surface before final set.

Sponge finish: After machine floating, obtain an even textured sand finish by wiping the surface using a damp sponge.

Surface finishes
General: Provide surface finishes in conformance with the Drawings and Finishes Schedule.

Slip resistant treatment
Surface treatment: Apply silicon carbide granules after floating and before the topping surface has set, and trowel into the surface so that the granules remain exposed.
Application rate: 1 kg/m² evenly distributed.

Surface colouring
General: Apply the colouring product after floating and before the topping surface has set and trowel into the surface so that it is even in colour.

Surface treatment
General: Apply the surface treatment after floating and before the topping surface has set.

Temperature
General: Make sure that the temperature of mixes, substrates and reinforcement are, at the time of application, ≥ 5°C or ≤ 35°C.

Severe temperature: If the ambient shade temperature is greater than 38°C, do not mix topping.

E34.3.4 CONTROL OF MOVEMENT

General
General: Provide control joints to the Control joints schedule and as follows:

- Location:
  - Over structural control joints.
  - To divide complex room plans into rectangles.
  - Around the perimeter of the floor.
  - At junctions between different substrates.
  - To divide large topping-finished areas into bays.
- At abutments with the building structural frame and over supporting walls or beams where flexing of the substrate is anticipated.

Control joints to divide topping into bays: Provide joints using one of the following methods:
- Form in situ using square edge steel forms and trowelling a 3 mm radius to edges.
- Form a groove, extending at least one quarter the depth of the section, either by using a grooving tool, by sawing, or by inserting a premoulded strip.
- Install a control joint product.

Depth of joint: Right through to the substrate.

Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

Topping joints: Provide joints to divide toppings into bays as follows:
- Form in situ using square edge steel forms and trowelling a 3 mm radius to edges.
- Form a groove, extending at least one quarter the depth of the section, either by using a grooving tool, by sawing, or by inserting a premoulded strip.
- Install a control joint product.

Bay sizes:
- Area: ≤ 15 m².
- Length to width ratio: ≤ 1:1.5.
E34.3.5 JOINT ACCESSORIES

Weather bars
General: Provide a corrosion resistant metal weather bar under hinged external doors. Locate under the centres of closed doors.

Floor finish dividers
General: Finish cementitious toppings at junctions with differing floor finishes with a corrosion resistant metal dividing strip suitable fixed to the substrate, with top edge flush to the finished floor. If changes of floor finish occur at doorways make the junction directly below the centre of the closed door.

E34.3.6 COMPLETION

Curing
General: Prevent premature or uneven drying out and protect from the sun and wind.
Curing: Use a curing product or, as soon as toppings have set sufficiently, keep them moist by covering with polyethylene film for seven days.

Joint sealant
General: If required, seal joints as follows.
- Formed joints ≤ 25 mm deep: With filler and bond-breaker.
- Sawn joints: Full depth of cut.

Protection
General: Protect finished work from damage during building operations.

Slip resistance
Field test of completed surface: To AS/NZS 4663.
E35 WATERPROOFING – WET AREAS

E35.1 GENERAL

E35.1.1 RESPONSIBILITIES

General
General: Provide wet area waterproofing systems which:
- Are graded to floor wastes to dispose of water without ponding.
- Prevent moisture entering the substrate or adjacent areas.
Selections: As documented.

E35.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Tiling

E35.1.3 STANDARDS

Wet areas
Standard: To AS 3740.

E35.1.4 INTERPRETATIONS

Definitions
General: For the purposes of this worksection the definitions given in AS 3740 and the following apply:
- Substrates: The surface to which a material or product is applied.
- Bond breaker: A system preventing a membrane bonding to the substrate, bedding or lining.
- Membranes: Impervious barriers to liquid water which may be:
  - Installed below floor finishes.
  - Installed behind the wall sheeting or render and termed External.
  - Installed to the face of the wall sheeting or render and termed Internal.
  - Liquid applied in liquid or gel form and air cured to form a seamless film.
  - Sheet in sheet form with joints lapped and sealed.
- Preformed shower base: A preformed, prefinished vessel (including integral upstands) installed as the finished floor of a shower compartment, and provided with a connection point to a sanitary drainage system.
- Shower tray: An internal or external liquid or sheet membrane system used to waterproof the floor and the wall/floor junctions of a shower area.
- Waterproof (WP): The property of a material that does not allow moisture to penetrate through it.
- Waterproofing systems: Combinations of membranes, flashings, drainage and accessories which form waterproof barriers and which may be:
  - Loose-laid.
  - Bonded to substrates.
- Water resistant (WR): The property of a material that restricts moisture movement and will not degrade under conditions of moisture.
- Wet area: An area within a building supplied with a floor waste.

E35.1.5 INSPECTION

Notice
Inspection: Give notice so inspection may be made of the following:
- Substrate preparation completed.
- Secondary layers preparation completed.
- Before membranes are covered up or concealed.

E35.1.6 SUBMISSIONS

Shop drawings
Submit shop drawings showing:
- Junctions with vertical surfaces and upstands.
- Junctions at perimeters.
- Drainage details.
- Control joints.
- Flashings.
- Penetrations.
- Corners.
- Terminations and connections.

Execution records
Placing records: Photographically record the application of membranes and information as follows:
- Date.
- Portion of work.
- Substrate preparation.
- Protection provided from traffic.
For large or complex projects consider adding the following requirement:
- 'Personnel: Employ a suitably qualified person to monitor the placing and protection of the membrane and prepare a daily report.'

Samples
General: Submit 300 x 300 mm samples of each type of membrane.

Products documentation
General: Submit copies of product manufacturers:
- Product technical data sheets.
- Material safety data sheets (MSDS).
- Type tests certificates verifying conformance to AS/NZS 4858.

E35.2 PRODUCTS

E35.2.1 PRODUCTS
Membranes
Standard: To AS/NZS 4858.
Water stop angles
Material: Rigid, corrosion resistant angles compatible with the waterproof membrane system.
Bond breakers
Requirement: Compatible with the flexibility class of the membrane to be used.
Material: Purpose made bond breaker tapes and closed cell foam backing rods or fillets of sealant.
Flashings
Requirement: Flexible waterproof flashings compatible with the waterproof membrane system.
Liquid membrane reinforcement
Requirement: Flexible fabric compatible with the waterproof membrane system.
Sealants
Requirement: Waterproof, flexible, mould-resistant and compatible with host materials.
Adhesives
Requirement: Waterproof and compatible with host materials.
E35.3 EXECUTION

E35.3.1 PREPARATION

Substrates
General: Make sure substrates are as follows:
- Clean and free of any deposit or finish which may impair adhesion of membranes.
- If walls are plastered, remove loose sand.
- If walls or floors are framed or discontinuous, support members are in full lengths without splicing.
- If floors are solid or continuous:
  - Excessive projections are removed.
  - Voids and hollows > 10 mm with abrupt edges are filled with a cement:sand mix not stronger than the substrate nor weaker than the bedding.
  - Depressions < 10 mm are filled with a latex modified cementitious product with feathering eliminated by scabbling the edges.
  - Cracks in substrates wider than 1.5 mm are filled with a filler compatible with the membrane system.
- External corners: Round or arris edges.

Moisture content
Concrete substrates: Cure for > 21 days.
Moisture content: Verify that the moisture content of the substrate is compatible with the water vapour transmission rate of the membrane system by testing to AS/NZS 2455.1 Appendix B.
Test type:
- Hygrometer test: Seal a hygrometer to the substrate for > 16 hours and measure the relative humidity of the air between the instrument and the slab.
- Electrical resistance test: Connect a resistance meter to the slab and read the moisture content.

Falls
Substrate: If the membrane is directly under the floor finish ensure the fall in the substrate conforms to the fall nominated for the finish.

Sheet substrate fastening
Requirement: Fasten or adequately fix to the supporting structure.

Control joints
Finishes: Align control joints in finishes and bedding with control joints or changes in materials in the substrate.

Water stop angles
Requirement: Provide water stop angles at door thresholds and shower enclosures to support the waterproof membrane at junctions between waterproofed and non-waterproofed areas.
Sizing: Size the vertical leg of the water stop angle to conform to the requirements of AS 3740.
Corners: Cut the horizontal leg and bend the vertical leg at corners instead of forming vertical joints between separate lengths of angle.
Fixing: Fix water stop angles to the substrate with compatible sealant or adhesive and corrosion-resistant countersunk or wafer head screws.

Priming
General: If required by the membrane manufacturer, prime the substrates with a primer compatible with the membrane system.

Bond breakers
Requirement: After the priming of surfaces, provide bond breakers at all wall/floor, hob/wall junctions and at control joints where the membrane is bonded to the substrate.
Sealant fillet bond breakers:
- Application: Form a triangular fillet or cove of sealant to internal corners within the period recommended by the membrane manufacturer after the application of the primer.
- Widths: 5 mm x 5 mm to vertical corners. 6 mm x 6 mm – 9 mm x 9 mm to horizontal corners.
Backining rod bond breakers: Retain in position with continuous length of tape pressed firmly in place against the surfaces on each side of the rod.

**E35.3.2 APPLICATION**

**Protection**
General: Protect membrane from damage during installation and for the period after installation until the membrane achieves its service characteristics that resist damage.

**Extent of waterproofing**
Waterproof or water resistant surfaces: To the requirements of BCA 3.8.1.2.

**Sheet membrane joints**
Bituminous sheet membranes:
- Side laps > 75 mm.
- End laps > 100 mm.

Synthetic rubber membranes:
- Factory-vulcanized laps > 40 mm.
- Field side laps > 50 mm for side laps.
- Field end-laps > 100 mm for end laps.

PVC membranes:
- Factory welded laps > 30 mm.
- Field-welded laps > 75 mm.

**Vertical membrane terminations**
Upstands: At least 150 mm above the finished tile level of the floor or 25 mm above the maximum retained water level, whichever is the greater.

Anchoring: Secure sheet membranes along the top edge.

Edge protection: Protect edges of the membrane.

**Flashings**
Junctions between waterproof surfaces: Provide a bond breaker at internal corners behind flashings.

Junctions between waterproof surfaces and other surfaces: Provide a bead of sealant at the following junctions:
- Waterproof and water-resistant surfaces.
- Water-resistant and water-resistant surfaces.
- Water-resistant and non water-resistant surfaces.

Perimeter flashings: Provide continuous flashings to the full perimeter of waterproof areas at wall/floor junctions and to water stop angles.

Vertical flashings: Provide vertical corner flashings continuous across wall/wall junctions to at least 1800 mm above finished floor level.

Vertical liquid applied flashings:
- Return legs at least 40 mm on each wall.
- Overlap the vertical termination of the floor waterproofing membrane at least 20 mm.

Vertical sheet flashings:
- Return legs at least 50 mm on each wall.
- Overlap shower tray upstands at least 50 mm.
- Do not penetrate flashing with wall lining fasteners.

Reinforcement: At coves, corners and wall/floor junctions with gaps greater than 3 mm reinforce liquid applied membranes with reinforcement fabric tape recommended by the membrane manufacturer. Fold the tape in half lengthways and imbed it in the first flashing coat of membrane with one half of the tape on each side of the corner or joint. Apply a second coat of liquid membrane to seal the fabric.

**Doorjams and architraves**
Requirement: Where the bottom of doorjams and architraves do not finish above the floor tiling, waterproof their surfaces below tile level to provide a continuous seal between the perimeter flashing to the wall/floor junction and the water stop angle.
Drainage connections
Floor wastes: Provide floor wastes of sufficient height to accommodate the thickness of floor finishes and bedding at the outlet position. Position drainage flange to drain at membrane level. Turn membrane down 50 mm minimum into the floor waste drainage flanges, and adhere to form a waterproof connection.

Floor wastes in shower trays: Provide drainage of the tile bed and a waterproof connection between the tray and the drain.

Preformed drainage channels with continuous drainage flanges: Provide a continuous waterproof connection between the membrane and the channel.

Preformed drainage channels without drainage flanges: Provide continuous waterproofing under the channel and terminate the membrane at a floor waste with a recessed drainage flange.

Membrane horizontal penetrations
Sleeves: Provide a flexible flange for all penetrations, bonded to the penetration and to the membrane.

Membrane vertical penetrations
Pipes, ducts, and vents: Provide separate sleeves for all pipes, ducts, and vents and have fixed to the substrate.

Curing of liquid applied systems
General: To the manufacturers instructions.
Curing: Allow membrane to fully cure before tiling.

Overlaying finishes on membranes
Requirement: Protect waterproof membranes with compatible water-resistant surface materials that do not cause damage to the membrane.
Suitable materials: Conform to AS 3740.
Bonded or partially bonded systems: If the topping or bedding mortar is required to be bonded to the membrane, provide sufficient control joints in the topping or bedding mortar to reduce the movement over the membrane.

E35.3.3 FLOOD TEST

General
Application: Perform a flood test before the installation of surface finishes.
Moisture measurement method: Conform to AS/NZS 2455.1 Appendix B.
Set-up:
- Measure the wall/floor junction of adjacent spaces and the floor soffit below for dryness.
- Record the result for each area.
- Dam the doorway(s) and seal floor wastes and drainage outlets to allow 50 mm water level.
- Fill space with clean water and leave overnight.
Evaluation:
- Make a visual inspection of the wall/floor junction of adjacent spaces and of the floor soffit below for obvious water or moisture.
- Test the same areas for dryness and compare the results to the measurements taken prior to flooding.
Compliance:
- Evidence of water from the visual test: Failure.
- No visual evidence of water: Proceed with moisture measurements.
- Test results indicating an increase in moisture before and after flooding: Failure.
Records:
- Submit records of all flood tests.

E35.3.4 COMPLETION

Protection
General: Keep traffic off membrane surfaces until bonding has set or for 24 hours after laying, whichever period is the longer.
Reinstatement: Repair or replace faulty or damaged work. If the work cannot be repaired satisfactorily, replace the whole area affected.

**Warranty**

Waterproofing: Cover materials and workmanship in the terms of the warranty in the form of interlocking written warranties from the supplier and the applicator.

- Form: Against failure of materials and execution under normal environment and use conditions.
- Period: Fifteen (15) years.

**E35.4 SELECTIONS**

**E35.4.1 SYSTEMS**

**Liquid membrane systems**

Location:
- Staff Toilet
- Family Accessible Toilet

Type: Proprietary liquid membrane

Proprietary item: Superflex 3 waterproofing system

**Certification**

The manufacturer must have a current Australian Building Products and Systems Scheme certificate; or a current technical opinion issued by the Australian Building Systems Appraisal Council stating that the system is suitable for use in wet areas, shower recesses and associated floors and wall/floor junctions which are to be tiled.
E36 CERAMIC TILING

E36.1 GENERAL

E36.1.1 RESPONSIBILITIES

General
General: Provide tiling systems to walls, floors and other substrates as follows and/or to the
SELECTIONS:
- Consistent in colour and finish.
- Firmly bonded to substrates for the expected life of the installation.
- Set out with joints accurately aligned in both directions and wall tiling joints level and plumb.
- To direct all water flowing from supply points to drainage outlets without leakage to the substrate or
adjacent areas.

E36.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.

E36.1.3 STANDARDS

Tiling
General: Comply with the recommendations of those parts of AS 3958.1 which are referenced in this
worksection.

Slip Resistance
Classification: To AS/NZS 4586 for the classifications noted in SELECTIONS.
Slip resistance measurement of existing installations: To AS/NZS 4663.

E36.1.4 INTERPRETATION

Definitions
General: For the purposes of this worksection the following definitions apply:
- Adhesives:
  . Cementitious (C): Adhesives in which the binders are hydraulic, e.g. Portland cement, with
    aggregates and organic additives.
  . Dispersion (D): Adhesives in which the binders are in the form of aqueous polymer dispersion
    with mineral fillers and organic additives.
  . Reaction resin (R): Adhesives in which in the binders are synthetic resins with mineral fillers and
    organic additives. The curing occurs by chemical reaction.
- Substrates: The surface to which a material or product is applied.
- Bedding: Mixtures of materials which are applied to substrates in a plastic state and which dry, cure
  and adhere tiles to substrates.
  . Adhesive bedding: Tiling adhered by adhesives.
  . Mortar bedding: Tiling adhered in a cementitious mortar bed.
- Pavers: Slabs made from clays, stone, precast concrete and/or other inorganic raw materials
  generally over 20 mm thick used as coverings for floors and supported over continuous substrates.
- Tiles: Thin slabs made from clays and/or other inorganic raw materials used generally as coverings
  for floors and walls and adhered to continuous supporting substrates.
  . Cementitious: Cement based pre-finished tiles.
  . Dry-pressed: Tiles made from a finely milled body mixture and shaped in moulds at high
    pressure. Also known as Type B.
  . Extruded: Tiles whose body is shaped in the plastic state in an extruder then cut to size. Also
    known as Type A.
- Wet area: An area within a building supplied with a floor waste.
- Acoustic underlay: A resilient underlay providing acoustic isolation.
- Lippage: Height deviation between adjacent tiles.
- Stepping: The relative surface level of adjacent paving elements within the expanse of the main pavement.

E36.1.5 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Substrate immediately before tiling.
- Trial set-outs before execution.
- Control joints before sealing and grouting.
- Grout and sealant colours before application.

E36.1.6 SUBMISSIONS

Samples
General: Submit labelled samples of tiles, including fittings, accessories, grout and sealants, illustrating the range of variation in colour and finish.

Execution
Grouting: Submit proposals for grouting methods and materials.
Margins: If it appears that variations in joint widths or overall dimensions will avoid cut tiles, submit a proposal.

Product conformity
Assessment: Submit current assessments of conformity as follows:
- Declaration of conformity by an AS/NZS ISO 9001 quality management system certified supplier.
  - Slip resistance of the tiles specified in Selections to AS/NZS 4586.
- Marking and Classification of tiles with regard to water absorption and shaping to AS 4662.
- Marking and Classification of tile adhesive to AS 4992.1.
- Weighted normalised impact sound pressure level to AS ISO 717.2 as measured for the acoustic underlay as part of the entire tiling system.

E36.1.7 TESTS

General
Tests: Submit tests as follows:
- Type test slip resistance of tiles to AS/NZS 4586.
- Site slip resistance test of completed surface to AS/NZS 4663.

E36.1.8 TOLERANCES

Completed tiling
Standard: To AS 3958.1 clause 5.4.6.

E36.2 PRODUCTS

E36.2.1 MARKING

Identification
General: Deliver materials to the site in the manufacturer’s original sealed containers legibly marked to show the following:
- Manufacturer’s identification.
- Product brand name.
- Product type.
- Dimensions and quantity.
- Product reference code and batch number.
- Date of manufacture.
- Material composition and characteristics such as volatility, flash point, light fastness, colour and pattern.
- Handling and installation instructions.

**E36.2.2 TILES AND ACCESSORIES**

**Tiles**
Standard: To AS 4662.

Tactile ground surface indicators: To AS/NZS 1428.4.1.

Coves, nosings and skirtings: Provide matching stop-end and internal and external angle tiles moulded for that purpose.

Exposed edges: Purpose-made border tiles with the exposed edge (whether round, square or cushion) glazed to match the tile face. If such tiles are not available, mitre tiles on external corners.

**Accessories**
General: Provide tile accessories which match the composition, colour and finish of the surrounding tiles.

**E36.2.3 ADHESIVES**

**General**
Standard: To AS 2358 and AS 4992.1.

**Type**
General: Provide adhesives to the Wall tiling schedule and to the Floor tiling schedule and compatible with the materials and surfaces to be adhered.

Prohibited uses: Do not provide the following combinations:
- Cement-based adhesives on wood, metal, painted or glazed surfaces, gypsum-based plaster.
- Organic solvent-based adhesives on painted surfaces.
- Organic PVC-based adhesives and organic natural rubber latex adhesives in damp or wet conditions.
- PVA (polyvinyl acetate) based adhesives in wet areas or externally.

**E36.2.4 MORTAR**

**Materials**
Cement type to AS 3972: GP.
- White cement: Iron salts content \( \leq 1\% \).
- Off-white cement: Iron salts content \( \leq 2.5\% \).

Lime: To AS 1672.1.

Sand: Fine aggregate with a low clay content selected for grading, sharp and free from efflorescing salts.

Measurement of volume: Measure binders and sand by volume using buckets or boxes. Do not allow sand to bulk by absorption of water.

**Bedding mortar**
Proportioning: Select proportions from the range 1:3 – 1:4 cement: sand (by volume) to obtain satisfactory adhesion. Provide minimum water.

Terra cotta tiles: Use proprietary polymer modified mortar.

Mixing: To AS 3958.1 clause 2.15.

**Water**
General: Clean and free from any deleterious matter.

**E36.2.5 GROUT**

**Type**
Cement based proprietary grout: Mix with water. Fine sand may be added as a filler in wider joints.

Terra cotta tiles: Use proprietary polymer modified grout.

Portland cement based grout: Mix with fine sand. Provide minimum water consistent with workability.
- For joints < 3 mm: 1 cement:2 sand (by volume).
- For joints ≤ 3 mm: 1 cement:3 sand (by volume).

**Pigments**

Pigments for coloured grout: Provide colourfast fillers compatible with the grout material. For cement-based grouts, provide lime-proof natural or synthetic metallic oxides compatible with cement.

**E36.2.6 CONTROL JOINTS**

**Control joint materials**

Control joint strip: A proprietary expansion joint consisting of a neoprene filler sandwiched between plates with lugs or ribs for mechanical keying. Set flush with the finished surface.

Proprietary slide plate divider strip: An arrangement of interlocking metal plates grouted into pockets formed in the concrete joint edges.

Sealant: One-part self-levelling non-hardening mould resistant, silicone or polyurethane sealant applied over a backing rod. Finish flush with the finished surface.

- Floors: Trafficable, shore hardness > 35.

Backing rod: Compressible closed cell polyethylene foam with a bond-breaking surface.

**E36.3 EXECUTION**

**E36.3.1 SUBSTRATES**

**Drying and shrinkage**

General: Before tiling, allow at least the following times to elapse (for initial drying out and shrinkage) for these substrates:

- Concrete slabs: 42 days.
- Concrete blockwork: 28 days.
- Toppings on slabs and rendering on brick or blockwork: A further 21 days.
- Rendering on swimming pool shell: A further 28 days minimum.

**Ambient temperature**

General: If the ambient temperature is < 5 or > 35°C, do not lay tiles.

**Substrates without wet area membranes**

General: Ensure substrates are as follows:

- Clean and free of any deposit or finish which may impair adhesion or location of tiles.
- If framed or discontinuous, support members are in full lengths without splicing.
- If solid or continuous:
  - Excessive projections are removed.
  - Voids and hollows > 10 mm with abrupt edges are filled with a cement:sand mix not stronger than the substrate or weaker than the bedding.
  - Depressions < 10 mm are filled with a latex modified cementitious product with feathering eliminated by scabbling the edges.

Absorbent substrates: If suction is excessive, control it by dampening but avoid over-wetting and do not apply mortar bedding to substrates showing surface moisture.

Dense concrete: If not sufficiently rough to provide a mechanical key, roughen by scabbling or the like to remove 3 mm of the surface and expose the aggregate; then apply a bonding treatment.

**Substrates with wet area membranes**

General: Ensure substrates are as follows:

- Clean and free of any deposit or finish which may impair adhesion or location of tiles.
- Compatible with all components of the floor system.
Trial set-out
General: Prepare a trial tile set-out of each area as follows to:
- Maximise the size of equal margins of cut tiles.
- Locate control joints.
- Note minor variations in joint widths to eliminate cut tiles at margins.
- Mark location of fittings on walls.

E36.3.3 TILING GENERALLY

Sequence
General: Fix wall tiles before floor tiles.

Cutting and laying
Cutting: Cut tiles neatly to fit around fixtures and fittings and at margins where necessary. Drill holes without damaging tile faces. Cut recesses for fittings such as soap holders. Rub edges smooth without chipping.
Laying: Return tiles into sills, reveals and openings. Butt up to returns, frames, fittings, and other finishes. Strike and point up beds where exposed. Remove tile spacers before grouting.

Variations
General: Distribute variations in hue, colour, or pattern uniformly, by mixing tiles or tile batches before laying.

Protection
Floor tiles: Keep traffic off floor tiles until the bedding has set and attained its working strength.
Cleaning: Keep the work clean as it proceeds and protect finished work from damage.

Floor finish dividers
General: Finish tiled floors at junctions with differing floor finishes with a corrosion-resistant metal dividing strip fixed to the substrate. If changes of floor finish occur at doorways, make the junction directly below the closed door.

E36.3.4 SETTING OUT

Tile joints
Joint widths: Set out tiles to give uniform joint widths within the following limits:
- Floors:
  - Dry pressed tiles: 3 mm.
  - Extruded tiles: 6 mm.
  - Vitrified: 3 to 5 mm.
  - Quarry tiles: 6 to 12 mm.
  - Chemical resistant epoxy jointed tiling: 5 to 6 mm.
- Large and/or irregular floor tiles: 6 to 12 mm.
- Mounted mosaics: To match mounting pattern.
- Walls:
  - Dry pressed tile: 1.5 mm.
  - Extruded tile: 6 mm.

Joint alignment: Set out tiling with joints accurately aligned in both directions and wall tiling joints level and plumb.
Joint position: Set out tiles from the centre of the floor or wall to be tiled.

Margins
General: Provide whole or purpose-made tiles at margins where practicable, otherwise set out to give equal margins of cut tiles. If margins less than half tile width are unavoidable, locate the cut tiles where they are least conspicuous.

Fixtures
General: If possible position tiles so that holes for fixtures and other penetrations occur at the intersection of horizontal and vertical joints or on the centre lines of tiles. Continue tiling fully behind fixtures which are not built in to the tiling surface. Before tiling ensure that fixtures interrupting the tile surfaces are accurately positioned in their designed or optimum locations relative to the tile layout.
E36.3.5 FALLS AND LEVELS

Grading
General: Grade floor tiling to even and correct falls to floor wastes and elsewhere as required. Make level junctions with walls. Where falls are not required lay level.
Fall, general: 1:100 minimum.
Fall, in shower areas: 1:60 minimum.
Change of finish: Maintain finished floor level across changes of floor finish including carpet.

E36.3.6 BEDDING

Standard
Cement mortar: To AS 3958.1 clause 5.5.
Adhesive: To AS 3958.1 clause 5.6.

Preparation of tiles
Adhesive bedding: Fix tiles dry; do not soak.
Mortar bedding: Soak porous tiles in water for half an hour and then drain until the surface water has disappeared.

Bedding
General: Use bedding methods and materials which are appropriate to the tile, the substrate, the conditions of service, and which leave the tile firmly and solidly bedded in the bedding material and adhered to the substrate. Form falls integral with the substrate.

Thin adhesive beds
General: Provide only if the substrate deviation is less than 3 mm when tested with a 3 m straight edge. Cover the entire tile back with adhesive when the tile is bedded.
Thickness: 1.5 – 3 mm.

Thick adhesive beds
General: Provide on substrates with deviations up to 6 mm when tested with a 3 m straight edge, and with tiles having deep keys or frogs.
Nominal thickness: 6 mm.

Adhesive bedding application
General: Apply adhesive by notched trowel to walls and floors and direct to tiles if required, to provide evenly distributed coverage after laying as follows:
- Domestic internal walls: > 65%.
- Domestic internal floors: > 80%.
- Other wall and floors: > 90%.
- Wet areas and bench tops: 100%.
Pattern of distribution of adhesive: As described in AS 3958.1 clause 5.6.4.3. Verify by examining one tile in ten as work proceeds.
Wall tile spacers: Do not use spacer types that inhibit the distribution of adhesive.
Curing: Allow the adhesive to cure for the period nominated by the manufacturer prior to grouting or allowing foot traffic.

Mortar beds
For floor tiles: Either lightly dust the screeded bed surface with dry cement and trowel level until the cement is damp, or spread a thin slurry of neat cement, or cement-based thin bed adhesive, on to the tile back. Do not provide mortar after initial set has occurred.
- Nominal thickness: 20 to 40 mm.
Thick reinforced beds: Place mortar bed in two layers, and incorporate the mesh reinforcement in the first layer.

Mechanical fixing
General: Provide a proprietary system of support and fixing appropriate to the type of tile and the substrate conditions.
E36.3.7 CONTROL OF MOVEMENT

General
General: Provide control joints carried through the tile and the bedding to AS 3958.1 clause 5.4.5, the Control joints schedule and as follows:
- Floor location:
  . Over structural control joints.
  . To divide complex room plans into rectangles.
  . Around the perimeter of the floor.
  . At junctions between different substrates.
  . To divide large tiled areas into bays.
  . At abutments with the building structural frame and over supporting walls or beams where flexing of the substrate is anticipated.
- Depth of joint: Right through to the substrate.
- Sealant width: 6 – 25 mm.
- Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

E36.3.8 GROUTED AND SEALANT JOINTS

Grouted joints
General: Commence grouting as soon as practicable after bedding has set. Clean out joints as necessary before grouting.
Face grouting: Fill the joints solid and tool flush. Clean off surplus grout. Wash down when the grout has set. When grout is dry, polish the surface with a clean cloth.
Edges of tiles: Grout exposed edge joints.
Epoxy grouted joints: Ensure that tile edge surfaces are free of extraneous matter such as cement films or wax, before grouting.

Sealant joints
General: Provide joints filled with sealant and finished flush with the tile surface as follows:
- Where tiling is cut around sanitary fixtures.
- At corners of walls in showers.
- Around fixtures interrupting the tile surface, for example pipes, brackets, bolts and nibs.
- At junctions with elements such as window and door frames and built-in cupboards.
Material: Anti-fungal modified silicone.
Width: 5 mm.
Depth: Equal to the tile thickness.

E36.3.9 JOINT ACCESSORIES

Floor finish dividers
General: Finish tiled floors at junctions with differing floor finishes with a corrosion resistant metal dividing strip suitably fixed to the substrate, with top edge flush with the finished floor. Where changes of floor finish occur at doorways make the junction directly below the closed door.
Stepping: Less than 5 mm.

Adjustments
If the floor finish divider was installed by the wet area waterproof membrane applicator check that the height is sufficient for the topping and tile thickness. Adjust as required with a matching flat bar adhesive fixed to the divider angle.

Weather bars
General: Provide a corrosion resistant metal weather bar under hinged external doors. Locate under the centres of closed doors.
E36.3.10 COMPLETION

Spare tiles
General: Supply spare matching tiles and accessories of each type for future replacement purposes. Store the spare materials on site.
Quantity: At least 1% of the quantity installed.
Storage location: As directed by the Principal’s Representative.

Cleaning
General: Clean tiled surfaces using an appropriate tile cleaning agent, and polish.

Operation and maintenance manuals
General: Submit a manual describing care and maintenance of the tiling, including procedures for maintaining the slip-resistance grading stating the expected life of the slip-resistance grade.

E36.4 SELECTIONS

E36.4.1 SCHEDULES

Floor tiling schedule

<table>
<thead>
<tr>
<th>Location</th>
<th>New Platform Building</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Staff Toilet</td>
</tr>
<tr>
<td></td>
<td>- Family Accessible Toilet</td>
</tr>
<tr>
<td></td>
<td>- Cleaners Room</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tiles</th>
<th>Better Tiles BFA700</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Type</td>
<td>Better Tiles BFA700</td>
</tr>
<tr>
<td>- Colour</td>
<td>As noted in the Finishes Schedule</td>
</tr>
<tr>
<td>- Size</td>
<td>600 x 300mm</td>
</tr>
<tr>
<td>- Bedding</td>
<td>Thick cement based bedding laid to falls</td>
</tr>
<tr>
<td>- Grout</td>
<td>Proprietary, cement based, natural colour</td>
</tr>
<tr>
<td>- Slip resistance classification</td>
<td>To comply with all relevant Australian Standards</td>
</tr>
</tbody>
</table>

Wall tiling schedule

<table>
<thead>
<tr>
<th>Location</th>
<th>New Platform Building</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Staff Toilet</td>
</tr>
<tr>
<td></td>
<td>- Family Accessible Toilet</td>
</tr>
<tr>
<td></td>
<td>- Splashback to Kitchenette</td>
</tr>
<tr>
<td></td>
<td>- Wall behind to Cleaners sink</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tiles</th>
<th>Better Tiles, BGY-107 (White) BGY-Red (Red)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Type &amp; colour</td>
<td>Better Tiles, BGY-107 (White)</td>
</tr>
<tr>
<td>- Extent of each colour</td>
<td>As noted in the Finishes Schedule</td>
</tr>
<tr>
<td>- Size</td>
<td>162 x 495mm</td>
</tr>
<tr>
<td>- Bedding</td>
<td>Thin adhesive bed</td>
</tr>
<tr>
<td>- Grout</td>
<td>Proprietary, cement based, to match colour of tiles</td>
</tr>
</tbody>
</table>

Skirting

<table>
<thead>
<tr>
<th>Location</th>
<th>Staff Toilet, Family Access Toilet and Cleaners Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tiles</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>- Type</td>
<td>Better Tiles BSP 105C coved skirting</td>
</tr>
<tr>
<td>- Colour</td>
<td>As noted in the Finishes Schedule</td>
</tr>
<tr>
<td>- Size</td>
<td>100 x 200mm</td>
</tr>
<tr>
<td>- Bedding</td>
<td>Thin adhesive bed</td>
</tr>
<tr>
<td>- Grout</td>
<td>Proprietary, cement based, to match colour of tiles</td>
</tr>
</tbody>
</table>
E37 RESILIENT FINISHES

E37.1 GENERAL

E37.1.1 RESPONSIBILITIES

General

General: Install resilient floor coverings to substrates as follows and/or to Selections:
- To remain secured for the warranty life of the covering.
- To remain consistently smooth for the warranty life of the covering.
- To form the pattern required.

E37.1.2 CROSS REFERENCES

General

Requirement: Conform to the following:
- General requirements.

E37.1.3 INTERPRETATION

Definitions

General: For the purposes of this worksection the following definitions apply:
- Resilient floor coverings classification: To BS EN 685.
- Substrate: The surface to which a material or product is applied.
- Underlay: A layer of sheet material or in situ filling on the substrate that modifies the behaviour of the subsequent finish.

E37.1.4 INSPECTION

Notice

Inspection: Give notice so that inspection may be made of the following:
- Completion of laying underlay, if any.
- Substrate immediately before fixing resilient finishes.
- Finished surface before applying sealers or polishes (if any).
- Completed installation.

E37.1.5 TESTS

Slip resistance

Submit tests as follows:
- Type test slip resistance of flooring product to AS/NZS 4586.
- Site test completed surfaces to AS/NZS 4663.

E37.1.6 SUBMISSIONS

Samples

Range: Submit labelled samples of resilient finishes illustrating the range of colour, pattern or texture as seen in the finished work.

Minimum size per sample:
- Sheet: 450 x 450 mm.
- Tiles: A whole tile or 0.09 m², whichever is the greater.
- Linear accessories (coving, skirting, stair nosing, protection strips, and the like): A piece 300 mm long.

Welded joints: Submit a sample joint 300 mm long.

Identification

Labelling: Label each sample, giving brand, product name, and manufacturer's code reference (including the code for each coat of multi-coat work).
Resilient finishes

Trial set-out: Prepare a trial set-out before fixing.

Subcontractors
General: Submit names and contact details of proposed suppliers and installers.

Tests
Manufacturer's test data: Submit independent testing authorities’ reports of factory or type tests showing that materials comply with cited standards.

Materials and components
Manufacturer’s data: Submit the manufacturer’s published product data for each type of finish, and recommendations for its application in the project including, where relevant, the following:
- Thickness and width of sheet or size of tile.
- Adhesive and jointing method.
- Resistance to wear, indentation, chemicals, light and fire.
- Flexibility and bending strength.

E37.2 PRODUCTS

E37.2.1 GENERAL
Critical radiant flux
Standard: To AS ISO 9239.1.
Floor finishes: Conform to the values of critical radiant flux nominated in Selections.

Smoke development rate
Standard: To AS ISO 9239.1.
Floor finishes in non-sprinklered buildings: 750 percent-minutes.

E37.2.2 MARKING
Identification
General: Deliver materials to the site in the manufacturer’s original sealed containers legibly marked to show the following:
- Manufacturer’s identification.
- Product brand name.
- Product type.
- Dimensions and quantity.
- Product reference code and batch number.
- Date of manufacture.
- Material composition and characteristics such as volatility, flash point, light fastness, colour and pattern.
- Handling and installation instructions.

E37.2.3 UNDERLAYS
Cementitious
General: Polymer modified cementitious self smoothing and levelling compound.
- Thickness: 3 mm minimum.

Fibre cement underlay
Standard: To AS/NZS 2908.2, Type B, category 2 minimum.
Thickness: 5 mm minimum.

Wet processed fibreboard (hardboard) underlay
Standard: To AS/NZS 1859.4.
Classification: General purpose medium board, manufactured specifically as flooring underlay.
Thickness: 5.5 mm.
E37.2.4 SHEETS AND TILES

Edges of sheets and tiles
General: Ensure edges are firm, unchipped, machine-cut accurately to size and square to the face, and that tile edges are square to each other.

Cork tiles
Standard: To BS EN 12104.

Linoleum
Standard: To BS EN 548.

Corklinoleum
Standard: To BS EN 688.

Rubber
Standard: To BS EN 12199.

Polyvinyl chloride (PVC)
Resilient floor covering, jute or polyester felt backing: To BS EN 650.
Resilient floor covering, with foam layer: To BS EN 651.

Adhesives
General: As recommended by the resilient finishes manufacturer.

Acoustic sheet vinyl
General: Unbacked flexible sheet vinyl laid over separate closed cell foam underlayment.
Underlayment thickness: 2 mm.

Slip resistant sheet vinyl
Verification: A product type tested to confirm the stated slip resistance classification.

Inlaid vinyl sheet
General: A layer of vinyl chips inlaid in a translucent vinyl matrix, bonded to a moisture resistant backing.

E37.3 EXECUTION

E37.3.1 SUBCONTRACTORS

General
General: Use specialist installers recommended by the materials manufacturers.

E37.3.2 PREPARATION

Substrates
General: To AS/NZS 2455.1 Section 2.
Tolerance: Conform to the Substrate tolerance table.

Substrate tolerance table

<table>
<thead>
<tr>
<th>Property</th>
<th>Length of straight edge laid in any direction</th>
<th>Max. deviation under the straight edge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flatness Class A</td>
<td>3 m</td>
<td>3 mm</td>
</tr>
<tr>
<td>Smoothness</td>
<td>150 mm</td>
<td>1 mm</td>
</tr>
<tr>
<td>Projections</td>
<td>50 mm</td>
<td>0.5 mm</td>
</tr>
</tbody>
</table>

Cleaning concrete surfaces: Mechanically remove the following surface treatments:
- Sealers and hardeners.
- Curing compounds.

Cleaning timber surfaces: Remove oil, grease and traces of applied finishes.
Concrete substrate correction: Remove projections and fill voids and hollows with a levelling compound compatible with the adhesive.
Timber substrate correction: Remove projections. If conformance to the Substrate tolerance table can not be achieved fix an underlay in brick pattern with joints avoiding substrate joints.

Moisture content: Do not commence installation unless:
- Concrete: The moisture content of the concrete has been tested to AS/NZS 2455.1 Appendix B and the values in clause 2.4.2 (c) have been obtained.
- Plywood and timber: The moisture content of battens/joists or plywood background has been tested to AS/NZS 1080.1 and values obtained as follows:
  - Air conditioned buildings: 8 to 10%.
  - Intermittently heated buildings: 10 to 12.5%.
  - Unheated buildings: 12 to 15%.

**Working environment**

General: Do not start work before the building is enclosed, wet work is complete and dry, and good lighting is available. Protect adjoining surfaces.

**Conditioning**

General: Stabilise the room temperature for seven days before, and two days after, installation of resilient finishes, as follows:
- Areas with air conditioning installed: Run air conditioning at operational temperature.
- Air conditioned areas not operational: Maintain a room temperature range of $< 30^\circ > 18^\circ$C.
- Underfloor heating: Turn off heating and allow background to stabilise at the temperature recommended by the carpet manufacturer.
- Non-air conditioned areas: Install at $< 30^\circ > 18^\circ$C.

Underlay: Expose both faces of each sheet for > 24 hours before fixing. Resilient sheet and tile floor covering: Stack for > 48 hours before installation.

**E37.3.3 SHEET AND TILE INSTALLATION**

**Sheet set out**
General: Set out sheets to give the minimum number of joints. Run sheet joints parallel with the long sides of floor areas, vertically on walls.

**Tile set out**
General: Wherever possible cut tiles at margins only, to give a cut dimension of at least 100 mm x full tile width. Match edges and align patterns. Arrange the material so that variation in appearance is minimised.

**Joints**
Non-welded: Butt edges together to form tight neat joints showing no visible open seam.

**Junctions**
General: Scribe neatly up to returns, edges, fixtures and fittings. Finish flush with adjoining surfaces.

**Rolling**
General: Where rolling is required, roll the finish in 2 directions before the adhesive sets, using a 70 kg multi-wheeled roller.

**Change of finish**
General: Maintain finished floor level across changes of floor finish including carpet.

**Cleaning**
General: Keep the surface clean as the work proceeds.

**E37.3.4 VINYL SHEETING**

**Welded joints**
Heat welding: After fixing, groove the seams using a grooving tool and weld the joints with matching filler rod and using a hot air welding gun. When the weld rod has cooled, trim off flush.

Cold welding: Apply seaming compound 100 mm wide to the substrate centrally under the seam. Roll the seam until the compound is forced up into the joint. Clean off flush using a damp cloth.

Epoxy jointing: Join seams with epoxy adhesive.

**Static control flooring**
General: Install conductive vinyl sheet on a copper grid comprising copper tape 80 µm thick x 10 mm wide adhered to the floor with conductive adhesive. Lay copper tape along each length of sheet vinyl and connect it at right angles to a 1 MΩ resistor. Connect to earth with copper tape at 20 – 30 m intervals.
Resilient finishes

E37.3.5 JOINTS AND ACCESSORIES

Junctions
General: Finish junctions tapered to with adjoining surfaces. Where changes of floor finish occur at doorways locate the joint on the centreline of the closed door leaf.

Accessories
General: Provide purpose-made matching moulded accessories for nosings, coves, skirtings, edge cover strips and finishes at junctions, margins, and angles, if available. Otherwise form accessories from the sheet material. Provide solid backing for radiused coves and nosings.

Edge strips
General: Provide edge cover strips at junctions with different floor finishes and to exposed edges.
Metal cover strip: Extruded tapered strip 25 mm wide, of the same thickness as the sheet or tile. Fix with matching screws to timber bases or to masonry anchors in concrete bases, at 200 mm maximum centres.
UPVC cover strip: Feather-edge strip matching the floor finish, fixed with contact adhesive.

Control joints
Location: Provide control joints as follows:
- Over structural control joints.
- At junctions between different substrates.
Depth of joint: Right through to the substrate.
Sealant width: 6 – 25 mm.
Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

Control joint materials – sheet flooring
Proprietary slide plate divider strip: An arrangement of interlocking metal plates grouted into pockets formed in the concrete joint edges to finish flush with the flooring surface.

Vinyl skirting
Feather edge: Moulded PVC skirting section.
Flat skirting: Flat PVC skirting section.
Fixing: Scribe as necessary. Mitre corners. Fix to walls with contact adhesive.
Minimum height: 100 mm.

Rubber coved skirtings and margins
General: Form from smooth flat sheet matching the colour and total thickness of the rubber flooring. Scribe and mitre at internal corners.
External corners and stop ends: Provide purpose-made matching moulded pieces.

E37.3.6 COMPLETION

Protection of sheet materials
General: Keep traffic off floors until bonding has set or for 24 hours after laying, whichever period is the longer. Do not allow water in contact with the finish for 7 days.

Reinstatement
Extent: Repair or replace faulty or damaged work. If the work cannot be repaired satisfactorily, replace the whole area affected.

Warranties
General: For each type of resilient finish specified, submit the installer’s warranty of the workmanship and application.

Certificate of compliance
General: Provide a Certificate of compliance for antistatic and conductive floor installations.

Maintenance manual
General: Submit manufacturer’s published use, care and maintenance requirements for each type of finish.

Spare materials
General: Supply spare matching covering materials and accessories of each type for future replacement purposes. Store the spare materials on site where directed.
Resilient finishes

Quantity: At least 1% of the quantity installed.

Cleaning
General: Clean the finished surface. Buff and polish. Before the date for practical completion, mop and leave the finished surface clean and undamaged on completion.

Cleaning antistatic and conductive flooring
General: Do not use sealers, wax or floor polish. Clean using a mild neutral detergent and lukewarm water. A clean floor may be dry buffed using a normal scrubbing machine and a white nylon pad.

E37.4 SELECTIONS

E37.4.1 SCHEDULES
Sheet and tile schedule
Location: Lobby, Kitchenette and Ticket Office in the new Platform Building
Type: Sheet vinyl
Manufacturer: Forbo
Product: Safestep R11
Thickness: 2mm
Colour: 82962
Skirting: Timber as specified in Lining

E37.5 SELECTIONS

E37.5.1 SCHEDULES
Sheet schedule
As detailed in the Finishes Schedule.
E38 PAINTING

E38.1 GENERAL

E38.1.1 RESPONSIBILITIES

General
Provide coating systems to new or previously painted substrates as follows:
- Consistent in colour, gloss level, texture and dry film thickness.
- Free of runs, sags, blisters, or other discontinuities.
- Paint systems fully opaque.
- Clear finishes at the level of transparency consistent with the product.
- Fully adhered.
- Resistant to environmental degradation within the manufacturer’s stated life span.

Selections: Conform to the Selections.

E38.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Texture coatings

E38.1.3 STANDARDS

Painting
General: Comply with the recommendations of those parts of AS/NZS 2311 which are referenced in this worksection.

E38.1.4 INTERPRETATION

Definitions
General: For the purposes of this worksection the following definitions apply:
- Adhesion: The sum total of forces of attachment between a dry film and its substrate.
- Finish coat: The final coat of a coating system.
- Gloss: The optical property of a surface, characterised by its ability to reflect light specularly.
- Gloss unit: Numerical value for the amount of specular reflection relative to that of a standard surface under the same geometric conditions.
- Levels of gloss finish: When the specular direction is 60 degrees, a surface with the following specular gloss reading are defined as follows:
  - Full gloss finish between 50 and 85 gloss units.
  - Semi gloss between 20 and 50 gloss units.
  - Low gloss between 5 and 20 gloss units (also known as low sheen).
  - Flat finish < 5 gloss units (also known as matt).
- Opacity: The ability of a paint to obliterate the colour difference of a substrate.
- Paint: A product in liquid form, which when applied to a surface, forms a dry film having protective, decorative or other specific technical properties.
- Primer, prime coat: The first coat of a painting system that helps bind subsequent coats to the substrate and which may inhibit its deterioration.
- Sealer: A product used to seal substrates to prevent:
  - Materials from bleeding through to the surface.
  - Reaction of the substrate with incompatible top coats.
  - Undue absorption of the following coat into the substrate.
- Sheen: Gloss which is observed on an apparently matt surface at glancing angles of incidence.
- Substrate: The surface to which a material or product is applied.
- Undercoat: An intermediate coat formulated to prepare a primed surface or other prepared surface for the finishing coat.

E38.1.5 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Painting stages:
  - Completion of surface preparation.
  - After application of prime or seal coats.
  - After application of undercoat.
  - After application of each subsequent coat.
- Clear finishing stages:
  - Before surface preparation of timber.
  - Completion of surface preparation.
  - After staining.
  - After sanding of sealer.
  - After application of each clear finishing coat.

E38.1.6 SUBMISSIONS

Clear finish coated samples
General: Submit pieces of timber or timber veneer matching the timber to be used in the works, prepared, puttied, stained, sealed and coated in accordance with the specified system, of sufficient size so that, each piece can be cut into 4 segments, marked for identification, and distributed as directed.

Opaque coated samples
General: Submit, on representative substrates, samples of each coating system showing surface preparation, colour, gloss level, texture, and physical properties.

Wet samples
General: Submit two 500 mL samples, clearly labelled, of each type of paint to be tested.

Paint
General: Submit the selected manufacturer's details at least 3 weeks before the paint is required, as follows:
- Paint brand name and paint line quality statement.
- Material safety data sheets (MSDS) showing the health and safety precautions to be taken during application.
- The published recommendations for maintenance.

Specialist applicators
General: Submit name and contact details of proposed specialist applicators.

E38.2 PRODUCTS

E38.2.1 PAINTS

Paint brand
Quality: If the product is offered in a number of levels of quality, provide premium quality lines.

Combinations
General: Do not combine paints from different manufacturers in a paint system.
Clear timber finish systems: Provide only the combinations of putty, stain and sealer recommended by the manufacturer of the top coats.

Delivery
General: Deliver paints to the site in the manufacturer's labelled and unopened containers.
Putty and fillers
Material: To the recommendation of the paint system manufacturer, as suitable for the substrate and compatible with the primer.

Tinting
General: Provide only products which are colour tinted by the manufacturer or supplier.

Toxic ingredients
General: Comply with the requirements of Appendix I Uniform Paint Standard to the Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP).

Standards
Paint types: Conform to the Australian Standard as referenced in the Paint type table.

Paint type table

<table>
<thead>
<tr>
<th>Paint type</th>
<th>AS/NZS 2311 Paint reference no. (Table 4.2)</th>
<th>Australian Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semi gloss solvent-borne: interior</td>
<td>B3</td>
<td>AS 3730.5</td>
</tr>
<tr>
<td>Full gloss solvent-borne: exterior</td>
<td>B5</td>
<td>AS 3730.6, AS/NZS 3750.22</td>
</tr>
<tr>
<td>Flat latex: exterior</td>
<td>B6</td>
<td>AS 3730.7</td>
</tr>
<tr>
<td>Flat latex: interior</td>
<td>B6</td>
<td>AS 3730.1</td>
</tr>
<tr>
<td>Low gloss latex: exterior</td>
<td>B7</td>
<td>AS 3730.8</td>
</tr>
<tr>
<td>Low gloss latex: interior</td>
<td>B7</td>
<td>AS 3730.3</td>
</tr>
<tr>
<td>Semi gloss latex: exterior</td>
<td>B8</td>
<td>AS 3730.9</td>
</tr>
<tr>
<td>Semi gloss latex: interior</td>
<td>B8</td>
<td>AS 3730.2</td>
</tr>
<tr>
<td>Gloss latex: exterior</td>
<td>B9</td>
<td>AS 3730.10</td>
</tr>
<tr>
<td>Gloss latex: interior</td>
<td>B9</td>
<td>AS 3730.12</td>
</tr>
<tr>
<td>Wood primer, solvent-borne</td>
<td>B10</td>
<td>AS 3730.13</td>
</tr>
<tr>
<td>Wood primer, latex</td>
<td>B10A</td>
<td>AS 3730.17</td>
</tr>
<tr>
<td>Metal primer for steel, lead and chromate free</td>
<td>B11</td>
<td>AS 3730.21, AS/NZS 3750.19</td>
</tr>
<tr>
<td>Metal primer, latex</td>
<td>B11A</td>
<td>AS 3730.15</td>
</tr>
<tr>
<td>Metal primer for metallic-coated surfaces solvent-borne</td>
<td>B12</td>
<td>AS 3730.21</td>
</tr>
<tr>
<td>Metal primer for metallic-coated surfaces, latex</td>
<td>B12A</td>
<td>AS 3730.15</td>
</tr>
<tr>
<td>Two-pack etch primer for metals, chromate free</td>
<td>B13</td>
<td>AS/NZS 3750.17</td>
</tr>
<tr>
<td>Zinc-rich organic binder/primer for steel</td>
<td>B14</td>
<td>AS/NZS 3750.9</td>
</tr>
<tr>
<td>Concrete and masonry sealer</td>
<td>B15</td>
<td>AS 3730.22</td>
</tr>
<tr>
<td>Undercoat, solvent-borne</td>
<td>B17</td>
<td>AS 3730.14</td>
</tr>
<tr>
<td>Undercoat, latex: exterior</td>
<td>B17A</td>
<td>AS 3730.18</td>
</tr>
<tr>
<td>Undercoat, latex: interior</td>
<td>B17A</td>
<td>AS 3730.18</td>
</tr>
<tr>
<td>Furniture varnish, one-pack</td>
<td>B19</td>
<td>AS 3730.25</td>
</tr>
<tr>
<td>Two-pack clear gloss floor finish</td>
<td>B20</td>
<td>AS 3730.27</td>
</tr>
<tr>
<td>Exterior latex stain, opaque</td>
<td>B22</td>
<td>AS 3730.16</td>
</tr>
<tr>
<td>Exterior stain, lightly pigmented</td>
<td>B23</td>
<td>AS 3730.28</td>
</tr>
<tr>
<td>One-pack paving paint for concrete</td>
<td>B24</td>
<td>AS 3730.29</td>
</tr>
<tr>
<td>Two-pack epoxy enamel</td>
<td>B29</td>
<td>AS/NZS 3750.1</td>
</tr>
<tr>
<td>Two-pack high build epoxy</td>
<td>B29</td>
<td>AS/NZS 3750.4</td>
</tr>
<tr>
<td>Texture finish latex coating for masonry and concrete: exterior</td>
<td>B38</td>
<td>AS/NZS 4548.1</td>
</tr>
<tr>
<td>Texture finish latex coating for masonry and concrete: interior</td>
<td>B38</td>
<td>AS/NZS 4548.2</td>
</tr>
<tr>
<td>Paint type</td>
<td>AS/NZS 2311 Paint reference no. (Table 4.2)</td>
<td>Australian Standard</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>---------------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Full gloss polyurethane (2-pack)</td>
<td>B44</td>
<td>AS/NZS 4548.3</td>
</tr>
<tr>
<td>for steel</td>
<td></td>
<td>AS/NZS 4548.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AS/NZS 3750.6</td>
</tr>
</tbody>
</table>

E38.3 EXECUTION

E38.3.1 PREPARATION

Order of work
Other trades: Before painting, complete the work of other trades as far as practicable within the area to be painted, except for installation of fittings, floor sanding and laying flooring materials.
Clear finishes: Complete clear timber finishes before commencing opaque paint finishes in the same area.

Protection
General: Before painting, clean the area and protect it against dust entry. Use drop sheets and masking to protect finished surfaces or other surfaces at risk of damage during painting.
Internal and external fixtures and furniture: Remove door furniture, switch plates, light fittings and other fixtures before starting to paint, and refix in position undamaged on completion of the painting.
Adjacent surfaces: Protect adjacent finished surfaces liable to damage from painting operations.

‘Wet paint’ warning
General: Place notices conspicuously and do not remove them until the paint is dry.

Repair
General: Clean off marks, paint spots and stains progressively and restore damaged surfaces to their original condition. Touch up new damaged decorative paintwork or misses only with the paint batch used in the original application.

Substrates
General: Prepare substrates to receive the painting systems.
Cleaning: Clean down the substrate surface. Do not cause undue damage to the substrate or damage to, or contamination of, the surroundings.
Filling: Fill cracks and holes with fillers, sealants, putties or grouting cements as appropriate for the finishing system and substrate, and sand smooth.
Clear finish: Provide filler tinted to match the substrate.
Clear timber finish systems: Prepare the surface so that its attributes will show through the clear finish without blemishes, by methods which may involve the following:
- Removal of bruises.
- Removal of discolorations, including staining by oil, grease and nailheads.
- Bleaching where necessary to match the timber colour sample.
- Puttying.
- Fine sanding (last abrasive no coarser than 220 grit) to show no scratches across the grain.

Unpainted surfaces
Standard: To AS/NZS 2311 Section 3.

Previously painted surfaces
Preparation of a substrate in good condition: To AS/NZS 2311 clause 7.4.
Preparation of a substrate in poor condition: To AS/NZS 2311 clause 7.5.
Preparation of steel substrates with protective coatings: To AS/NZS 2312 Section 10 and AS 1627.1.
Additional preparation:
- Seal stained ceilings before the application of latex paints.
- Clean PVC with methylated spirit and a nylon scouring pad.
- Remove wall paper and glue size with clean water and seal before painting.
- Remove water based kalsomine or lime wash paints by brushing with warm water.
Painting

Cleaning external surfaces
Sound external surfaces other than timber: Remove dirt, grease, loose and foreign matter, efflorescence and mould by water blasting or steam cleaning without damaging the surface. Remove remaining loose material with appropriate hand tools. Use sanding blocks to preserve the arrises of masonry and stone details.

E38.3.2 PAINTING

Light levels
General: ≥ 400 lux.

Drying
General: Use a moisture meter to demonstrate that the moisture content of the substrate is at or below the recommended maximum level for the type of paint and the substrate material.

Paint application
Standard: To AS/NZS 2311 Section 6.
Timing: Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Apply subsequent coats after the manufacturer’s recommended drying period has elapsed.

Painting conditions
General: Do not paint in dusty conditions, or otherwise unsuitable weather as follows unless the paint is suitable and recommended for such conditions:
- Relative humidity: ≥ 85%.
- Surface temperature ≤ 10°C or ≥ 35°C.

Priming before fixing
General: Apply one coat of wood primer (2 coats to end grain) to the back of the following before fixing in position:
- External fascia boards.
- Timber door and window frames.
- Bottoms of external doors.
- Associated trims and glazing beads.
- Timber board cladding.

Spraying
General: If the paint application is by spraying, use conventional or airless equipment which does the following:
- Satisfactorily atomises the paint being applied.
- Does not require the paint to be thinned beyond the maximum amount recommended by the manufacturer.
- Does not introduce oil, water or other contaminants into the applied paint.

Paint with known health hazards: Provide masking, ventilating and screening facilities generally to the standards set out for spray painting booths, AS/NZS 4114.1 and AS/NZS 4114.2.

Sanding
Clear finishes: Sand the sealer using the finest possible abrasive (no coarser than 320 grit) and avoid cutting through the colour. Take special care with round surfaces and edges.

Repair of galvanizing
General: For galvanized surfaces which have been subsequently welded, power tool grind to remove all rust and weld splatter. Remove all surface contaminants then immediately prime the affected area.
Primer: Organic zinc rich coating for the protection of steel to AS/NZS 3750.9 Type 2.

Tinting
General: Tint each coat of an opaque coating system so that each has a noticeably different tint from the preceding coat, except for top coats in systems with more than one top coat.

Services
General: If not embedded, paint new services and equipment including in plant rooms, except chromium, anodised aluminium, GRP, UPVC, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces. Repaint proprietary items only if damaged.
Painting

Door leafs
Drying: Leave doors fixed open to allow drying. Do not allow door hardware, accessories or the like to damage the door finish during the drying process.

E38.4 SELECTIONS

E38.4.1 PAINTING SYSTEMS

New unpainted interior surfaces
Standard: To AS/NZS 2311 Table 5.1.

New unpainted exterior surfaces
Standard: To AS/NZS 2311 Table 5.2.

Specialised painting systems
Standard: To AS/NZS 2311 clause 5.2 for the following final coats:
- High build textured or membrane finishes (B38 to AS/NZS 2311).
- 2 pack gloss pigmented polyurethane (B44 to AS/NZS 2311).
- 2 pack epoxy (B29 to AS/NZS 2311).
- 2 pack water based epoxy (B29A to AS/NZS 2311).

Previously painted surfaces
Standard: To AS/NZS 2311 Section 8.

E38.4.2 PAINTING SCHEDULES

General
Number of coats: Unless specified as one or two coat systems, each paint system consists of at least 3 coats.

Final coat selection: To the Interior painting schedule and the Exterior painting schedule.

Low VOC emitting paints
Where available, use paints with low VOC emission.

Paint colours
Refer to the Finishes Schedule for paint colours.

Interior painting schedule

<table>
<thead>
<tr>
<th>Location</th>
<th>Substrate</th>
<th>Paint type and finish</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Platform Building</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Walls generally</td>
<td>Plasterboard</td>
<td>Semi-gloss latex</td>
<td>Refer to Finishes Schedule</td>
</tr>
<tr>
<td>- Walls to external</td>
<td>Compressed fibre cement</td>
<td>Semi-gloss latex</td>
<td>Refer to Finishes Schedule</td>
</tr>
<tr>
<td>cupboard</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Ceilings</td>
<td>Plasterboard</td>
<td>Low-gloss latex</td>
<td>Refer to Finishes Schedule</td>
</tr>
<tr>
<td>- Doors</td>
<td>Plywood</td>
<td>Full gloss enamel</td>
<td>Refer to Finishes Schedule</td>
</tr>
<tr>
<td>- Door frames</td>
<td>Steel</td>
<td>Full gloss enamel</td>
<td>Refer to Finishes Schedule</td>
</tr>
<tr>
<td>- Skirting</td>
<td>Timber</td>
<td>Full gloss enamel</td>
<td>Refer to Finishes Schedule</td>
</tr>
</tbody>
</table>

Exterior painting schedule

<table>
<thead>
<tr>
<th>Location</th>
<th>Substrate</th>
<th>Paint type and finish</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposed concrete surfaces, including columns, walls,</td>
<td>Concrete</td>
<td>Texture coating</td>
<td>Refer to Finishes Schedule</td>
</tr>
</tbody>
</table>
Painting

<table>
<thead>
<tr>
<th>Sections</th>
<th>Finish</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walls to TVM recess in new Platform building</td>
<td>Compressed fibre cement</td>
<td>Semi-gloss latex</td>
</tr>
<tr>
<td>Doors</td>
<td>Steel</td>
<td>Full gloss enamel</td>
</tr>
<tr>
<td>Door frames</td>
<td>Steel</td>
<td>Full gloss enamel</td>
</tr>
<tr>
<td>Steel roof framing to canopy outside new platform building</td>
<td>Steel</td>
<td>Epoxy paint</td>
</tr>
<tr>
<td>Stair balustrades</td>
<td>Galvanised steel</td>
<td>Epoxy paint</td>
</tr>
<tr>
<td>Balustrade to footbridge and Lift landings</td>
<td>Galvanised steel</td>
<td>Epoxy paint</td>
</tr>
<tr>
<td>Framing to anti-throw screens</td>
<td>Galvanised steel</td>
<td>Epoxy paint</td>
</tr>
</tbody>
</table>

E38.4.3 ADDITIONAL DATA

**Anti graffiti treatment**

Apply Clear Anti-graffiti treatment to walls and other elements noted on the drawings and/or Finishes Schedule, including:

- Texture coating on various concrete walls as noted on the drawings and/on the Finishes Schedule, including Lift shafts, balustrades and miscellaneous concrete walls.
- Other areas indicated on drawings and/or Finishes Schedule.

**Proprietary Item:** Durobond water-based non-sacrificial Anti-graffiti sealer or approved equal.

**Epoxy paint**

Epoxy paint to structural steelwork, balustrades and other areas as scheduled shall be equivalent to Vitrithane 580/590 and Vitreflon 700/744 as supplied by A&I Coatings.

Prepare steelwork in accordance with the instructions of the manufacturer, including blast clean to AS 1627.1 – whip blast.

Apply the following coating in accordance with the manufacturer’s printed instructions.

- Vitrithane Two Pack Epoxy Primer in two coats to a minimum dry film thickness of 200 microns. Allow to dry overnight.
- Vitreflon 700/744 Anti Graffiti Two Pack Fluoropolymer in two coats wet on wet, to a minimum dry film thickness of 50 microns. Finish must be smooth, consistent and free of dry spray.

**Textured finish**

Refer to Textured Coatings
E39 TEXTURED COATINGS

E39.1 GENERAL

E39.1.1 RESPONSIBILITIES

General
General: Provide coating systems to substrates as follows:
- Consistent in colour, gloss level, texture and dry film thickness.
- Free of runs, sags, blisters, or other discontinuities.
- Textured coating systems fully opaque.
- Clear finishes at the level of transparency consistent with the product.
- Fully bonded.
- Resistant to environmental degradation within the manufacturer’s stated life span.
- Will accommodate movement in the substrate between control joints.

Selections: Conform to the Selections.

E39.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Painting

E39.1.3 STANDARDS

Textured and membrane coatings
General: Comply with the recommendations of those parts of AS/NZS 2311 which are referenced in this worksection.

E39.1.4 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions given below apply.
- Substrate: The surface to which a material or product is applied.
- Latex extensible wall coating (or ‘membrane’ coating): A non-aggregate flexible watertight finish.
- High-build low profile latex coating: A water based coating designed to be used over textured coatings to elevate the exposure performance of the paint system.
- Non-aggregate textured latex coating: A latex coating selected for aesthetic purposes to provide decorative profiles according to the application technique used.
- Aggregate filled textured latex coating: An aggregate filled medium to high profile textured coating selected for aesthetic purposes to provide maximum relief from underlying surface irregularities according to the application technique used.
- Paint or coating system: A product in liquid form, which when applied to a surface, forms a dry film having protective, decorative or other specific technical properties.
- Sealer: A product used to seal substrates to prevent:
  . Materials from bleeding through to the surface.
  . Reaction of the substrate with incompatible top coats.
  . Undue absorption of the following coat into the substrate.
- Primer, prime coat: The first coat of a coating system that helps bind subsequent coats to the substrate and which may inhibit its deterioration.
- Undercoat: An intermediate coat formulated to prepare a primed surface or other prepared surface for the finishing coat.
- Finish coat: The final coat of a coating system.
- Gloss: The optical property of a surface, characterised by its ability to reflect light specularly.
- Sheen: Gloss which is observed on an apparently matt surface at glancing angles of incidence.
- Levels of gloss finish: When the specular direction is 60 degrees, a surface with the following specular gloss reading are defined as follows:
  - Full gloss finish between 50 and 85 gloss units.
  - Semi gloss between 20 and 50 gloss units.
  - Low gloss between 5 and 20 gloss units (also known as low sheen).
  - Flat finish < 5 gloss units (also known as matt).
- Opacity: The ability of a paint to obliterate the colour difference of a substrate.
- Adhesion: The sum total of forces of attachment between a dry film and its substrate.
- Gloss unit: Numerical value for the amount of specular reflection relative to that of a standard surface under the same geometric conditions.

E39.1.5 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Application stages:
  . Completion of substrate preparation.
  . After application of prime or seal coats.
  . After application of undercoat.
  . After application of each subsequent coat.

E39.1.6 SUBMISSIONS

Textured or membrane coated samples
General: Submit, on representative substrates, samples of each coating system showing surface preparation, colour, gloss level, texture, and physical properties, to the Coated samples schedule.

Coating system
General: Submit the selected manufacturer's details at least 3 weeks before the paint is required, as follows:
- Coating brand name.
- Technical data sheets.
- Material safety data sheets (MSDS) showing the health and safety precautions to be taken during application.
- The published recommendations for maintenance.

Specialist applicators
General: Submit name and contact details of proposed specialist applicators.

Tests
Fire retardant systems: Submit type test results to confirm minimum indices, when tested to AS/NZS 1530.3, on a substrate representative of the intended use, for paint systems specified as Low flame spread or Fire retardant:
- Spread of flame index: 3.
- Sum of Ignitability index and Heat evolved index: 7.
- Smoke developed index: 3.

Substrate acceptance
Applicator: Submit the applicator's certification of the acceptability of the paint finish substrate.
Timing: Before commencing installation.

Samples
Prepare a sample area of a concrete wall, including recesses, painted in the selected colours, and complete with anti graffiti barrier.
Size of sample area: 2m x 2m approximately

Warranty
Material Warranty: Submit the manufacturer's material warranty as follows:
Textured coatings

- Extent: Paintwork generally.
- Terms: Paint systems are suitable for their intended use.
- Warranty period: As defined by the manufacturer.

Material performance warranty: Submit an alternative performance warranty to include materials and application as follows:
- Terms: Submit the performance criteria as defined by the manufacturer.
- Measure: As defined by the manufacturer.
- Warranty period: As defined by the manufacturer.

Timing: Before the application of the paint system.

E39.2 PRODUCTS

E39.2.1 COATINGS

Combinations
General: Do not combine coatings from different manufacturers in a coating system.

Delivery
General: Deliver coatings to the site in the manufacturer's labelled and unopened containers.

Tinting
General: Provide only products which are colour tinted by the manufacturer.

Toxic ingredients
General: Comply with the requirements of Appendix I Uniform Paint Standard to the Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP).

Standards
Coating types:
- Wall coatings - latex extensible: To AS/NZS 4548.1
- Latex finish coatings – high-build, low profile: To AS/NZS 4548.2.
- Latex – textured coatings – non aggregate: To AS/NZS 4548.3.
- Latex – textured coatings – aggregate filled: To AS/NZS 4548.4.

E39.3 EXECUTION

E39.3.1 PREPARATION

Standards
General: To AS/NZS 2311 Sections 3.

Order of work
Other trades: Before painting, complete the work of other trades as far as practicable within the area to be painted, except for installation of fittings, floor sanding and laying flooring materials.

Protection
Fixtures: Remove door furniture, switch plates, light fittings and other fixtures before starting to paint, and refix in position undamaged on completion of the painting.
Adjacent surfaces: Protect adjacent finished surfaces liable to damage from painting operations.

‘Wet paint’ warning
General: Place notices conspicuously and do not remove them until the paint is dry.

Restoration
General: Clean off marks, paint spots and stains progressively and restore damaged surfaces to their original condition.

Touch up: Apply seamless repairs to damaged decorative coatings or misses with the coating batch used in the original application.

Substrate preparation
General: Prepare substrates to receive the coating systems.
Cleaning: Clean down the substrate surface. Do not cause undue damage to the substrate or damage to, or contamination of, the surroundings.

Filling: Fill cracks and holes with fillers, sealants or grouting cements as recommended by the coating system manufacturer and as appropriate for the substrate.

Moisture content: Do not commence application unless:
- Concrete: The moisture content of the concrete has been tested to AS/NZS 2455.1 Appendix B and the values in clause 2.4.2 (c) have been obtained.

E39.3.2 APPLICATION

Proprietary coating systems
Generally: Apply the complete coating system to the manufacturer’s technical data sheets.

Standard
Methods of application: To AS/NZS 2311 clause 6.7.

Light levels
General: \[ \geq 400 \text{ lux} \]

Drying
General: Use a moisture meter to demonstrate that the moisture content of the substrate is at or below the recommended maximum level for the type of coating and the substrate material.

Paint application
General: Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Apply subsequent coats after the manufacturer’s recommended drying period has elapsed.

Spraying
Coatings with known health hazards: Not permitted on site.

E39.4 SELECTIONS

E39.4.1 COATING SYSTEMS

Textured coating
Location: Apply textured paint coating to all exposed concrete walls, balustrades, soffits, hobs of Lift shafts and Platform Building and other areas as detailed in the Finishes Schedule. Allow for painting recesses in concrete walls in a different colour from the main face of the walls.

Material: Dulux Acratex texture coating, with Dulux AcraShield protective top coat

Colours: As detailed in the Finishes Schedule.

Application: Apply the coating in accordance with the manufacturer’s printed recommendations.

Anti graffiti barrier: In addition to the texture and protective coating, apply an approved anti graffiti barrier as specified in Painting.
E40 SIGNS AND DISPLAY

E40.1 GENERAL

E40.1.1 RESPONSIBILITIES

General
General: Provide signage systems to the Selections.

E40.1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- General requirements.
- Metals and prefinishes

E40.1.3 STANDARDS

Signs
Safety signs - design and use: To AS 1319.
Signs and graphics for disabled access: AS 1428.1 and AS 1428.2.
TfNSW standards
Refer to TfNSW's Station, Interchange & Carpark Signage Types Guide April 2009 for manufacturing specifications and details.

E40.1.4 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions given below apply.
- Changeable plate systems: Sign systems consisting of fixed plate holders to which may be attached or inserted removable interchangeable sign plates.
- Variable room identification systems: Changeable plate systems incorporating fixed room numbers and removable name strips.
- Changeable letter systems: Sign systems consisting of display boards or holders into which can be inserted removable individual letters, numbers, etc.
- Illuminated signs: Signs consisting of cabinets enclosing an illuminated source, lighting translucent face panels bearing the specified signage.
- House signage: Internal and external project specific signs.
- Statutory signage: Signs prescribed by the BCA and statutory authorities.

E40.1.5 INSPECTION

Notice
Inspection: Give notice so that inspection may be made of the following:
- Custom-built graphics items fabricated and ready to be delivered to the site.
- Graphics items delivered to site before installation.
- Building locations or substrates prepared to receive graphics items before they are installed.

E40.1.6 SAMPLES

General
Materials: Submit samples showing each colour and finish of exposed graphics materials and accessories. If there is a range of colours and/or textures for a particular item, submit samples showing the extremes and mean of the range.

E40.1.7 SUBMISSIONS

Shop drawings
General: Submit shop drawings showing the following information where relevant:
- Layout, construction and fixing details for custom designed (non standard) sign systems.
- Large scale (full size if practicable) lettering layouts for individual letter signs.
- Computer generated graphic images.
- Full size spacing templates for individually mounted characters.
- Location template drawings for anchorages to permanent construction. Show type of anchorage.
- Wiring diagrams for illuminated signs.

**E40.2 PRODUCTS**

**E40.2.1 MATERIALS**

**Materials standards**

Aluminium:
- Plate for engraving: Alloy and temper designation 6063-0.
- For casting: To AS 1874.

Stainless steel: Surface finish designation 4 (general purpose polished).

Plastics:
- Rigid cellular polystyrene: To AS 1366.3, class VH for cut-out shapes.

**E40.3 EXECUTION**

**E40.3.1 WORKMANSHIP**

**Production**

General: Form graphics items accurately with clean, well defined edges or arises, free from blemishes.

Engraving to two layer plastic laminate: Lettering excavated to expose the lower laminate.

Engraved and filled: Lettering precision excavated and filled colouring material. Clean faces of all filling material.

Casting: Produce shapes free of pits, scale, blow holes or other defects, hand or machine finished if necessary.

Laser cut: Individual vinyl letters with self adhesive backing.

Printed lettering: Lettering and graphic images screen printed film with self adhesive backing.
- Film with self adhesive backing.
- Acrylic sheet.
- Aluminium plate.
- Stainless steel plate.

Large format digital printing: Lettering and graphic images screen printed film with self adhesive backing.

Signwriting: Lettering and graphic images hand painted direct to the background by a tradesman with recognised qualifications and demonstrated experience.

Fabricated: Three dimensional, formed as follows:
- Laser cutting from solid material and hand finished as necessary.
- Moulding: Individual plastic hollow three dimensional characters and shapes formed by:
  - Injection moulding.
  - Vacuum forming.
- Built-up individual shapes by fabricating the faces and edges from separate pieces neatly and securely joined.

**Installation**

General: Install signage level and plumb, securely mounted, with concealed theft-resistant fixings. Fix self adhesive signs free of bubbles and creases.
### E40.4 SELECTIONS

#### E40.4.1 GENERAL SIGNS

**Sign type schedule**

Provide general directional, passenger information, notices and other signage.

Refer to the drawings and TfNSW Standards for the design and specification of the various signs.

#### E40.4.2 STATUTORY SIGNS

**Lifts – warning**

<table>
<thead>
<tr>
<th>Position</th>
<th>Near every call button for passenger lift(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message</td>
<td>DO NOT USE LIFTS IF THERE IS A FIRE (or) Do not use lifts if there is a fire</td>
</tr>
<tr>
<td>Letter size</td>
<td>10 mm (upper case) 8 mm (lower case)</td>
</tr>
<tr>
<td>Sign type</td>
<td>Incised, inlaid or embossed on metal, wood, plastic or similar plate securely and permanently attached to the wall; or letters incised or inlaid directly into the surface of the material forming the wall</td>
</tr>
<tr>
<td>Compliance</td>
<td>BCA E3.3</td>
</tr>
</tbody>
</table>

**Fire hose reels and fire hydrants**

<table>
<thead>
<tr>
<th>Position</th>
<th>Cupboard door or adjacent the FHR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message</td>
<td>FIRE HOSE REEL (and/or) FIRE HYDRANT</td>
</tr>
<tr>
<td>Letter size</td>
<td>External cabinets: 75 mm Internal cabinets: 50 mm</td>
</tr>
<tr>
<td>Sign type</td>
<td>White adhesive backed vinyl</td>
</tr>
<tr>
<td>Compliance</td>
<td>AS 2441 AS 2419.1 BCA E1.3 and BCA E1.4</td>
</tr>
</tbody>
</table>

**Fire hose reel location sign**

<table>
<thead>
<tr>
<th>Position</th>
<th>Above or adjacent the FHR if located in a recess or obscure location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message</td>
<td>To AS 2441 Figure 10.1</td>
</tr>
<tr>
<td>Letter size</td>
<td>16 mm</td>
</tr>
<tr>
<td>Sign type</td>
<td>Adhesive backed vinyl</td>
</tr>
<tr>
<td>Compliance</td>
<td>AS 2441</td>
</tr>
</tbody>
</table>

**Fire brigade booster assembly cabinet**

<table>
<thead>
<tr>
<th>Position</th>
<th>Cabinet doors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message</td>
<td>FIRE HYDRANT BOOSTER, or FIRE HYDRANT AND SPRINKLER BOOSTER, or COMBINED FIRE HYDRANT AND SPRINKLER BOOSTER, as appropriate. If a feed fire hydrant is enclosed in the cabinet, add the symbol FH within a 100 mm circle of thickness and colour to match lettering</td>
</tr>
<tr>
<td>Letter size</td>
<td>≥ 50 mm</td>
</tr>
<tr>
<td>Sign type</td>
<td>Adhesive backed vinyl</td>
</tr>
<tr>
<td>Compliance</td>
<td>AS 2419.1 clause 7.9</td>
</tr>
</tbody>
</table>

**Hose reel system valve**

<table>
<thead>
<tr>
<th>Position</th>
<th>At any system valve that can isolate flow in the hose reel water supply main</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message</td>
<td>FIRE SERVICE VALVE – CLOSE ONLY TO SERVICE FIRE HOSE REELS</td>
</tr>
<tr>
<td>Letter size</td>
<td>8 mm</td>
</tr>
</tbody>
</table>

---

Contract No  
Cardiff Railway Station Easy Access Upgrade  
Tender Issue  
February 2012  
287 of 301
<table>
<thead>
<tr>
<th><strong>Sign type</strong></th>
<th>Label with engraved non-ferrous metal tag</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compliance</strong></td>
<td>BCA E1.4 (b)(v)(d)</td>
</tr>
</tbody>
</table>

**Portable fire extinguishers**

<table>
<thead>
<tr>
<th><strong>Position</strong></th>
<th>Cabinet</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Message</strong></td>
<td>FIRE EXTINGUISHER</td>
</tr>
<tr>
<td><strong>Letter size</strong></td>
<td>32 mm min</td>
</tr>
<tr>
<td><strong>Sign type</strong></td>
<td>Adhesive backed vinyl</td>
</tr>
<tr>
<td><strong>Compliance</strong></td>
<td>BCA E1.6 AS 2444 clause 3.6 Fire Brigade</td>
</tr>
</tbody>
</table>

**Portable fire extinguishers – location signs**

<table>
<thead>
<tr>
<th><strong>Position</strong></th>
<th>As nominated in AS 2444 clause 3.2 at every installed extinguisher nominated BCA Table E1.6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Message</strong></td>
<td>Prescribed graphic</td>
</tr>
<tr>
<td><strong>Letter size</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Sign type</strong></td>
<td>Computer generated adhesive backed vinyl graphic</td>
</tr>
<tr>
<td><strong>Compliance</strong></td>
<td>BCA E1.6 AS 2444 clause 3.3 Fire Brigade</td>
</tr>
</tbody>
</table>

**Fire blankets**

<table>
<thead>
<tr>
<th><strong>Position</strong></th>
<th>As nominated in AS 2444 clause 6.4 at every blanket location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Message</strong></td>
<td>Prescribed graphic</td>
</tr>
<tr>
<td><strong>Letter size</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Sign type</strong></td>
<td>Computer generated adhesive backed vinyl graphic</td>
</tr>
<tr>
<td><strong>Compliance</strong></td>
<td>BCA E1.6 AS 2444 clause 5.1, 5.3 and Fig 5.1 Fire Brigade</td>
</tr>
</tbody>
</table>

**Signage for disabled access**

<table>
<thead>
<tr>
<th><strong>Position</strong></th>
<th>As nominated BCA D3.3, and AS 1428.1 clause 8 To each: Sanitary facility Accessible entrance Accessible lift(s) Path of travel to accessible facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Message</strong></td>
<td>International symbols to AS 1428.1 clause 8</td>
</tr>
<tr>
<td><strong>Letter size</strong></td>
<td>AS 1428.2 clause 16, Table 1</td>
</tr>
<tr>
<td><strong>Sign type</strong></td>
<td>Printed acrylic sheet adhesive fixed</td>
</tr>
<tr>
<td><strong>Compliance</strong></td>
<td>BCA Spec A1.3, BCA D3.3(c), BCA D3.6 AS 1428.1</td>
</tr>
</tbody>
</table>

**Braille and tactile signs**

<table>
<thead>
<tr>
<th><strong>Position</strong></th>
<th>To each: Sanitary facility Accessible entrance Accessible lift(s) Path of travel to accessible facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Message</strong></td>
<td>International symbols to AS 1428.1 clause 8 for access or deafness</td>
</tr>
</tbody>
</table>
Signs and display

| Letter size | BCA Spec D3.6 |
| Sign type | Adhesive fixed polyvinyl membrane with raised message |
| Compliance | BCA D3.6  
AS 1428.1 |

| Deafness Position | Where hearing augmentation is installed BCA D3.7 |
| Message size | International symbols to AS 1428.1 clause 8 |
| Letter size | BCA Spec D3.6, clause 16, Table 1 AS 1428.2 |
| Sign type | Printed acrylic sheet adhesive fixed |
| Compliance | BCA D3.7  
AS 1428.1 |

Main switchboard - main entry, excluding Class 1 dwellings

| Position | Main entry or fire indicator panel |
| Message | Indicate location of main switchboard. Incorporate the term 'Main Switchboard'. |
| Letter size | |
| Sign type | Printed acrylic sheet adhesive fixed |
| Compliance | AS/NZS 3000 clause 2.9.2.4 |

Main switchboard - room or enclosure, excluding Class 1 dwellings

| Position | The room or enclosure containing the main switchboard. |
| Message | MAIN SWITCHBOARD |
| Letter size | |
| Sign type | Printed acrylic sheet adhesive fixed |
| Compliance | AS/NZS 3000 clause 2.9.2.4 |

E40.4.3 TRAFFIC CONTROL SIGNS

General
The Contractor is responsible for the supply, delivery and installation of signs including all necessary accessories for signs shown on the Contract drawings.

The Contract drawings show the general arrangement and layout for all signs. The actual position of all signs shall be governed by details of the site.

The drawings shall be regarded as indicative and all details, dimensions and locations shown thereon are subject to confirmation before commencement of the works. The layout shown is subject to reasonable alteration as may be found necessary on setting out the work on the site and prior to commencement without additional charge by the Contractor.

All work and materials shall comply with the latest editions of all relevant Australian codes or standards, including but not necessarily limited to:
- AS1742.1 (Manual of Uniform Traffic Control Devices – General introduction and index of signs);
  and
- AS1742.2 (Manual of Uniform Traffic Control Devices – Traffic control devices for general use)

Sign support structures are to be provided in accordance with RTA specification R143. The Contract Drawings shall take the place of Annexure R143/A (details of work) and Annexure R143/B shall not apply.
### E41 FINISHES SCHEDULE

<table>
<thead>
<tr>
<th>Item</th>
<th>Supplier/ Product</th>
<th>Code</th>
<th>Finish/Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>E41.1 NEW LIFTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Wall cladding panels</td>
<td>1.6mm thick steel sheet Vitreous Enamelled Panels with 12mm calcium silicate board backing bonded to panel.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD-01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete Skirting Base of External Wall PNT-01</td>
<td>Dulux Acratex paint system with anti-graffiti paint top coat</td>
<td>Colour: PG2.C2 Malay Grey (dark grey)</td>
<td></td>
</tr>
<tr>
<td>Exposed External structural steel roof members PNT-02</td>
<td>Hot dipped Galvanised with Vitrathane 580/690 epoxy primer and Vitreflon 700/744 Fluoropolymer.</td>
<td>Colour: K168 (dark grey)</td>
<td></td>
</tr>
<tr>
<td>Roofing RS-01</td>
<td>Ritek roof panel system 75mm</td>
<td>Colorbond : Shale Grey</td>
<td></td>
</tr>
<tr>
<td>External Window Framing GS-01</td>
<td>Commercial Aluminium Glazing Suite. Nominal 100mm profile Equivalent to ‘G James 475 series frames’. 35mm min rebates required by TfNSW.</td>
<td>Natural Anodised Aluminium</td>
<td></td>
</tr>
<tr>
<td>Louvres Ventilation LVR-01</td>
<td>Aluminium Double Bank Louvre. 50% open area required in accordance with mechanical drawings Alps louvres</td>
<td>Natural Anodised Aluminium</td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td>Viridian – New World Glass VFloat SuperGreen</td>
<td>SuperGreen, 10.38mm Laminated annealed Safety Glass with Anti-blast film on inside and anti graffiti</td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Supplier/ Product</td>
<td>Code</td>
<td>Finish/Colour</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
<td>------</td>
<td>---------------</td>
</tr>
<tr>
<td>GLZ-01</td>
<td>3M Film</td>
<td>n</td>
<td>film on outside</td>
</tr>
</tbody>
</table>

**E41.2 NEW STAIRCASE AND LANDINGS, FOOTBRIDGE EXTENSION, RAMPS, NEW REGRaded PATH FROM MAIN ROAD.**

<table>
<thead>
<tr>
<th>Concrete Floor Finish</th>
<th>Concrete / Sealer</th>
<th>Broom finish. Natural / Clear.</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL-01</td>
<td>Class 2 finish</td>
<td>Slip resistance to R12min</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stair Nosing Strip -- to new staircase</th>
<th>Safety Stride Pty Ltd.</th>
<th>SN-CL4-MBN-TP5</th>
<th>Crystalline with luminous sparkling black inserts. Recessed in treads and risers for flush finish with concrete. Slip resistance rating min of Ramp R11 and Pendulum ‘W’ required in accordance with Australian Standards AS3661, AS4586 and HB197, AS1428 all parts. Evidence of compliance with these standards will be required prior to product ordering and installation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNS-01</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stair Nosing Strip -- to existing staircase</th>
<th>Safety Stride Pty Ltd.</th>
<th>SN-CL4</th>
<th>Crystalline with luminous sparkling black inserts. Recessed in treads and risers for flush finish with concrete. Slip resistance rating min of Ramp R11 and Pendulum ‘W’ required in accordance with Australian Standards AS3661, AS4586 and HB197, AS1428 all parts. Evidence of compliance with these standards will be required prior to product ordering and installation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNS-02</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tactile Ground Surface Indicators</th>
<th>Individual pin fixed &amp; 600mm wide x full width of stair or ramp</th>
<th>Contrasting black.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TGSI-01</td>
<td>Pathfinder Systems Australia</td>
<td>Minimum 30% luminance contrast against the surrounding surface, Slip resistance rating accordance with Australian Standards AS4586:1999 and HB197:1999. Evidence of compliance with these standards will be required prior to product ordering and installation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PNT-02</td>
<td>Architectural and Industrial Coatings P/L</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anti-throw screen Security mesh</th>
<th>Woven Wire 25 x 25 mm max Apt size.</th>
<th>Galvanised Mild Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locker Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Supplier/ Product</td>
<td>Code</td>
</tr>
<tr>
<td>---------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Concrete upturn Balustrade to New footbridge</td>
<td>Dulux Acratex paint system with anti-graffiti paint top coat</td>
<td></td>
</tr>
<tr>
<td>PNT-01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Concrete Walls (including recesses) and hobs and all exposed concrete including soffits</td>
<td>Dulux Acratex paint system with anti-graffiti paint top coat</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Colour of recesses: PG2.C2 Malay Grey (dark grey)</td>
</tr>
<tr>
<td>PNT-01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weather protection Screens at Lift landings</td>
<td>Horizontal and Vertical 'Z' shaped Waterproof Type louvers with Perimeter frames fixed to top rail of balustrade. CS Group</td>
<td>Refer to Architectural Plans and Elevations for sizes</td>
</tr>
<tr>
<td>SCN-01</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E41.3 NEW CANOPIES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposed external structure steel including beams and columns</td>
<td>Hot dipped Galvanised with Vitrathane 580/590 epoxy primer and Vitreflon 700/744 Fluoropolymer.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PNT-02</td>
<td>Architectural and Industrial Coatings P/L</td>
<td></td>
</tr>
<tr>
<td>Roofing</td>
<td>Ritek roof panel system 100mm thick</td>
<td></td>
</tr>
<tr>
<td>RS-02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capping</td>
<td>Colorbond</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eaves gutter and downpipes</td>
<td>Colorbond</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Half round gutter</td>
<td></td>
</tr>
<tr>
<td><strong>E41.4 PLATFORM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raised concrete floor finish</td>
<td>To gradients as documented on drawings</td>
<td>Broom finish. Light grey coloured concrete. Scabble back existing surface. R13 Slip resistance rating to TfNSW requirements and in accordance with Australian Standards AS3661, AS4588 and HB197, AS1428 all parts.</td>
</tr>
<tr>
<td>To existing platform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FL-01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Contract No  Cardiff Railway Station Easy Access Upgrade  292 of 301
Tender Issue  February 2012
<table>
<thead>
<tr>
<th>Item</th>
<th>Supplier/Product</th>
<th>Code</th>
<th>Finish/Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platform Extension FL-02</td>
<td>To gradients as documented on drawings</td>
<td></td>
<td>Pendulum test, and not ramp test is to be used. Evidence of compliance with these standards will be required prior to product ordering and installation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Broom finish. Light grey coloured concrete.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Scabble back existing surface.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R13 Slip resistance rating to TfNSW requirements and in accordance with Australian Standards AS3661, AS4586 and HB197, AS1428 all parts. Pendulum test, and not ramp test is to be used. Evidence of compliance with these standards will be required prior to product ordering and installation.</td>
</tr>
<tr>
<td>Coping tiles FL-03</td>
<td>Exposed aggregate concrete paver Urbanstone</td>
<td></td>
<td>Light short blast finish, colour Western Cream 832 L/B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R13 &amp; W Slip resistance rating to TfNSW requirements and in accordance with Australian Standards AS3661, AS4586 and HB197, AS1428 all parts. Pendulum test, and not ramp test is to be used. Evidence of compliance with these standards will be required prior to product ordering and installation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>400 x 300 x 40mm Nominal Paving sealer: Sure Seal – Stone sealer 24/7 stone impregnator - clear</td>
</tr>
<tr>
<td>Tactile Ground Surface Indicators TGSI-01</td>
<td>Exposed aggregate concrete paver Stone Directions</td>
<td></td>
<td>Shotblast or off-form Colour: sunmetal Minimum 30% luminance contrast against the surrounding surface, compliant with DDA Public transport Standards sections 18.2(1) and 18.4 and AS1428.4. R13 &amp; W Slip resistance rating in accordance with Australian Standards AS3661, AS4586 and HB197, AS1428 all parts. Evidence of compliance with these standards will be required prior to product ordering and installation. Type 'B' 300x300x40mm</td>
</tr>
<tr>
<td>Item</td>
<td>Supplier/ Product</td>
<td>Code</td>
<td>Finish/Colour</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------------------------</td>
<td>-------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Yellow Warning</td>
<td>Pigmented concrete paver</td>
<td></td>
<td>Contrasting yellow</td>
</tr>
<tr>
<td></td>
<td>Urbanstone</td>
<td></td>
<td>Minimum 30% luminance contrast against the surrounding surface, compliant with DDA Public transport Standards sections 18.2(1) and 18.4 and AS1428.4. R13 &amp; W Slip resistance rating in accordance with Australian Standards AS3861, AS4586 and HB197, AS1428 all parts. Evidence of compliance with these standards will be required prior to product ordering and installation. Paving sealer: Sure Seal – Stone sealer 24/7 stone impregnator - clear</td>
</tr>
</tbody>
</table>

**E41.5 NEW PLATFORM BUILDING**

**STRUCTURAL STEEL FRAMING**

<table>
<thead>
<tr>
<th>Item</th>
<th>Supplier/ Product</th>
<th>Code</th>
<th>Finish/Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposed external structure steel including beams and columns</td>
<td>Hot dipped Galvanised with Vitrathane 580/590 epoxy primer and Vitreflon 700/744 Fluoropolymer.</td>
<td></td>
<td>Colour: K168 (dark grey)</td>
</tr>
<tr>
<td>PNT-02</td>
<td>Architectural and Industrial Coatings P/L</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ROOFING**

<table>
<thead>
<tr>
<th>Item</th>
<th>Supplier/ Product</th>
<th>Code</th>
<th>Finish/Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roofing</td>
<td>Ritek roof panel system 140mm thick</td>
<td></td>
<td>Colorbond : Shale Grey</td>
</tr>
<tr>
<td>RS-03</td>
<td>Insulation to R3.2 rating min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capping</td>
<td>Colorbond</td>
<td></td>
<td>Colorbond : Shale Grey</td>
</tr>
<tr>
<td>Eaves gutter and downpipes</td>
<td>Colorbond</td>
<td>Half round gutter</td>
<td>Colorbond : Shale Grey</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bluescope Steel. Dp's to stop 50mm short of rain water outlets</td>
</tr>
<tr>
<td>Roof anchor points and ladder bracket Safety System</td>
<td>To Workcover requirements.</td>
<td>To be provided to existing canopies also</td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Supplier/ Product</td>
<td>Code</td>
<td>Finish/Colour</td>
</tr>
<tr>
<td>------</td>
<td>-------------------</td>
<td>------</td>
<td>---------------</td>
</tr>
<tr>
<td></td>
<td>to provide access to platform building roof.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EXTERNAL WALLS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Wall cladding panels</td>
<td>1.6mm thick steel sheet Vitreous Enamelled Panels with 12mm calcium silicate board backing bonded to panel.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD-01</td>
<td>Concealed panel fixing with silicone joints HH Robertson – Phil O' Loan 0411 Or equivalent approved</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete Skirting Base of External Wall</td>
<td>Dulux Acratex paint system with anti-graffiti paint top coat</td>
<td></td>
<td>Colour: PG2.C2 Malay Grey (dark grey)</td>
</tr>
<tr>
<td>PNT-01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Window Framing</td>
<td>Commercial Aluminium Glazing Suite. Nominal 100mm profile</td>
<td></td>
<td>Natural Anodised Aluminium Frames</td>
</tr>
<tr>
<td>GS-01</td>
<td>Equivalent to ‘G James 475 series frames’. Equiv.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35mm min rebates required by TfNSW.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td>Viridian – New World Glass 3M Film</td>
<td>VFloat SuperGreen</td>
<td>SuperGreen. Laminated annealed Safety Glass with Anti-blast film on inside and anti graffiti film on outside</td>
</tr>
<tr>
<td>GLZ-02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Louvres</td>
<td>Aluminium Double Bank Louvre.</td>
<td>Type 2UL/SH</td>
<td>Natural Anodised in Commercial Window Aluminium Frames</td>
</tr>
<tr>
<td>LVR-01</td>
<td>50% open area required in accordance with mechanical drawings Alps louvres</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EXTERNAL DOORS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Steel door frames</td>
<td>Dulux Paint/full gloss</td>
<td>Colour: PG2.C3 Flooded gum (mid grey)</td>
<td></td>
</tr>
<tr>
<td>PNT-03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Solid core doors</td>
<td>Dulux Paint/full gloss</td>
<td>Colour: PG2.C3 Flooded gum (mid grey)</td>
<td></td>
</tr>
<tr>
<td>PNT-03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FLOORING</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tiles to New Staff toilet,</td>
<td>Better Tiles</td>
<td>BFA700</td>
<td>300 x 600mm Dark Grey.</td>
</tr>
<tr>
<td>Item</td>
<td>Supplier/ Product</td>
<td>Code</td>
<td>Finish/Colour</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
<td>------</td>
<td>---------------</td>
</tr>
<tr>
<td>New F.A.T Room and Cleaners Room</td>
<td></td>
<td></td>
<td>Slip resistance rated to comply with Australian Standards AS3661, AS4586 and HB197, AS1428 all parts. Evidence of compliance with these standards will be required prior to product ordering and installation.</td>
</tr>
<tr>
<td>CT</td>
<td></td>
<td></td>
<td>Dark grey. Slip resistance rated to comply with Australian Standards AS3661, AS4586 and HB197, AS1428 all parts. Evidence of compliance with these standards will be required prior to product ordering and installation.</td>
</tr>
<tr>
<td>Vinyl - to all other rooms/areas</td>
<td>Forbo Commercial grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VYL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**INTERNAL WALLS**

<p>| Wall Tiles to New Staff toilet and New F.A.T Room and entire wall behind Cleaners sink | Better Tiles | BGY-107(White) | BGY-Red (Red) | Full height. White to 3 walls. Red on Feature Wall only (Wall behind toilet suite) 162 x 495mm |
| Paint to plasterboard - to all other rooms | Dulux paint/semi gloss | | Colour: PW2.D4 White Watsonia |
| Skirting - Coved Tiles to New Staff toilet, New F.A.T Room and Cleaners room | Better Tiles | BSP 105C | 100 x 200mm Dark grey to match floor tiles |
| Skirting - to all other rooms | | | Colour: PW2.D4 White Watsonia - Super Enamel High Gloss |
| Splashback to Kitchenette | Better Tiles | | White 150 x 150mm |
| CEILING | | | |
| 13mm plasterboard Flush set suspended (wet area) | Dulux paint/matt | | Colour: PW2.D4 White Watsonia |</p>
<table>
<thead>
<tr>
<th>Item</th>
<th>Supplier/Product</th>
<th>Code</th>
<th>Finish/Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>plasterboard to New Staff toilet and New F.A.T room)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PNT-05</td>
<td>Rondo P50 shadowline stopping angle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cornice</td>
<td>Rondo P50 shadowline stopping angle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INTERNAL DOORS</td>
<td>Internal Steel door frames</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PNT-03</td>
<td>Dulux Paint/full gloss</td>
<td>Colour: PG2.C3 Flooded gum (mid grey)</td>
<td></td>
</tr>
<tr>
<td>Internal Solid core doors</td>
<td>Dulux Paint/full gloss</td>
<td>Colour: PG2.C3 Flooded gum (mid grey)</td>
<td></td>
</tr>
<tr>
<td>JOINERY</td>
<td>Carcasses</td>
<td>Melamine</td>
<td></td>
</tr>
<tr>
<td>LAM-02</td>
<td>Laminex Laminate</td>
<td>Laminex 205</td>
<td>Polar White natural finish</td>
</tr>
<tr>
<td>Office bench tops</td>
<td>32mm thick Laminex Laminate</td>
<td>Laminex 442</td>
<td>Evening Shale natural finish</td>
</tr>
<tr>
<td>Kitchen bench tops</td>
<td>32mm thick Laminex Laminate</td>
<td>Laminex 442</td>
<td>Evening Shale natural finish</td>
</tr>
<tr>
<td>FIXTURES</td>
<td>Kitchen sink</td>
<td>Clark 1 bowl Benchmark 930mm single end bowl</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>SNK-01</td>
<td>Enware Single Lever sink mixer with extended lever</td>
<td>SLM607D</td>
<td>Chrome</td>
</tr>
<tr>
<td>TAP-01</td>
<td>Caroma Care 800 Wall Faced Invisi™ Series II Suite with buttons and panels</td>
<td>718100W</td>
<td>White</td>
</tr>
<tr>
<td>Accessible WC</td>
<td>Caroma Care 800 Wall Faced Invisi™ Series II Suite with buttons and panels</td>
<td>718100W</td>
<td>White</td>
</tr>
<tr>
<td>Accessible basin</td>
<td>Caroma Care Integra 500 with one tap hole</td>
<td>648210W</td>
<td>White</td>
</tr>
<tr>
<td>Accessible taps</td>
<td>Caroma Nordic Care Basin Mixer 5 star WELS rating model</td>
<td>90695C5A</td>
<td>Chrome</td>
</tr>
<tr>
<td>Toilet roll holders</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Supplier/ Product</td>
<td>Code</td>
<td>Finish/Colour</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------------------------</td>
<td>---------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>TRH-01</td>
<td>Kimberly Clark</td>
<td>Jumbo – Code 4972</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>TRH-02</td>
<td>Bradley</td>
<td>Code 5084</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>Soap dispensers SD-01</td>
<td>Kimberly Clark</td>
<td>Code 6340</td>
<td>White</td>
</tr>
<tr>
<td>Hand dryers HD-01</td>
<td>Dyson Airblades</td>
<td>A01 Model</td>
<td>Silver</td>
</tr>
<tr>
<td>Clothes Hook CH-01</td>
<td>Single robe hook</td>
<td>7340</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>Baby Change Unit BCU-01</td>
<td>RBA. Builder to construct frame.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleaner's sink SNK-02</td>
<td>Caroma</td>
<td>811592W</td>
<td>White</td>
</tr>
<tr>
<td>Cleaner's sink tapware TAP-02</td>
<td>Caroma</td>
<td>G91842C4 A</td>
<td></td>
</tr>
<tr>
<td>Mop and Broom Holder Rack MBH-01</td>
<td>JD Mcdonald</td>
<td>8215-3</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>Lockers LK-EXST</td>
<td>Relocate existing to as shown on architectural drawings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Supplier/ Product</td>
<td>Code</td>
<td>Finish/Colour</td>
</tr>
<tr>
<td>---------------------------------------------------------------------</td>
<td>-------------------</td>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>E41.6 OTHER</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fencing – SF1 Security Fence (Palisade)</td>
<td>Design and install Security Fence (palisade) to define the boundary of the commuter car park and road areas in the immediate vicinity of the Station. Tamper resistant, security-type fasteners shall be used. As indicated on architectural drawing CV0420727. Leda Security or Bluedog Fences Australia</td>
<td>2400mm powdercoated high palisade 'W' profile palings with triple-point spear top fence. To be designed and installed by manufacturer in accordance with TfNSW Standards SPC 511 BOUNDARY FENCES Version 1.1 Issued December 2009, and ESC 510 - BOUNDARY FENCES; Version 2.1, Issued December 2009 and TMC 511. Colour: Powdercoat black</td>
<td></td>
</tr>
<tr>
<td>SF-01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fencing – SF2 Enhanced Urban Fence (Tubular)</td>
<td>Design and install Enhanced Urban Fence (tubular steel) type fencing to define the operational rail corridor and Station platform. Tamper resistant, security-type fasteners shall be used. This is to include fencing for 50 metres past each end of the platforms. As indicated on architectural drawing CV0420727. Leda Security or Bluedog Fences Australia</td>
<td>2400mm powdercoated high tubular steel fence. 2.5mm wall thickness, square section, crimped spear pointed. Provide lockable gates to match existing size and locations (including vehicle gate) and any new gates required by TfNSW. To be designed and installed by manufacturer in accordance with TfNSW Standards SPC 511 BOUNDARY FENCES Version 1.1 Issued December 2009 and ESC 510 - BOUNDARY FENCES; Version 2.1, Issued December 2009 and TMC 511. Colour: Powdercoat black</td>
<td></td>
</tr>
<tr>
<td>SF-02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fencing – SF3 Enhanced Urban Fence (Tubular)</td>
<td>To both ends of platform. Leda Security or Bluedog Fences Australia</td>
<td>As per SF2 but 2100mm high. Provide 1 x lockable gate at steps. Colour: Powdercoat black</td>
<td></td>
</tr>
<tr>
<td>SF-03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fencing – Garbage Bin storage area</td>
<td>As per Fence type SF2</td>
<td>As per Fence type SF2</td>
<td></td>
</tr>
<tr>
<td>SF-02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seating -- New</td>
<td>3 person seat with integrated armrests. Supplied by TfNSW. Wall Mounted to TfNSW standards.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Contract No*  
Cardiff Railway Station Easy Access Upgrade  
Tender Issue  
February 2012  
299 of 301
<table>
<thead>
<tr>
<th>Item</th>
<th>Supplier/ Product</th>
<th>Code</th>
<th>Finish/Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seating — New</td>
<td>To match existing seats on platform</td>
<td></td>
<td>Supplied by TfNSW. Floor mounted to TfNSW standards</td>
</tr>
<tr>
<td>SE-02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seating — Existing</td>
<td>Relocate existing platform seats to new locations as shown on architectural drawing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE-EXIST</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bin — New</td>
<td>To match existing bins on platform</td>
<td></td>
<td>As per TfNSW requirements</td>
</tr>
<tr>
<td>BN-01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bollards Vehicle protection - Fixed</td>
<td>AEGIS 150NB Fixed Aluminium Bollard with Heavy duty Galvanised pipe.</td>
<td>AAE 150NB FIXED ALUM</td>
<td>Finish and Colour: Powdercoat precious silver pearl</td>
</tr>
<tr>
<td>BL-01</td>
<td>To shared area of proposed accessible parking spaces at lower ground level.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Leda Security</td>
</tr>
<tr>
<td>Ticket Vending Machine (TVM)</td>
<td>Existing Relocated as directed. Services provision only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telstra Public Telephone</td>
<td>Relocate existing as shown on architectural drawings, and install in accordance with reach height criteria as set out for disability standards in AS1428.2(1992)</td>
<td></td>
<td>Installation and Supply by Telstra</td>
</tr>
<tr>
<td>Light Poles</td>
<td>Galvanised Steel / Painted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial Vending Machines (CVM)</td>
<td></td>
<td></td>
<td>Supply &amp; Install by others, Electrical supply provision only</td>
</tr>
<tr>
<td>Kerbs</td>
<td>Concrete</td>
<td>Natural</td>
<td>150mm high with accessible compliant kerb ramps at crossings. Broom Finish</td>
</tr>
<tr>
<td>Bicycle Parking Racks</td>
<td>Bicycle hitch rail fixed insitu</td>
<td>BR85F</td>
<td>Proprietary 5 Secure Racks allowing storage for 10 bicycles.</td>
</tr>
<tr>
<td>BK-01</td>
<td>Leda Security</td>
<td></td>
<td>Stainless Steel</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GHD

133 Castlereagh St Sydney NSW 2000

T: 2 9239 7100  F: 2 9239 7199  E: sydmail@ghd.com.au

© GHD 2012

This document is and shall remain the property of GHD. The document may only be used for the purposes for which it was commissioned and in accordance with the Consultancy Agreement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Document Status

<table>
<thead>
<tr>
<th>Rev No.</th>
<th>Author</th>
<th>Reviewer</th>
<th>Name</th>
<th>Signature</th>
<th>Approved for Issue</th>
<th>Name</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-Tender</td>
<td>J. Saliba</td>
<td>V. Lugovoy</td>
<td>N. Nicotra</td>
<td></td>
<td></td>
<td>29 Feb 2012</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**FUSION2**

**HARDWARE SPECIFIER**

---

### Cover Letter

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>CARDIFF STATION - EASY ACCESS UPGRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Address:</td>
<td>MAIN ROAD  CARDIFF NSW 2285</td>
</tr>
<tr>
<td>Schedule No:</td>
<td>11NSWCA034A (24 Feb 2012)</td>
</tr>
<tr>
<td>Keying System:</td>
<td>Existing</td>
</tr>
<tr>
<td>Architect Company</td>
<td>GHD GROUP PTY LTD</td>
</tr>
<tr>
<td>Architect Name</td>
<td>Joe Saliba</td>
</tr>
</tbody>
</table>

**Sales Rep:** Chris Theyers

---

This schedule is based upon the following documentation:

**Drawing Nos:**

**Spec/Doc Nos:**

Door hardware schedule to be checked against final floor plans and specification prior to the ordering of hardware by hardware supplier / builder.

This schedule is to be read in conjunction with any Electronic & Security documentation to avoid duplications.

### Project Comments

- An existing master key system has been allowed for. Key quantities and subsequent costs will need to be determined in conjunction with the relevant supplier.

- Temporary construction keyed cylinders have been allowed for on all lockable doors for the duration of the project. The Hardware Distributor should allow for 4 construction keys.

- The builder will need to make arrangements and allow for the cost of the change over from construction cylinders to the final master keyed cylinders.

- Where door closers have been scheduled they should generally be mounted to the less visible side of the door.

- All Lockwood stainless steel hinges specified in this schedule are manufactured from 304 Grade stainless steel.

- Where equal pairs of doors are specified it has been assumed that, when viewed from the outside, the right hand leaf is active.

- Please coordinate the supply of the specified electronic products with electrical and security contractors to ensure adequate power and cabling has been allowed for. Also please confirm who is to supply to ensure the products are not supplied to site twice.

- All electronic security products are to have the voltage, power and security mode requirements to be verified on site prior to ordering. The electronic security products specified in this door hardware schedule should be checked and coordinated with the information shown on the electrical drawings.

---

© 2007 ASSA ABLOY Australia Pty Limited ABN 90 096 451 907 This document is the intellectual property of ASSA ABLOY Australia Pty Limited. Any changes or alterations to this document can only be made by the author or authorised representative of ASSA ABLOY Australia Pty Limited. No party, other than the author or authorised representative of ASSA ABLOY Australia Pty Limited, is permitted to provide this document in whole or in part, unless expressly permitted in writing by ASSA ABLOY Australia Pty Limited.
## Door Hardware Schedule

**Project Name:** CARDIFF STATION - EASY ACCESS UPGRADE  
**Project Address:** MAIN ROAD CARDIFF NSW 2285  
**Schedule No:** 11NSWCA034A (24 Feb 2012)

### Stations

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Brand</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATION BUILDING : D.01 OFFICE LOBBY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height:</td>
<td>Width:</td>
<td>Door Type:</td>
<td>Frame Type:</td>
</tr>
<tr>
<td>Thick:</td>
<td>2040</td>
<td>920</td>
<td>LH Oil</td>
</tr>
<tr>
<td>570/101SC</td>
<td>570 OVAL CYLINDER ASSEMBLY WITH &quot;U&quot; CAM</td>
<td>570 TEMPORARY OVAL CONSTRUCTION CYLINDER</td>
<td>Not Branded</td>
</tr>
<tr>
<td>CK 670</td>
<td>CUT KEY 6 PIN</td>
<td>GMK6P KEYING CHARGE - 6 PIN GRAND MASTER KEYING</td>
<td>Lockwood</td>
</tr>
<tr>
<td>3P72SS-E23E</td>
<td>60MM B-SET MORTICE ESCAPE, STOREROOM LOCK</td>
<td>WS9-CH DOOR VIEWER 170 DEG 30MM TO SUIT 40-95MM DOORS</td>
<td>Lockwood</td>
</tr>
<tr>
<td>109001-000</td>
<td>ES9000 PRE - LOAD MULTI FUNCTION STRIKE</td>
<td>184SC BRASS DOUBLE BEND PULL HANDLE</td>
<td>Padde</td>
</tr>
<tr>
<td>1905/70SC</td>
<td>SQUARE END VIS FIX PLATE, CYLINDER HOLE ONLY</td>
<td>7714SSS STD ARM CLOSER SIZE 1-4, D-ACTION, B-CHECK</td>
<td>Lockwood</td>
</tr>
<tr>
<td>LW10075BBSS</td>
<td>100X75X2.5MM BROAD BUTT BEARING HINGE, BUTTON TIP, FIXED PIN</td>
<td>A250SC FLOOR MOUNTED DOORSTOP</td>
<td>Lockwood</td>
</tr>
<tr>
<td>NB: CARD READER</td>
<td>BY SECURITY CONTRACTOR</td>
<td>NB: REED SWITCH</td>
<td>BY SECURITY CONTRACTOR</td>
</tr>
</tbody>
</table>

### STATION BUILDING : D.02 TICKET OFFICE |

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Brand</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height:</td>
<td>Width:</td>
<td>Door Type:</td>
<td>Frame Type:</td>
</tr>
<tr>
<td>Thick:</td>
<td>2040</td>
<td>920</td>
<td>LH Oil</td>
</tr>
<tr>
<td>570/101SC</td>
<td>570 OVAL CYLINDER ASSEMBLY WITH &quot;U&quot; CAM</td>
<td>570 TEMPORARY OVAL CONSTRUCTION CYLINDER</td>
<td>Not Branded</td>
</tr>
<tr>
<td>CK 670</td>
<td>CUT KEY 6 PIN</td>
<td>GMK6P KEYING CHARGE - 6 PIN GRAND MASTER KEYING</td>
<td>Lockwood</td>
</tr>
<tr>
<td>3P72SS-E23E</td>
<td>60MM B-SET MORTICE ESCAPE, STOREROOM LOCK</td>
<td>WS9-CH DOOR VIEWER 170 DEG 30MM TO SUIT 40-95MM DOORS</td>
<td>Lockwood</td>
</tr>
<tr>
<td>109001-000</td>
<td>ES9000 PRE - LOAD MULTI FUNCTION STRIKE</td>
<td>184SC BRASS DOUBLE BEND PULL HANDLE</td>
<td>Padde</td>
</tr>
<tr>
<td>1905/70SC</td>
<td>SQUARE END VIS FIX PLATE, CYLINDER HOLE ONLY</td>
<td>7714SSS STD ARM CLOSER SIZE 1-4, D-ACTION, B-CHECK</td>
<td>Lockwood</td>
</tr>
<tr>
<td>LW10075BBSS</td>
<td>100X75X2.5MM BROAD BUTT BEARING HINGE, BUTTON TIP, FIXED PIN</td>
<td>A250SC FLOOR MOUNTED DOORSTOP</td>
<td>Lockwood</td>
</tr>
<tr>
<td>NB: CARD READER</td>
<td>BY SECURITY CONTRACTOR</td>
<td>NB: REED SWITCH</td>
<td>BY SECURITY CONTRACTOR</td>
</tr>
</tbody>
</table>
# Door Hardware Schedule

**Total Pages:** 3

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Brand</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATION BUILDING : D.03 CLEANERS ROOM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height: 2040</td>
<td>Width: 920</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thick: 40</td>
<td>Handing: LH O/O</td>
<td>SOLID CORE</td>
<td></td>
</tr>
<tr>
<td>570/101SC</td>
<td>570 OVAL CYLINDER ASSEMBLY WITH &quot;U&quot; CAM</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>CK 570</td>
<td>TEMPORARY OVAL CONSTRUCTION CYLINDER</td>
<td>Not Branded</td>
<td>1</td>
</tr>
<tr>
<td>CUTKEY-6PIN</td>
<td>CUT KEY 6 PIN</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>GMK6P</td>
<td>KEYING CHARGE - 6 PIN GRAND MASTER KEYING</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>3P72SS-E23E</td>
<td>50MM B-SET MORTICE ESCAPE, STOREROOM LOCK</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>1801/70SC</td>
<td>SQUARE END CON FIX PLATE, CYLINDER HOLE, LEVER</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>1905/70SC</td>
<td>SQUARE END VIS FIX PLATE, LEVER ONLY</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>LW10075FPSSS</td>
<td>100X75X2.5MM BROAD BUTT HINGE, BUTTON TIP, FIXED PIN</td>
<td>Lockwood</td>
<td>3</td>
</tr>
<tr>
<td>A260SC</td>
<td>FLOOR MOUNTED DOORSTOP</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>KP0920X150JUSSS</td>
<td>STAINLESS STEEL KICKPLATE UNDRILLED 920MM X 150MM</td>
<td>Lockwood</td>
<td>2</td>
</tr>
<tr>
<td>STATION BUILDING : D.04 STAFF ACCESSIBLE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height: 2040</td>
<td>Width: 920</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thick: 40</td>
<td>Handing: RH O/O</td>
<td>STEEL 1/2&quot; REBATED</td>
<td></td>
</tr>
<tr>
<td>3P72ESS-A11N</td>
<td>60MM B-SET MORTICE ESCAPE, ANTI LOCKOUT, PRIVACY LATCH</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>1814/70SC</td>
<td>SQUARE END CON FIX PLATE, INDICATING EMERGENCY TURN, LEVER</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>1939P7/70LSC</td>
<td>SQUARE END VIS FIX PLATE, L-HAND DISABLED TURN, LEVER (SUIT 3P72)</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>2516-104SIL</td>
<td>2516 SERIES SLIDE RAIL MOUNTING BRACKET (PUSH SIDE)</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>2516DASSSS</td>
<td>SLIDE RAIL CAM ACTION CLOSER SIZE 1-6, D-ACTION, B-CHECK</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>LW10075BBSSS</td>
<td>100X75X2.5MM BROAD BUTT BEARING HINGE, BUTTON TIP, FIXED PIN</td>
<td>Lockwood</td>
<td>3</td>
</tr>
<tr>
<td>KP0920X150JUSSS</td>
<td>STAINLESS STEEL KICKPLATE UNDRILLED 920MM X 150MM</td>
<td>Lockwood</td>
<td>2</td>
</tr>
<tr>
<td>297 SSS</td>
<td>297 BUMPER &amp; HOOK</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>STATION BUILDING : D.05 FAMILY ACCESS TOILET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height: 2040</td>
<td>Width: 920</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thick: 40</td>
<td>Handing: LH O/O</td>
<td>STEEL 1/2&quot; REBATED</td>
<td></td>
</tr>
<tr>
<td>CK 570</td>
<td>TEMPORARY OVAL CONSTRUCTION CYLINDER</td>
<td>Not Branded</td>
<td>1</td>
</tr>
<tr>
<td>570/101SC MLAK</td>
<td>FINAL KEYED OVAL CYLINDER KEYED TO MLAK</td>
<td>Not Branded</td>
<td>1</td>
</tr>
<tr>
<td>CUTKEY-6PIN</td>
<td>CUT KEY 6 PIN</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>GMK6P</td>
<td>KEYING CHARGE - 6 PIN GRAND MASTER KEYING</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>3P721PTESC</td>
<td>60MM B-SET MORTICE PRIVACY DEADBOLT (THROUGH FIX TURN FIXINGS)</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>3P72SS-E23E</td>
<td>60MM B-SET MORTICE ESCAPE, STOREROOM LOCK</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>109001-003</td>
<td>ES9000 PRE-LOAD MULTI FUNCTION STRIKE</td>
<td>Padde</td>
<td>1</td>
</tr>
<tr>
<td>1227DPRSC</td>
<td>DISABLED TURNSNIB (46.5MM DIA CON FIX ROSE) (SUIT 3P72)</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>1229PS</td>
<td>INDICATING EMERGENCY SNIB (46.5MM DIA CON FIX ROSE)</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>1845SC</td>
<td>BRASS DOUBLE BEND PULL HANDLE</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>1900SC</td>
<td>SQUARE END VIS FIX PLATE, CYLINDER HOLE ONLY</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>1905/70SC</td>
<td>SQUARE END VIS FIX PLATE, LEVER ONLY</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>2516-104SIL</td>
<td>2516 SERIES SLIDE RAIL MOUNTING BRACKET (PUSH SIDE)</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>2516-153</td>
<td>OPENING DAMPER</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>2516DASSSS</td>
<td>SLIDE RAIL CAM ACTION CLOSER SIZE 1-6, D-ACTION, B-CHECK</td>
<td>Lockwood</td>
<td>1</td>
</tr>
<tr>
<td>LW10075BBSSS</td>
<td>100X75X2.5MM BROAD BUTT BEARING HINGE, BUTTON TIP, FIXED PIN</td>
<td>Lockwood</td>
<td>3</td>
</tr>
<tr>
<td>KP0920X150JUSSS</td>
<td>STAINLESS STEEL KICKPLATE UNDRILLED 920MM X 150MM</td>
<td>Lockwood</td>
<td>2</td>
</tr>
<tr>
<td>297 SSS</td>
<td>297 BUMPER &amp; HOOK</td>
<td>Lockwood</td>
<td>1</td>
</tr>
</tbody>
</table>
# Door Hardware Schedule

## Code | Description | Brand | Qty
--- | --- | --- | ---
EQUIPMENT ROOM : D.06 STORAGE

<table>
<thead>
<tr>
<th>Height:</th>
<th>Width:</th>
<th>Door Type:</th>
<th>Rev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100</td>
<td>550+550</td>
<td>SOLID CORE</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thick</th>
<th>Handing:</th>
<th>Frame Type:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>PAIR O/O</td>
<td>STEEL 1/2&quot; REBATED</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>570/101SC</td>
<td>570 OVAL CYLINDER ASSEMBLY WITH &quot;U&quot; CAM</td>
<td>1</td>
</tr>
<tr>
<td>570-2SC</td>
<td>570X CYLINDER</td>
<td>1</td>
</tr>
<tr>
<td>CK 570</td>
<td>TEMPORARY OVAL CONSTRUCTION CYLINDER</td>
<td>1</td>
</tr>
<tr>
<td>CUTKEY-6PIN</td>
<td>CUT KEY 6 PIN</td>
<td>1</td>
</tr>
<tr>
<td>QMK6P</td>
<td>KEYING CHARGE - 6 PIN GRAND MASTER KEYING</td>
<td>1</td>
</tr>
<tr>
<td>3P72SS-E23E</td>
<td>60MM B-SET MORTICE ESCAPE, STOREROOM LOCK</td>
<td>1</td>
</tr>
<tr>
<td>3P72-RX32SS</td>
<td>REBATE KIT SUIT 3P70 SERIES DEADLATCH 32MM LIP</td>
<td>1</td>
</tr>
<tr>
<td>184SC</td>
<td>BRASS DOUBLE BEND PULL HANDLE</td>
<td>1</td>
</tr>
<tr>
<td>1900SC</td>
<td>SQUARE END VIS FIX PLATE, CYLINDER HOLE ONLY</td>
<td>1</td>
</tr>
<tr>
<td>1905/70SC</td>
<td>SQUARE END VIS FIX PLATE, LEVER ONLY</td>
<td>1</td>
</tr>
<tr>
<td>791O/SX450SC</td>
<td>VIS FIX PANIC BOLT 450M OFFSET</td>
<td>1</td>
</tr>
<tr>
<td>791X230SC</td>
<td>VISIBLE FIX PANIC BOLT 230MM</td>
<td>1</td>
</tr>
<tr>
<td>LW10075PFSSS</td>
<td>100X75X2.5MM BROAD BUTT HINGE, BUTTON TIP, FIXED PIN</td>
<td>6</td>
</tr>
</tbody>
</table>

24/02/2012 1:38:08PM

11NSWCA034A (24 Feb 2012)
Transport for NSW

Cardiff Station Easy Access Upgrade

Mechanical Specification

March 2012
# Contents

1. Project Information  
   1.1 Definitions  
   1.2 The Project  
   1.3 Specification Objectives  
   1.4 Obligations of Installer  
   1.5 Required Submissions  
   1.6 Quality Assurance

2. General  
   2.1 Responsibilities  
   2.2 System Description  
   2.3 Associated Works  
   2.4 Standards  
   2.5 Design  
   2.6 Submissions  
   2.7 Products  
   2.8 Execution

3. Completion  
   3.1 Commissioning  
   3.2 Cleaning  
   3.3 Operating and maintenance instructions  
   3.4 Warranties  
   3.5 Training

4. Selections
1. Project Information

1.1 Definitions

<table>
<thead>
<tr>
<th>Role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client</td>
<td>TfNSW</td>
</tr>
<tr>
<td>Consulting Engineer</td>
<td>GHD</td>
</tr>
<tr>
<td>Works</td>
<td>Mechanical Services as described in Section 2</td>
</tr>
<tr>
<td>Mechanical Contractor</td>
<td>The company contracted to undertake the works</td>
</tr>
</tbody>
</table>

1.2 The Project

This project involves the Easy Access upgrade to the existing Railway Station at Cardiff, NSW. This specification covers the Design and Construction of Mechanical Services for the new extension and refurbishment at Cardiff Station.

1.3 Specification Objectives

The intent of this specification and the associated documents is:

- To provide a clear statement of contractual requirements against which compliance can be assessed.
- To provide documentation for the Client to demonstrate what is being bought.
- To define the expectations upon the Contractor by the Consulting Engineer.
- To define the roles of the parties involved with the works.
- To enable other interested parties to assess their obligations and to understand expectations of them.
- To define the requirements of the installer with respect to Quality Assurance.

1.4 Obligations of Installer

In writing this specification the Consulting Engineer expects and relies upon the tenderers' possessing specialist trade expertise necessary to complete the works in accordance with the documentation.

In addition, the installer has the following obligations:

- To raise in good time, issues requiring design intent or clarification from the Consulting Engineer, particularly in respect to:
  1. Interpretation of the design intent specification or drawings.
  2. Problems in complying with the specification.
  3. Omissions from the tender documents.
- To certify compliance with contract documents, including all variation instructions, at Practical Completion.
- To certify compliance with Authority requirements, as far as he/she can ascertain.
To implement procedures to ensure that only competent tradesmen are used for the works.

To be cognisant of the role of all relevant parties during the construction phase of the project and to assist them in the conduct of their duties wherever possible.

To contribute, in the spirit of partnering, towards the successful execution of the contract.

To provide manufacturer’s and construction drawings.

To make final equipment selections to meet the requirements listed.

1.5 Required Submissions

The Main Contractor shall provide a program, in good time to allow review without impediment.

Certified schedule of compliance for all equipment, prior to placing orders.

Certified schedule of competency for all tradesmen intended to work on the project.

Factory test results where applicable.

All product data, performance test and commissioning results required by this specification.

Shop drawings for fabrication and installation of all equipment and items supplied.

Inspection and test plans for every section of the works. Detail the procedure of how to complete the task, the skill or competency of the person undertaking the works, the review or testing procedure to assure satisfactory completion of the task, the person within the installer’s organisation authorised to sign-off the task as accepted.

Client handover/training proposals.

Record and installation drawings: Record all changes to equipment and services layouts, wiring and any other items during the construction period, which may have been incorporated into these works.

Operating and Maintenance manuals.

Certifications for compliance with project specific Code/Design requirements of the completed works.

Maintenance and servicing during the defects liability period.

Fully developed functional descriptions, written in simple sentences, of each system including but not limited to start up, normal running, shut down, fire mode operation, operation in fault conditions, alarms, safety controls and manual over-ride provisions.

Control schematics or diagrams illustrating control logic, valve and damper sequences, external interlocks, and interfaces.

Details of connections to external interfaces and components outside the automatic control system.

When requested, provide manuals, data sheets and other explanatory information needed to interpret the material submitted.

Test reports: Submit a report showing the test results. Carry out necessary modifications and re-test.

Samples of ceiling grilles and all exposed elements and as required by the lead architect

Data sheets for each item of mechanical plant, type of controller, actuator, sensor and other hardware component.
1.6 Quality Assurance

A Quality Assurance plan shall be provided in order to propose, establish, maintain, monitor and document a quality assurance system covering all aspects of the design, purchase, fabrication, installation and completion of the works. The plan shall be in accordance with ISO 9001:2008 (as appropriate).
2. General

2.1 Responsibilities

General

General: Provide air conditioning and mechanical ventilation.
Selections: As documented.

2.1.1 Extent of works

The extent of work comprises the supply, installation, testing, commissioning, maintenance and defects liability service, of materials, labour and equipment for the complete Mechanical Services installation.

The work shall include all necessary minor and incidental work required to implement the intent and meaning of this specification.

Whether or not the words "supply and install" appear in this specification, unless clearly excluded, all items of equipment for the complete installation are required and shall be supplied and installed.

Scope of works

Provide mechanical service systems as documented in drawings CV0420791 - CV0420793 and as follows:

- Supply and install new split systems to serve the ticketing office and kitchen of the new building as scheduled and as shown on the drawings CV0420791.
- Supply and install new weather proof louvers to each of the lift shafts to provide cross ventilation.
- Supply and install supply air fans and filters at low level of the lift shafts behind the louvers.
- Supply and install mechanical exhaust system to the toilets.

2.2 System Description

2.2.1 Air Conditioning

The Ticketing office and the Kitchen areas are to include the following

- Ceiling mounted reverse cycle cassette type indoor units in the ticketing office and kitchen area including outdoor condenser units, complete with matching hard-wired wall mounted touch pads.

2.2.2 Lift Shaft Ventilation

Lift shaft ventilation to include the following

- Filtered outside air supply via speed controllable supply air fans to each of the lift shafts installed approximately 2.2 m above the platform level to provide positively pressurised ventilation within the shaft.
Removable weatherproof proof louvers where exposed to rain for easy access and maintenance of filters and fans at the platform level complete with protective steel wire mesh and manehelic gauge indicating filter change.

Fixed weatherproof louvers at high level of the shaft to maintain positively pressurised cross flow ventilation.

Thermostat to monitor the temperature in the lift shaft and to activate the supply air fan high speed when temperature exceeds 27°C (temperature set point adjustable).

2.2.3 Exhaust
The Toilet Exhaust system to include the following:

- Supply and install new exhaust system including grilles ductwork, and roof mounted exhaust fans.
- The toilets shall also be provided with a 100% redundancy system, which will operate on a lead-lag arrangement.

2.3 Associated Works

2.3.1 Works by Builder
Builder is to provide penetrations and any structural support, concrete plinths and the like.

The mechanical contractor is to liaise with the builder and provide all pertinent information in good time and in a professional manner.

2.3.2 Works by Electrical Trade
Mains power for the proposed air conditioning systems is to be supplied from the new electrical distribution boards.

The electrical contractor shall provide isolators within 1.5m of all condensing units for connection by the mechanical contractor.

2.3.3 Works by Civil Trade
Stormwater pits to drain the condensate lines to local authority requirements & approval.

The mechanical contractor is to liaise with the civil contractor and provide all pertinent information and requirements in good time and in a professional manner.

2.4 Standards
The complete installation shall comply with the latest standards and requirements, referenced herein as well as and including all amendments, of the following:

- The Building Code of Australia, including section J.
- The Department of Environment and Planning.
- RailCorp Stations & Buildings Standards ESB-001 to 004
The Insurance Council of Australia.
NSW Fire Brigade.
Current Australia Standards:
- AS1345 The Identification of Pipes, Conduits and Ducts
- AS1668.2-1991 The Use Of Ventilation and Air Conditioning in Buildings Part 2 Mechanical Ventilation for Acceptable Indoor-Air Quality
- AS/NZS2053 Conduits & Fittings for Electrical Installations
- AS/NZS2107 Acoustics – Recommended Design Sound Levels & Reverberation Times for Building Interiors
- AS2625.4 Mechanical Vibration – Evaluation of Machine Vibration by Measurements on Non-Rotating Parts – Industrial Machines with Nominal Power Above 15kW & Nominal Speeds Between 120r/min & 15000r/min When Measured In Situ
- AS/NZS3000:2007 Electrical Installations
- AS/NZS3947 Low Voltage Switchgear & Controlgear
- AS4254 Ductwork for Air-Handling Systems in Buildings
- AS4426 Thermal Installation of Pipework, Ductwork and Equipment – Selection, Installation and Finish
- AS60529 Degrees of Protection Provided by Enclosures (IP Code)
- HB40.1 The Australian Refrigeration and Air Conditioning Code of Good Practice – Reduction of Emissions of Fluorocarbon Refrigerants in Commercial and Industrial Refrigeration and Air-Conditioning Applications

2.5 Design
Provide all design work necessary to complete the mechanical services documentation to work shop fabrication level.
Use only appropriately experienced and qualified persons to undertake mechanical design work. If requested, provide documents verifying the qualification and experience.

2.5.1 Electrical
General: Supply system to be 240V, 50Hz with single phase for indoor and 3 phase for outdoor units.
Fault level protection: To withstand the fault level of the incoming supply at the equipment location.

2.5.2 Uniformity
General: All products of the same type to be of the same manufacture.
2.6 Submissions

2.6.1 Drawings
Minimum drawing size shall be at least A1.
Standard: To AS 1100 Parts 101, 201, 301, 401 and 501 as applicable.
The following drawings shall be submitted:
- Building work drawings showing all building work required to complete the mechanical services.
- Detailed drawings, at 1:50 scale or larger, showing:
  - Pipe work and equipment layouts and sections.
  - For refrigerant piping include slope of horizontal runs, oil traps, double risers and valving;
  - Relevant performance data for each item of equipment including make, model, speed, capacity etc., as appropriate.
- Submission drawings required by authorities;
- Wiring diagrams.
Services coordination: Coordinate with other building and service elements. Show adjusted positions on the shop and record drawings.
Space requirements: Check space requirements of equipment and services indicated diagrammatically in the contract documents.

2.6.2 Execution details
Before starting the respective portions of the installation the following shall be submitted:
- Typical details of locations, types and methods of fixing of services to structure.
- If services will be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.
- Proposals for location of exposed piping.
- Proposals for location and mounting of outdoor condensing units.

2.6.3 Technical data
Certification shall be submitted that the plants and equipment submitted meets the requirements and capacities of the contract documents except for departures that are identified in the submission.
Technical data shall be submitted for all items of plant and equipment.

2.6.4 Standards
General
Mechanical ventilation: To AS/NZS 1668.1 and AS 1668.2, as required by the Building Code of Australia.
Refrigeration systems: To AS/NZS 1677.2 and the recommendations of SAA HB 40.1 and SAA HB 40.2.
Microbial control: To AS/NZS 3666.1, AS/NZS 3666.2 and the recommendations of SAA/SNZ HB 32.
2.6.5 Submissions

General

Before starting work, submit the following:

- Outside design conditions, corresponding geographic location and source of data.
- Calculated total and sensible cooling capacities and heating capacity.
- Name of calculation method used.
- Makes and model numbers of proposed equipment.
- Total and sensible cooling capacities and heating capacity of the proposed equipment, adjusted for the documented outdoor and indoor conditions and any effects of the proposed plant configuration.
- Any assumptions on which the calculations are based.
- Details of any departures from this specification.
- Details of fire provisions.
- A drawing of the proposed duct, pipe and equipment layout. Show proposed zoning and methods of heating.
- Mechanical contractor provision for attendance to breakdowns.
- AREMA certification of equipment.
- Proposed ventilation systems.
- Licence numbers and type of licences held by persons responsible for the installation.

2.7 Products

2.7.1 Air-conditioning equipment

Standards

Ducted air conditioners: To AS/NZS 3823.1.2.
Non-ducted air conditioners: To AS/NZS 3823.1.1.

Equipment

Performance: Provide equipment in conformance with the following:

- Made by a manufacturer with a demonstrated ability to provide spare parts and service promptly to the site.
- Operational within the documented range of outdoor design conditions under the calculated loads without excessive head pressure or icing.
- Labelled to AS/NZS 3823.2.

Reverse cycle units: Provide an effective outdoor coil defrost facility that prevents room temperature dropping more than 2°C during defrost.

Head pressure control: Provide manufacturer's standard head pressure control kit on units that operate in cooling mode at low ambient temperatures.
Cabinet: Aluminium, powder coated steel or moulded ABS plastic with metallic-coated steel or stainless steel fasteners. Insulate and vapour seal cabinet and drain trays to prevent external condensation under all operating conditions.

Drain trays: Aluminium, stainless steel or plastic to collect all moisture inside indoor and outdoor units.

Filters:
1) Air conditioning: Disposable panel type
Performance when tested to AS 1324.2:
- Test Dust No. 1: ≥ 20% efficiency.
- Test Dust No. 4: ≥ 85% arrestance.
- Dust holding capacity: ≥ 130 g at 125 Pa against Test Dust No 4 for a nominal 600 mm x 600 mm cell.

2) Lift shaft ventilation: Disposable panel type
Performance when tested to AS 1324.2:
- Test Dust No. 4: ≥ 85% arrestance.

Controls
General: Provide the following functions:
- Temperature control for each zone located to accurately sense zone temperature.
- Fan speed selection for multi and variable speed fans.
- Time switch for each system with ≥ 6 temperature programs per day, separate programs for each day of the week, manual set point override and Vacation temperature set back.

2.7.2 Grilles and diffusers
General
Size and locate diffusers to provide even air distribution and temperatures without draughts.

Ceiling diffusers: Provide at least one per air-conditioned room and at least one per 12 m².

Construction:
- Variable volume diffusers: Powder coated pressed steel.
- All others: Powder coated aluminium.

Dampers: Provide a damper to each diffuser and grille. If connected by flexible duct, locate the damper at the duct spigot unless a damper in this position is inaccessible.

Return or exhaust grilles – indoor
Ceiling and wall louver type: Half chevron louvres at 25 mm maximum centres.

Egg crate type (ceiling use only): Elements at 90° to each other, and at 15 mm maximum centres.
Door grilles: Full chevron, 50% minimum free area. Frame to suit door thickness.

2.7.3 Fans

General
Guards: Provide galvanized steel or bronze mesh guards.
Steel components: Provide corrosion protection by zinc plating or better.
Motors in air stream: Direct mount to impellers with minimum thermal class of 155 (F) insulation to IEC 60085. Provide terminal boxes external to fan casings and wired to fan motors.
Motor minimum degree of protection: IP55.
Bearings: Provide sealed for life or grease packed bearings.
Balancing: Dynamically balance impellers.
Connections: Provide flexible duct connections at fan.

Roof mounted fans
Type: Centrifugal, mixed flow, axial flow aerofoil or propeller. Comply with the respective clauses above.
Housing: House fans in compact bases fitted with weathering skirts and manufactured from zinc-coated steel or UV stabilised plastic or composite.
Finish:
- Metallic-coated steel: UV stabilised powder coat to match roof colour.
- Other materials: Manufacturer's standard colour.

Vertical discharge fans: Provide weatherproof galvanized steel, plastic or aluminium backdraft dampers where the weather may enter when units are stopped.

Bird mesh: Where backdraft dampers are not fitted, provide bird mesh guards.

2.8 Execution

2.8.1 Ductwork

Standard
Ductwork: To AS 4254.

Rigid duct
Provide approved vermin screens over all duct penetrations to outside.

Flexible duct
Material: Aluminized fabric clamped on formed metal helix with insulation blanket wrapped around duct and covered with an outer vapour barrier.
Installation: Install flexible duct as straight as possible with minimum number of bends. Maximise bend radius. Check for and rectify any crushed flexible duct.

Support: To AS 4254. Limit sag to < 40 mm/m.

Duct insulation

General: Insulate ducts to reduce heat gain and prevent condensation. Provide continuous vapour barrier around ducts carrying conditioned air. Insulate flexible connections on ducts carrying air below ambient temperature.

Cleaning

Clean interior of ductwork progressively during installation.

Insulation and sealing: Notwithstanding the class of building, conform to BCA Spec J5.2.

2.8.2 Refrigeration pipework

General

Conform to equipment manufacturer’s recommendations for the refrigerant used.

Pipes: To AS/NZS 1571.

Deemed to comply: Split system manufacturer’s standard pre-charged piping kit

Provide all refrigerant pipe work and ancillaries for the proper operation of each system including any additional refrigerant charge if required.

Pipe insulation

General: Insulate all refrigerant and drain piping that may sweat with chemically blown closed cell nitrile rubber in tubular form to ASTM C534. Apply to manufacturer’s recommendations. Protect insulation from sunlight and mechanical damage.

Insulation thickness: 13 mm for pipes < DN 20, 19 mm otherwise.

Condensate drains

Requirements: Provide trapped ≥ DN 20 condensate drains to AS/NZS 3666.1 from each indoor coil and safety tray. Provide drains from each reverse cycle outdoor condenser coil unless casing freely drains to a roof or other location where condensate will not cause damage or pond.

2.8.3 Unit installation

General

Supply all components and install to manufacturer’s recommendations.

Outdoor equipment: Provide clearance around units for condenser air flow and maintenance access. Ensure discharge air does not short-circuit to condenser intake.

Equipment at ground level: Mount on 100 mm high concrete plinth or equivalent impervious material.

Duct connections: Provide internal or external flexible duct connections at indoor unit.
All electrical connections and wiring for the proper operation of the entire system.
All internal wall mounted units shall have power supplied to them from their associated outdoor units.
All model numbers for units scheduled on the drawings shall be used as a base only.
Contractor is to provide product of equivalent or better performance, if the installation of the scheduled unit is not possible.
Site deliveries, off-loading and hoisting of equipment and materials to the positions where they are.
Cost of wiring for temporary power, which may be required for temporary portable lighting.
All electrical control equipment and services for the operation of the heating, ventilation and air conditioning systems.
Cutting, patching, framing up, furring in, chasing and making good associated with the building construction for the passage of ductwork, pipes, conduits and grilles etc. Details are to be provided in the mechanical shop drawings.

Vibration isolation

Suspended units: Provide ≥ 4 metal spring or rubber-in-shear isolation mountings with ≥ 25 mm static deflection and 98% isolation efficiency.

Floor mounted units: Provide neoprene waffle pads. Bolt in place.

Safety trays

General: If leaks or condensation from equipment could cause nuisance or damage to the building or its contents, provide a galvanized steel safety tray under the equipment.
3. Completion

3.1 Commissioning
General: Commission the systems to manufacturer’s recommendations using instruments calibrated within the past 12 months. Check ductwork for leaks. Test all safety controls by simulating fault.

Air quantities: Balance systems to accord with design air quantities.

Tolerance on air quantities: Between +10% and -0% of the design air quantities.

Check list: Submit signed commissioning check list before the date for practical completion.

Painting and labelling of equipment as specified. Painting of all ducting, duct supports and equipment located externally of the building and on roofs of all buildings. No untreated items of plant, equipment or associated materials are to be used on this project.

Testing, commissioning and balancing of all systems and equipment supplied and installed under this specification.

3.2 Cleaning
General: Clean filters, outdoor coils, grilles and diffusers immediately before the dates for practical completion.

3.3 Operating and maintenance instructions
Requirements: Provide written operating and maintenance instructions containing:

- Contractor’s contact details for service calls.
- Manufacturer’s maintenance and operation literature.
- Manufacturer’s warranty certificates if the manufacturer’s warranty period is greater than the defects liability period.
- Description of day to day operation.
- Setting of time switches.
- Schedule of recommended maintenance.
- Provide workshop drawings for review and as-built documentation at project completion
- Provide operation and maintenance manuals and training of relevant to staff
- Provide 12 months defects liability period on the installation and manufacturers warranty on the equipment.

Record drawing: Provide a drawing of the system as installed.

3.3.1 Maintenance

General

Provide corrective and preventative maintenance on the installation.
Maintenance period: The greater of 12 months from the date of completion of commissioning of the systems and the duration of the Defects Liability Period.

The plant should have at least 12 months warranty and maintenance period to ensure it operates through the full range of cooling and heating seasons.

Corrective maintenance: Attend site and undertake corrective maintenance within 24 hours of receipt of verbal or written advice.

Preventative maintenance: Provide preventative maintenance recommended by the equipment manufacturer. Provide all materials including consumable items and refrigerant.

Summer preventative maintenance visit: Provide at least one preventative maintenance visit during the months of December, January or February. Carry out preventative maintenance and provide electronic data logger or thermo-hydrograph to record temperatures at one location in each zone a period of 7 days. Submit results. If the temperature recorded is outside the specified tolerance identify and correct the cause and repeat the test.

Maintenance reports: Provide a signed maintenance report setting out the work done and any measured values after each visit.

3.4 Warranties

General

The contractor shall provide a guarantee that:

- All equipment is of such capacity and is installed in such a manner that it shall satisfactorily perform the work specified
- The performance data for all equipment shall be as specified in the contract documents, or as detailed by the contractor in the tender form
- All equipment, unless otherwise specified or directed, shall be installed in accordance with the manufacturer's instructions and recommendations
- The contractor shall rectify, make good, and pay all associated costs arising from poor workmanship, incorrect installation of equipment and services, or if the performance data for all equipment is not met.

3.5 Training

Explain and demonstrate to the principal's staff the purpose, function and operation of the installations.
4. Selections

For Schedules – refer to CV0420791
GHD
133 Castlereagh St Sydney NSW 2000
T: 2 9239 7100 F: 2 9239 7199 E: sydmail@ghd.com.au
© GHD 2011
This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Document Status

<table>
<thead>
<tr>
<th>Rev No.</th>
<th>Author</th>
<th>Reviewer</th>
<th>Approved for Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Name</td>
<td>Signature</td>
</tr>
<tr>
<td>A - 60% issue</td>
<td>R. Jananayakam</td>
<td>H. Wilson</td>
<td>H. W*</td>
</tr>
<tr>
<td>B - 90% Issue</td>
<td>A. Awan</td>
<td>H. Wilson</td>
<td>H. W*</td>
</tr>
<tr>
<td>C-Issued for Tender</td>
<td>A. Awan</td>
<td>H. Wilson</td>
<td>H. W*</td>
</tr>
<tr>
<td>D-Re-issued for Tender</td>
<td>A. Awan</td>
<td>H. Wilson</td>
<td>H. W*</td>
</tr>
</tbody>
</table>
## Contents

1. Project Information  
   1.1 Definitions  
   1.2 The Project  
   1.3 Extent of works

2. Scope of Works  
   2.1 General  
   2.2 Specification Objectives  
   2.3 Obligations of Installer  
   2.4 Extent of Works  
   2.5 Contract Drawings  
   2.6 Pre Tender requirements  
   2.7 Setting out of works  
   2.8 Site Supply  
   2.9 Uniformity  
   2.10 Associated Works  
   3.3 Submissions  
   3.4 Submissions  
   3.5 Quality Assurance

4. Cable Support and Duct Systems  
   4.1 General  
   4.2 External Reticulation  
   4.3 Products  
   4.4 Execution  
   4.5 Selections

5. Earthing  
   5.1 General  
   5.2 Execution

6. Low Voltage Power Systems  
   6.1 General
12.3 Execution

13. Access Control
   13.1 Access Control

14. Public Address and Hearing Augmentation
   14.1 General

15. Completion
   15.1 Operation and maintenance manuals
   15.2 Record drawings
   15.3 Commissioning
   15.4 Cleaning
   15.5 Completion tests
   15.6 Training
   15.7 Maintenance

75
77
77
79
79
80
80
81
81
81
82
82
83
1. Project Information

1.1 Definitions

Client - TfNSW
Consulting Engineer - GHD
Works - Electrical Services as described in Section 2
Electrical Contractor - The company contracted to undertake the Electrical works

1.2 The Project

This project involves the Easy access upgrade to the existing Railway Station at Cardiff, NSW. This involves:
- station building,
- platform extension,
- pedestrian foot bridge
- Extension of the foot bridge to the carpark,

This specification covers the electrical works required for the new Cardiff Station.

1.3 Extent of works

This specification, together with the drawings are based upon the information available at the time of publication. The drawings are coordinated, where obvious, however this should not be relied upon as the basis of tender. Tenders must view the site and exercise there own initiative based on experience in respect to the commercial implications of installing conduits and pits and possible structural impediments. The contractor must allow in the tender return costs coordination of all services and systems with all other trades. Coordination must take place prior to any works on site. Any part of the installation which is not coordinated and requires relocation / repair will be at the cost of the contractor.

The extent of work comprises the completion of detailed design, supply, installation, testing, commissioning, maintenance and defects liability for the entire electrical services package.

The work shall include all necessary minor and incidental work required to implement the intent and meaning of this specification.

Whether or not the words "supply and install" appear in this specification, unless clearly excluded, all items of equipment for the complete installation are required and shall be supplied and installed.
1.3.1 Constraints

The following site constraints apply to the electrical services for this project:

- Exiting railway tracks and overhead wiring are adjacent to the new railway station. All works will need to be coordinated with the existing track and overhead wiring during the construction.
2. Scope of Works

2.1 General
This specification, together with the drawings is based upon the information available at the time of publication. The drawings are coordinated, where obvious, however this should not be relied upon as the basis of tender. Tenders must view the site and exercise there own initiative based on experience in respect to the commercial implications of installing conduits and pits and possible structural impediments. The contractor must allow in the tender return costs coordination of all services and systems with all other trades. Coordination must take place prior to any works on site. Any part of the installation which is not coordinated and requires relocation / repair will be at the cost of the contractor.

The extent of work comprises the completion of detailed design, supply, installation, testing, commissioning, maintenance and defects liability for the entire electrical services package.

The work shall include all necessary minor and incidental work required to implement the intent and meaning of this specification.

Whether or not the words "supply and install" appear in this specification, unless clearly excluded, all items of equipment for the complete installation are required and shall be supplied and installed.

2.2 Specification Objectives
The intent of this Specification and the associated documents is:

- To provide a clear statement of contractual requirements against which compliance can be assessed.
- To provide documentation for the Client to demonstrate what is being bought.
- To define the expectations upon the Contractor by the Consulting Engineer.
- To define the roles of the parties involved with the works.
- To enable other interested parties to assess their obligations and to understand expectations of them.
- To define the requirements of the installer with respect to Quality Assurance.

2.3 Obligations of Installer
In writing this specification the Consulting Engineer expects and relies upon the tenderers' possessing specialist trade expertise necessary to complete the works in accordance with the documentation.

In addition, the installer has the following obligations:

- To raise in good time, issues requiring design intent or clarification from the Consulting Engineer, particularly in respect to:
1. Interpretation of the design intent specification or drawings.
2. Problems in complying with the specification.
3. Omissions from the tender documents.

- To certify compliance with contract documents, including all variation instructions, at Practical Completion.
- To certify compliance with Authority requirements, as far as he/she can ascertain.
- To implement procedures to ensure that only competent tradesmen are used for the works.
- To be cognisant of the role of all relevant parties during the construction phase of the project and to assist them in the conduct of their duties wherever possible.
- To contribute, in the spirit of partnering, towards the successful execution of the contract.
- To provide manufacturer's and construction drawings.
- To make final equipment selections to meet the requirements listed.

2.4 Extent of Works

This section of the specifications details the requirements of the work included in the Electrical Services, but is not limited to, the following:

- Obtain supply authority approval prior to construction, obtain easement as required and pay all costs associated with the supply authority.
- Supply and install new submain cabling from Installation Main Switchboard (IMSB) to new station building distribution board (DB-1) located in store room.
- Supply and install new site distribution boards as indicated on the drawings.
- Supply and install new submains to all equipment as indicated on the drawings. Provide fire rated submains to the lifts and the IMSB.
- Supply and install a new 16kW Uninterruptible Power Supply (UPS), with an external maintenance by pass switch, and 30 minute battery autonomy at end of life confirm with TINSW before installation.
- Supply and install underground conduits for all electrical and communications cable reticulation.
- Supply and install cable duct systems with clip on lids for power and data cable reticulation beneath the platform awnings.
- Provide draw wire for all conduits to allow for future cable reticulation.
- Supply and install electrical and communications pits for all underground cable reticulation. Provide drainage to all cable pits via rubble drains.
- Allow for all trenching and backfilling for underground cable reticulation.
- Provide power and communications cable paths via the overbridge for cable reticulation across the tracks, coordinate with structural.
- Provide a complete earthing system for the electrical distribution system in accordance with AS 3000. Provide equipotential bonding to all metallic pipe work.
- Provide new lighting throughout. Provide all luminaires complete with lamp and accessories. Supply and install all brackets and light poles.
- Provide underground cable reticulation paths for all external pole mounted light fittings.
- Supply and install a complete lighting control system for external lighting, with override controls.
- Provide local lighting controls for the individual rooms in the station building.
- Supply and install all required electrical subcircuits.
- Supply and install all electrical outlets and accessories. Final location of all outlets and accessories to be confirmed on site.
- Provide a CAT 6 structured cabling system for all data/telephone points.
- Provide power circuits to mechanical and hydraulic services.
- Supply and install a complete Public Address (PA) system on the platforms and the overbridge.
- Supply and install an array hearing induction loops on the platforms.
- Supply and install a smoke detection system in the station building. Provide a fire panel in the equipment room to automate call outs in the event of fire.
- Supply and install an access controls and intruder detection system. Provide electronic access via proximity cards to all rooms.
- Supply and install a complete CCTV system. Locate cameras as positioned on the drawings, and as documented in the security report to achieve the desired coverage.
- Coordinate the location of services with all other service trades to avoid clashes.
- Provide shop drawings for approval prior to commencing any works on site.
- Test and commission all equipment.
- Provide as-built drawings.
- Provide a operation and maintenance manual for all installed equipment
- Submit test reports, provide client with all test results, bound for review. The certificate for practical completion will only be signed after the complete test reports have been reviewed including hard and soft copy of the full test reports in the operation and maintenance manuals.

The contractor shall:
• Coordinate the electrical services with all other trades.
• Liaise with local authorities for all inspections.
• Review all works for compliance with the specifications prior to calling for inspections.
• Review all submissions prior to submitting the items to the superintendent.

2.5 Contract Drawings
The electrical services drawings that accompany this Specification shall be referred to herein as 'the drawings' or 'the Contract drawings'.

The electrical drawings shall be read in conjunction with this specification.

2.6 Pre Tender requirements

• It is the Electrical Contractor's responsibility to inspect the site to establish the extent, nature and constraints.
• The Electrical Contractor shall be responsible for becoming familiar with all staging of the works.
• The Electrical Contractor shall become familiar with all temporary works required during the construction period.
• The information shown on the drawings will not necessarily be complete and the Tenderer shall obtain any other available drawings referenced to satisfy himself the full extent of work.

2.7 Setting out of works

• The position of all equipment shown on the drawings is to be taken as approximate only and the exact positions shall be ascertained prior to installation on site.
• It is the Electrical Contractor's responsibility to ensure that the setout of the electrical installation presents an ordered appearance and coordinates with the structure and other services. In heavily serviced areas the Electrical Contractor shall prepare layout drawings showing dimensioned setout and RL's of electrical equipment and submit these for approval.

2.8 Site Supply
The site supply will be managed and installed by TfNSW.

2.9 Uniformity
All electrical equipment shall as follows:
- Power: All products of the same type are to be of the same manufacturer.
- Lighting: All products as per luminaire schedule.

## 2.10 Associated Works

### 2.10.1 General

"Associated work" is defined as work required to be provided by other trades in order to ensure completion of the electrical services works.

<table>
<thead>
<tr>
<th>Trade</th>
<th>Works provided for others</th>
<th>Works provided by others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Services</td>
<td>Provide submains for mechanical services switchboard. Coordination with mechanical Contractor of all ceiling services and in ceiling services.</td>
<td>Sub main cable shall be terminated by the Mechanical contractor who shall provide all lugs, cable glands and gland plates as required. Mechanical contractor to confirm selected equipment loadings to ensure correct sub main cable and breaker sizing to mechanical services switchboards and equipment.</td>
</tr>
<tr>
<td>Hydraulic Services</td>
<td>Supply and install power cabling and isolators / outlets for connection of hydraulic services equipment including pumps, filters, hot water units, chilled/boiling water units etc.</td>
<td>Hydraulic contractor shall coordinate with the Electrical contractor to confirm selected equipment loadings to ensure correct outlet ratings and cable sizes.</td>
</tr>
<tr>
<td>Equipment Racks</td>
<td>Provide captive socket outlets in equipment room</td>
<td>Equipment/system vendors shall supply racks and rack mounted equipment</td>
</tr>
</tbody>
</table>
3. General Requirements

3.1 Design

3.1.1 General
Provide all design work necessary to complete the electrical services documentation to work shop fabrication level.

Use only appropriately experienced and qualified persons to undertake electrical design work. If requested, provide documents verifying the qualification and experience.

3.1.2 Design Criteria

<table>
<thead>
<tr>
<th>Item</th>
<th>Standards</th>
<th>Design Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply conditions</td>
<td>AS 3000</td>
<td>415/240 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50 Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>125% of initial maximum demand</td>
</tr>
<tr>
<td>Reticulation Design</td>
<td>AS 3439.1</td>
<td>Volt Drop (max)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Consumer mains &lt; 1.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Submains approx &lt; 2.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Final sub-circuits, &lt; 2.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All cabling shall utilise copper conductors</td>
</tr>
<tr>
<td>IMSB</td>
<td></td>
<td>IMSB TO BE INSTALLED BY TFNSW</td>
</tr>
<tr>
<td>Item</td>
<td>Standards</td>
<td>Design Criteria</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Distribution Boards</td>
<td>AS 3439.1</td>
<td>Final subcircuit protection -Miniature cb's, &lt; 100 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rating 25% above initial load</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Local Main Switch Isolator Form 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Construction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minimum 160A main switch and busbar chassis rating (final sizing to be confirmed during detailed design)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25% spare pole capacity after initial loads</td>
</tr>
<tr>
<td>Consumer Mains</td>
<td>AS/NZS 3000 and AS/NZS 3008.1.1</td>
<td>Fire rated to WS52 classification</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Max. Demand + 25% spare capacity</td>
</tr>
<tr>
<td>Submains</td>
<td>AS/NZS 3000 and AS/NZS 3008.1.1</td>
<td>Capacity maximum demand + 25% spare capacity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lift submains will be WS52 classification.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduced neutral shall not be utilised</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 core less than 35mm2 cabling, single core cabling to be used for 50mm2 and larger.</td>
</tr>
<tr>
<td>Earthing</td>
<td>AS/NZS 3000 and EP 12 10 00 21 SP - Low voltage Installations Earthing</td>
<td>Earth cabling to meet the requirements of the relevant standards</td>
</tr>
<tr>
<td>Final subcircuits</td>
<td>AS/NZS 3000 and AS/NZS 3008.1.1</td>
<td>Power 2.5mm2 minimum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lighting 2.5mm2 minimum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Max 80% utilisation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Initial spare outlet capacity of 25%.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Final lighting and general power circuits will be supplied using 30mA RCD circuit breakers.</td>
</tr>
</tbody>
</table>
### Design Criteria

<table>
<thead>
<tr>
<th>Item</th>
<th>Standards</th>
<th>Design Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uninterruptible Power Supply Systems</td>
<td></td>
<td>Circuit breaker protecting UPS to be selected to handle inrush current and battery recharging</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UPS equipment to be sized for initial load + 25% spare.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Autonomy time 30 minutes at end of life</td>
</tr>
</tbody>
</table>

### Lighting Levels

All lighting levels are to comply with TfNSW Requirements as set out below.

The following lighting design criteria have been extracted from Part E technical requirements provided by TfNSW for Cardiff Station.

<table>
<thead>
<tr>
<th>Location</th>
<th>Lighting Level (Lux)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car Parks:</td>
<td></td>
</tr>
<tr>
<td>Covered areas</td>
<td>50</td>
</tr>
<tr>
<td>Open Areas</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Bus-Rail Stations:</td>
<td></td>
</tr>
<tr>
<td>Covered Areas</td>
<td>50</td>
</tr>
<tr>
<td>Open Areas</td>
<td>20</td>
</tr>
<tr>
<td>Pathways</td>
<td>50</td>
</tr>
<tr>
<td>External approaches</td>
<td>85</td>
</tr>
<tr>
<td>Covered areas, entrance halls &amp; verandas</td>
<td>150 – 200</td>
</tr>
<tr>
<td>Awnings on platforms</td>
<td>100</td>
</tr>
<tr>
<td>Platforms</td>
<td></td>
</tr>
<tr>
<td>- underground</td>
<td>150</td>
</tr>
<tr>
<td>- open</td>
<td>50</td>
</tr>
<tr>
<td>Location</td>
<td>Lighting Level (Lux)</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Waiting rooms</td>
<td>150 – 200</td>
</tr>
<tr>
<td>Overbridges</td>
<td>150</td>
</tr>
<tr>
<td>Stairs (covered)</td>
<td>150</td>
</tr>
<tr>
<td>Stairs (uncovered)</td>
<td>150</td>
</tr>
<tr>
<td>Subways</td>
<td>100</td>
</tr>
</tbody>
</table>

The above levels are minimum average service illuminance after lamp and dirt depreciation factors (maintenance factor of 0.75) are allowed for.

The minimum illumination on open platforms shall not be less than 30 lux and the uniformity shall not be less than 0.5 (ratio of the minimum illumination level to the average illumination level).

3.2 Standards

3.2.1 Australian Standards

The Australian Standards listed below, including latest amendments, shall apply to the design:

<table>
<thead>
<tr>
<th>Standard Number</th>
<th>Standard Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCA 2010</td>
<td>Building Code of Australia</td>
</tr>
<tr>
<td>AS/NZS 1125:2001</td>
<td>Conductors in insulated electric cables and flexible cords</td>
</tr>
<tr>
<td>AS 2184</td>
<td>Low voltage switchgear and controlgear - Moulded-case circuitbreakers for rated voltages up to and including 600 V a.c. and 250 V d.c.</td>
</tr>
<tr>
<td>AS 3000</td>
<td>Electrical Installations - (SAA Wiring Rules)</td>
</tr>
<tr>
<td>AS/NZS 3008.1.1</td>
<td>Electrical Installations - Selection of Cables</td>
</tr>
<tr>
<td>AS/NZS 3013</td>
<td>Electrical installations - Wiring systems for specific applications</td>
</tr>
<tr>
<td>AS/NZS 3017</td>
<td>Electrical installations – Testing guidelines</td>
</tr>
<tr>
<td>AS 3439.1</td>
<td>Low voltage switchgear and control gear assemblies</td>
</tr>
<tr>
<td>AS 3851</td>
<td>The calculation of short-circuit currents in three-phase a.c. systems</td>
</tr>
<tr>
<td>AS 3947.2</td>
<td>Low voltage switchgear and control gear – General Rules</td>
</tr>
<tr>
<td>AS 3947.1</td>
<td>Low voltage switchgear and control gear – Circuit breakers</td>
</tr>
<tr>
<td>Standard Number</td>
<td>Standard Name</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>AS 3947.5.1</td>
<td>Low voltage switchgear and control gear – Control circuit devices and switching elements – Electromechanical control circuit devices</td>
</tr>
<tr>
<td>AS 3947.6.1</td>
<td>Low Voltage Switchgear and Control gear</td>
</tr>
<tr>
<td>AS 60529</td>
<td>Degrees of protection provided by enclosures for electrical equipment (IP Code)</td>
</tr>
<tr>
<td>AS 5000.1</td>
<td>Approval and Test Specification - Electric Cables</td>
</tr>
<tr>
<td>AS/NZS 61000</td>
<td>Electromagnetic Compatibility (EMC) series of standards</td>
</tr>
<tr>
<td>AS/NZS 1680</td>
<td>Interior and Workplace Lighting</td>
</tr>
<tr>
<td>AS/NZS 1158</td>
<td>Lighting for Roads and Public Spaces</td>
</tr>
</tbody>
</table>

### 3.2.2 TfNSW Engineering Standards

The TfNSW Engineering Standards listed below shall apply to the design:

<table>
<thead>
<tr>
<th>Standard Number</th>
<th>Standard Name</th>
<th>Rev</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESB 004</td>
<td>Station Services and Systems</td>
<td>1.1</td>
<td>May 2010</td>
</tr>
<tr>
<td>EP 17 00 00 11 SP</td>
<td>Low Voltage Isolation Transformer</td>
<td>3</td>
<td>May 2010</td>
</tr>
<tr>
<td>EP 12 10 00 11 SP</td>
<td>Distribution Substation Earthing</td>
<td>3</td>
<td>May 2010</td>
</tr>
<tr>
<td>EP 00 00 00 13 SP</td>
<td>Electrical Power Equipment – Design Ranges of Ambient Conditions</td>
<td>2</td>
<td>May 2010</td>
</tr>
<tr>
<td>EP 00 00 00 15 SP</td>
<td>Common Requirements for Electrical Power Equipment</td>
<td>3</td>
<td>May 2010</td>
</tr>
<tr>
<td>EP 12 10 00 20 SP</td>
<td>Low Voltage Distribution Earthing</td>
<td>3</td>
<td>May 2010</td>
</tr>
<tr>
<td>EP 12 10 00 21 SP</td>
<td>Low Voltage Installations Earthing</td>
<td>3</td>
<td>May 2010</td>
</tr>
<tr>
<td>EP 20 00 00 03 SP</td>
<td>Above Ground Cable Installation Systems – Selection Guide</td>
<td>1.1</td>
<td>May 2010</td>
</tr>
<tr>
<td>EP 00 00 00 16 SP</td>
<td>Electrical Power Systems Signage</td>
<td>2</td>
<td>May 2010</td>
</tr>
<tr>
<td>EP 20 00 03 01 SP</td>
<td>Requirements for Cable Polymeric Terminations and Joints</td>
<td>2</td>
<td>May 2010</td>
</tr>
<tr>
<td>EP 20 00 04 01 SP</td>
<td>Cable Route Selection Guide</td>
<td>2</td>
<td>May 2010</td>
</tr>
</tbody>
</table>
### 3.2.3 TfNSW Drawings – Standard

The TfNSW Drawings listed below shall apply to the design:

<table>
<thead>
<tr>
<th>Drawing Number</th>
<th>Drawing Name</th>
<th>Rev</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>EL 0474151</td>
<td>Distribution Padmount Substation Low Voltage Switchboard (DSMSB) General Arrangement</td>
<td>A</td>
<td>-</td>
</tr>
<tr>
<td>EL 0494646</td>
<td>415V/415V Padmount Isolating transformer Schematic Diagram</td>
<td>A</td>
<td>-</td>
</tr>
<tr>
<td>EL 0480479</td>
<td>415V/415V Padmount Isolating transformer General Arrangement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EL 0474149</td>
<td>Distribution Padmount Substation Double Insulated Metering Panel General Arrangement</td>
<td>A</td>
<td>-</td>
</tr>
<tr>
<td>EL 0474159</td>
<td>Distribution Padmount Substation type R Kiosk Assembly General Arrangement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EL 0455387</td>
<td>TfNSW 415V/415V Padmount Assembly Minimum Requirements information Footprint Arrangement.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 3.3 Submissions

**General**

Default timing: Make submissions with notice before ordering products for, or starting installation of, the respective portion of the works.

Program: Allow in the construction program for at least the following times for response to submissions:

- Shop drawings: 2 weeks.
- Samples and prototypes: 2 weeks
- Manufacturers' or suppliers' recommendations: 2 weeks
- Product data: 2 weeks
- Product/design substitution or modification: 2 weeks.

Proposed products schedules: If major products are not specified as proprietary items, submit a schedule of those proposed for use within 3 weeks of site possession.

3.4 Submissions
- Shop drawings prior to any works onsite.
- Certified schedule of compliance for all equipment, prior to placing orders.
- Certified schedule of competency for all tradesmen intended to work on the project.
- Factory test results where applicable.
- All product data, performance test and commissioning results required by this specification.
- Inspection and test plans for every section of the works. Detail the procedure of how to complete the task, the skill or competency of the person undertaking the works, the review or testing procedure to assure satisfactory completion of the task, the person within the installer's organisation authorised to sign-off the task as accepted.
- Client handover/training proposals.
- Record and installation drawings: Record all changes to equipment and services layouts, wiring and any other items during the construction period, which may have been incorporated into these works.
- Operating and Maintenance manuals.
- Certifications for compliance with project specific Code/Design requirements of the completed works.
- Maintenance and servicing during the defects liability period.
- Details of connections to external interfaces and components.
- Certification of the entire installation.

3.4.1 Shop & As-built Drawings
- Minimum drawing size shall be at least A1.
- Standard: To AS 1100 Parts 101, 201, 301, 401 and 501 as applicable.
- Submissions: The following drawings shall be submitted:
  - Workshop drawings for review prior to construction
  - As-Built drawings prior to project completion
Prior to commencement of any works on site, submit three (3) hard copies of the following workshop drawings to the Project Manager.

Shop drawings are required to detail all elements of the electrical installation works, which include, but are not limited to the following:

- Distribution boards including main switchboard (shop drawing level)
- Cable schedules
- Site plan reticulation layouts and support systems details
- Lighting layouts and support system details
- Lighting control details.

Data to be submitted: Include at least the following information in technical submissions:

- Assumptions.
- Calculations.
- Certification of compliance with the applicable code or standard.
- Design basis and performance parameters.
- Drawings.
- Installation and maintenance requirements.
- Manufacturers' technical literature.
- Risk assessment.
- Samples where relevant.
- Sketch, single line diagram, flowchart.
- Technical data schedules corresponding to the equipment schedules in the contract documents. If there is a discrepancy between the two, substantiate the change.

All as-built drawings shall be provided as hard copies, PDF's and in AutoCAD dwg format.

3.4.2 Authorities

Authorities' approvals: Submit documents showing approval by the authorities whose requirements apply to the work.

Correspondence: Submit copies of correspondence and notes of meetings with authorities whose requirements apply to the work.

3.4.3 Hard copy submissions

Standard contract drawing size: A1
3.4.4 Errors
General: If a submission contains errors, make a new or amended submission as appropriate, indicating changes made since the previous submission.

3.4.5 Inspection and testing plan
General: Submit an inspection and testing plan which is consistent with the construction program. Include particulars of test stages and procedures.
Test reports: Submit written reports on nominated tests.

3.4.6 Materials and components
Product certification: If products must conform to product certification schemes, submit evidence of conformance.
Product data: For proprietary equipment, submit the manufacturer's product data as follows:
- Technical specifications and drawings.
- Type-test reports.
- Performance and rating tables.
- Recommendations for installation and maintenance.
- Additional product data for services equipment:
  - Model name, designation and number.
  - Country of origin and manufacture.
  - Capacity of all system elements.
  - Size, including required clearances for installation.
  - Materials used in the construction.

3.4.7 Substitution
Identified proprietary items: Identification of a proprietary item does not necessarily imply exclusive preference for the item so identified, but indicates the necessary properties of the item.
Alternatives: If alternatives to the documented products, methods or systems are proposed, submit sufficient information to permit evaluation of the proposed alternatives, including the following:
- Evidence that the performance is equal to or greater than that specified.
- Evidence of conformance to a cited standard.
- Samples.
- Essential technical information, in English.
- Reasons for the proposed substitutions.
- Statement of the extent of revisions to the contract documents.
- Statement of the extent of revisions to the construction program.
- Statement of cost implications including costs outside the contract.
- Statement of consequent alterations to other parts of the works.

Availability: If the documented products or systems are unavailable within the time constraints of the construction program, submit evidence.

Criteria: If the substitution is for any reason other than unavailability, submit evidence that the substitution:
- Is of net enhanced value TNSW.
- Is consistent with the contract documents and is as effectual as the identified item, detail or method.

3.4.8 Samples
Submission: Submit nominated samples.
Incorporation of samples: If it is intended to incorporate samples into the works, submit proposals. Incorporate samples in the works which have been endorsed for incorporation. Do not incorporate other samples.
Retention of samples: Keep endorsed samples in good condition on site, until practical completion.

3.4.9 Certification
Submit certification that the plant and equipment submitted meets all requirements and capacities of the contract documents except for departures that are identified in the submission.

3.5 Quality Assurance
A Quality Assurance plan shall be provided in order to propose, establish, maintain, monitor and document a quality assurance system covering all aspects of the design, purchase, fabrication, installation and completion of the works. The plan shall be in accordance with ISO 9001

A designated Project Quality Inspector shall be appointed to execute the quality plan, which must include the following minimum:
- Check all shop drawings for conformance to requirements prior to submission.
- Check equipment compliance schedule against the particular specification requirements and equipment schedules prior to submission.
  - Check all samples for conformance to requirements prior to submission.
  - Check all tests required for proper manufacturing of the equipment.
- Check all manufactured items for compliance prior to dispatch to site.
- Check installation of all items fixed under this specification.
- Check all materials, welding, joining, terminations, fixing and finishes.
- Check all on-site tests required to commission the works.
- Check operating and maintenance manuals to ensure they contain adequate information to permit systems to be operated by the Client at the end of defects liability period. (Including adequate training and tuition of the client's representative.)
- Submit the following documentation:
  - Quality System third party certification, if any, to the Standards specified by the Joint Accreditation System of Australia and New Zealand.
  - Quality manual detailing, corporate QA. policy statement, system element description and register of procedures.
4. Cable Support and Duct Systems

4.1 General
Arrangement: Arrange services so that services running together are parallel with each other and with adjacent building elements.
Fixing: If non-structural building elements are not suitable for fixing equipment and services to, fix directly to structure and trim around holes or penetrations in non-structural elements.
Installation: Install equipment and services plumb, fix securely and organise reticulated services neatly. Allow for movement in both structure and services.
Lifting: Provide heavy items of equipment with permanent fixtures for lifting as recommended by the manufacturer.

4.1.1 Aims

Responsibilities
General: Provide cable support, trunking and duct systems as documented.

4.1.2 Cross references

General
General: Conform to the General requirements worksection.

Associated worksections
Associated worksections: Conform to the following:
- Electrical general requirements.

4.1.3 Submissions

Shop drawings
General: Submit shop drawings showing the following:
- Cable tray and trunking routes.
- Layout of cable supports and enclosures on the current architectural background coordinated with the structure and other services.
- Layout of underground conduits, pits and drainage trenches.
- Invert levels for underground conduits.
- Depth of burial for cables and conduits.
- In situ pits.
• Provision for expansion and ground movement.
• Fabricated columns.
• Footing for columns.

Technical data
General: Submit technical data for the following:
• Ducted wiring enclosure systems.
• Cable support systems.
• Proprietary pits.
• Proprietary columns.

4.2 External Reticulation

4.2.1 Site Reticulation
• Provide new underground conduits for cable reticulation throughout the site for power and comms. Allow sufficient space capacities within the conduits to allow for future reticulation.
• Provide draw wire for all conduits.
• Routes shown on the drawings are indicative only. The electrical contractor shall be responsible for determining routes which do not clash with other services and structural elements.

4.2.2 Trenches
• Backfilling: Place backfill in layers not exceeding 200 mm loose thickness and compact to the required density.
• Backfill soil thermal resistivity: Where the thermal resistivity of the excavated soil exceeds 1.2 K.m/W backfill trench with either cement-bound sand or gravel in accordance with AS 3008.1.

4.2.3 Under roadways
• Under roadways and areas subject to traffic movement, install cables in a duct or conduit extending to not less than 1 m on either side of the sealed surface or trafficable area.
• Minimum depth: 500mm

4.2.4 Sealing ducts, pipes and conduits
Seal the buried entries to ducts, pipes and conduits with a pliable non-setting waterproof compound. Seal spare ducts, pipes or conduits immediately after installation, and seal the others after the cable installation.
4.2.5 Survey
Prior to backfilling accurately record the routes of underground cables.

4.2.6 Location marking
Accurately mark the location of underground cables by route markers consisting of a marker plate set flush in a concrete base not less than 200 mm diameter x 200 mm deep, placed at each joint, route junction, change of direction, termination and building entry point and in straight runs at intervals of not more than 100 m.

4.2.7 Cable Pits
- Provide covers to meet the requirements of the surrounding environment in accordance with to AS 3996. Minimum C class pits and lids.
- Provide drainage from the bottom of all cable pit to an absorption trench filled with rubble or to the storm water drainage system.
- Absorption trench: Minimum size 300 x 300 x 2000 mm.
- Suitably label pits “ELECTRICITY” or “COMMUNICATIONS”
- Pit lids on platforms are to be the infill type.

4.3 Products

4.3.1 Conduits
General
Standards: AS/NZS 2053 Parts 1, 2, 3, 4, 5, 6, 7 and 8.

Type
General: Rigid.

Fixings
Saddles: Double sided fixed.

Colour
Conduits for telecommunications systems: White.
Conduits for Electrical systems: Electric orange.

Galvanized water pipe
Medium or heavy: To AS 1074.
4.3.2 Metallic conduits and fittings

General
Standards: AS/NZS 2053.7 or AS/NZS 2053.8.

Type
General: Screwed steel.

Fixings
Saddles:
- Internal: Zinc plated.
- External: Hot-dipped galvanized.

Corrosion protection
Steel conduits: Paint ends and joint threads with zinc rich organic primer to AS/NZS 3750.9.

4.3.3 Non-metallic conduits and fittings

General
Standards: Non-metallic conduits and fittings: AS/NZS 2053 Parts 2, 3, 4, 5 or 6.
Solar radiation protection: Required for conduits and fittings exposed to sunlight.

Flexible conduit
General: Provide flexible conduit to connect with equipment and plant subjected to vibration. If necessary, provide for adjustment or ease of maintenance. Provide the minimum possible length.

Associated fittings
Type: The same type and material as the conduit.
Wall boxes on UPVC conduits: For special size wall boxes not available in UPVC, provide prefabricated earthed metal boxes.

Inspection fittings
General: Provide inspection-type fittings only in accessible locations and where exposed to view.

Joints
Type: Cemented or snap on joints.
4.3.4 Cable duct/trunking

General

Standards:
- Cable duct/trunking systems: To AS/NZS 4296.

Cable duct

Material: Metal.

Material finish: Metallic-coated to AS 1397 Grade G2, Coating Class Z275.

Construction: Solid.

Covers:
- Accessible locations: clip-on type removable only with the use of tools.

Accessories: Purpose-made to match the duct system.

Cable support: Except for horizontal runs where the covers are on top, support wiring with retaining clips at intervals of not more than 1000 mm.

Proprietary trunking systems

General: Provide proprietary, skirting duct, wall duct, floor duct and service column systems, incorporating segregation where used for multiple services. Provide rigid supports. Round off sharp edges and provide bushed or proprietary cable entries into metallic trunking.

Accessories: Provide proprietary fixings and mountings facilities for accessories and outlets.

Covers: Screw-fixed or clip-on type removable only with the use of tools.

4.3.5 Cable tray/ladder support systems

General

System: Provide a complete cable support system consisting of trays or ladders and including brackets, fixings and accessories.

Selection: Run cables < 13 mm diameter on cable trays or in ducts.

Standard: NEMA VE-1.

Type tests: To NEMA VE-1.

Manufacture: Provide proprietary trays, ladders, fittings and accessories from a single manufacturer for the same support system.

Selection: Select cable tray/ladder in conjunction with support system installation to achieve the documented loading and deflection requirements.

Spare capacity: ≥ 25%.

Support:
- Power cables: Trapeze or centre rail structure.
- Communications cables: Single sided.

Dimensions: To the preferred dimensions nominated in NEMA VE-1.

Material: Corrosion-resistant finished steel.

Material finish: Metallic-coated to AS 1397, Grade G2, Coating Class Z275.

Covers: Provide ventilated flat covers to cable trays/ladders installed in accessible locations.

4.3.6 Catenary systems

General

Catenary systems: May be used within suspended ceiling spaces in lieu of cable tray and ladder systems.

Wire: Provide stainless steel or coated galvanized cable and couplings for catenary systems.

4.3.7 Cable pits

General

Cable draw-in pits: Provide. Sizes given are internal dimensions.

Proprietary cable pits

Pits ≤ 1200 x 1200 mm: Provide proprietary concrete or polymer moulded pits.

Pit covers

General: Provide pit covers to suit external loads. Fit flush with the top of the pit.

Standard: To AS 3996.

Weight: < 40 kg for any section of the cover.

Lifting handles: Provide a lifting handle for each size of cover section.

Drainage

General: Provide drainage from the bottom of cable pits, either to absorption trenches filled with rubble or to the stormwater drainage system.

Absorption trenches: Minimum size 300 x 300 x 2000 mm.

4.3.8 Columns

General

Columns: Conform to the following for fabricated columns more than 2400 mm high which are designed to support accessories outdoors.

Standards: Comply with the following standards as appropriate:
- AS 1798 for public lighting poles.
- AS 3600 for concrete structures.
- AS 4100 for steel structures.
- AS/NZS 4676 for structural design of columns.
- AS 4680 for hot-dipped galvanized (zinc) coatings on ferrous articles.

4.4 Execution

4.4.1 Conduit systems — installation

Set out
General: If exposed to view, install conduits in parallel runs with right angle changes of direction.

Bends
General: Install conduits with the equivalent of ≤ 2 right angled bends per cable draw-in run.

Conduits in roof spaces:
General: Locate below roof insulation and sarking. In accessible roof spaces, provide mechanical protection for light-duty conduits.

Inspection fittings
General: Locate in accessible positions.

Draw cords
General: Provide 5 mm² polypropylene draw cords for all conduits with spare capacity.

Expansion
General: Allow for thermal expansion/contraction of conduits and fittings due to changes in ambient temperature conditions. Provide expansion couplings as required.

Rigid conduits
General: Provide straight long runs, smooth and free from rags, burrs and sharp edges.

Routes
General: Run conduits concealed in wall chases, embedded in floor slabs or installed in inaccessible locations directly between points of termination.

Conduits in concrete slabs
Route: Do not run in concrete toppings. Do not run within pretensioning cable zones. Cross pretensioning cable zones at right angles. Route to avoid crossovers and minimise the number of conduits in any location. Space parallel conduits ≥ 50 mm apart.
Minimum cover: The greater of the conduit diameter and 20 mm.
Fixing: Fix directly to top of the bottom layer of reinforcing.

**Hollow-block floors**
Locate conduits in the core-filled sections of precast hollow-block type floors.

**Columns**
Confirm with structural all conduits in columns, conduits in columns:
- \( \leq 4 \) per column.
- \( \leq 80 \) mm diameter.
- Locate conduits centrally in each column.

Bends: Enter columns via \( \geq 150 \) mm radius sweep bends. Do not use elbows.
Chasing: Do not chase columns.

### 4.4.2 Cable tray/duct/ladder support systems – installation

**General**
Standard: To NEMA VE-2.
Design: Support cable trays/ladders to achieve the in accordance with the manufacturers specification and the below:
- Concealed trays/ladders: Support spacing \( \leq \) length of tray/ladder section.
- Visible trays/ladders: Loaded deflection \( \leq \frac{\text{span}}{350} \).

**Fixing to building structure**
General: Fix supports to the building structure or fabric by means of \( \geq 8 \) mm threaded rod hangers attached to hot-dipped galvanized U-brackets, or by means of proprietary brackets.

**Cable fixing**
General: Provide strapping or saddles suitable for fixing cable ties.

**Bend radius**
General: Provide bends with an inside radius \( \geq 12 \) times the outside diameter of the largest diameter cable carried.

**Cable protection**
General: Provide rounded support surfaces under cables where they leave trays or ladders.

**Access**
General: Locate trays and ladders to provide \( \geq 150 \) mm free space above and \( \geq 600 \) mm free space on at least one side.
Clearances
From hot water pipes: > 200 mm.

EMI: Locate support systems for electrical power cabling and communication cabling to minimise electromagnetic interference.

4.4.3 Cables in trenches – installation

Sand bed and surround
General: Provide clean sharp sand ≥ 150 mm around cables and conduits installed underground.

Sealing ducts and conduits
General: Seal buried entries to ducts and conduits with waterproof seals. Seal spare ducts and conduits immediately after installation. Seal other ducts and conduits after cable installation.

4.4.4 Columns – installation

General
General: Install columns as documented including the provision of in situ reinforced concrete footings to the Wiring enclosures and cable support systems schedule.

4.5 Selections

4.5.1 Wiring enclosures and cable support systems schedule

<table>
<thead>
<tr>
<th>Cable trays/ladders</th>
<th>Ezystrut or approved equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>Galvanized steel</td>
</tr>
<tr>
<td>Finish</td>
<td>Galvanized steel</td>
</tr>
<tr>
<td>Dimensions</td>
<td>As shown on drawings</td>
</tr>
<tr>
<td>Usable width</td>
<td>As shown on drawings</td>
</tr>
<tr>
<td>Usable depth</td>
<td>50 mm minimum</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cable duct</th>
<th>Esco Industries, Cableway or approved equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>Galvanized steel</td>
</tr>
<tr>
<td>Finish</td>
<td>Galvanized steel</td>
</tr>
<tr>
<td>Dimensions</td>
<td>As shown on drawings</td>
</tr>
<tr>
<td>Usable width</td>
<td>mm minimum</td>
</tr>
<tr>
<td>Usable depth</td>
<td>100 mm minimum</td>
</tr>
</tbody>
</table>
5. Earthing

5.1 General
Provide a complete earthing system for the installation, in accordance with TfNSW Standards. Provide a separate earthing conductor with each sub-main.

The main earth conductor will be installed by TfNSW at the Distribution Supply Main Switchboard (DSMSB). A Multiple Earthed Neutral (MEN) link will be provided between the main earth bar and the main neutral bar at the DSMSB.

Full sized earth cable will be reticulated from the DSMSB to the Installation Main Switchboards (IMS) will be installed by TfNSW.

Copper earth conductors will be used to link the earth bars of all distribution boards back to the ISMSB. The minimum earth conductor for submains cables will be 16mm².

Each rack within the equipment room shall be individually connected to earth link bar by a 6.0mm² copper conductor.

Earthing of LV subcircuits will be provided as per the requirements of AS/NZS3000 and the minimum fault loop impedance.

5.2 Execution

5.2.1 Tests
- Testing: Submit an earth resistance test report detailing the testing of the earth resistance and the results of that test. If the measured earth resistance is outside specification provide proposals for additional earthing to reduce the resistance.
- Test Point: Measure earth resistance for the earth pits before all bonding connections are connected.

5.2.2 Earthing Terminal Bars
- Terminations shall comprise cable lugs bolted to terminal bar with stainless steel nuts bolts and locknuts.
- Provide a tinned copper earthing terminal bar mounted on standoff insulators and predrilled for 25% additional terminations.
- Label each cable terminating on the terminal bar and numbers stamp each termination.

5.2.3 Switchboards
- Effectively earth all metal work in the vicinity of the switchboards. Do not earth equipment via the neutral bus or the neutral earth connection.
- Where items of equipment (push buttons, instruments or switches) are mounted on doors:
- Bond the doors to the main body of the cubicle via a tinned copper braided flexible cable sufficient in length to allow the door to open 180 degrees.
- Attach the braided cable at each end by studs at least 5mm in diameter and 12mm in length.
- Securely weld the studs to each anchoring point prior to painting.
- Use flat brass washers and lock washers beneath a brass nut for securing ends of the cable.

5.2.4 Cabling Accessories & Appliances
- Earth lighting fittings, socket outlets and fixed wiring to appliances by means of the earth conductor which forms part of the respective circuit cabling.
- Use a separate earthing conductor for each circuit.
- Run earthing conductors back to the earth bar within the switchboard from where the supply originated.
- Number each earth bar terminal and record on Circuit Schedules.
- Earth all exposed metal fittings, e.g. cable trays, ducts, etc. associated with the Electrical Services.
- Earth all metal door frames fitted with a switch, electric lock etc.
- Where cable trays, troughs, ladders etc. support cables that penetrate a fire wall or separation, maintain earthing continuity of the support system through the penetration.

5.2.5 Earthing of Accessible equipment
- Provide earthing in accordance with AS/NZS 3000 Section 5 and AS/NZS 3003.
6. Low Voltage Power Systems

6.1 General

6.1.1 Aims

Responsibilities
General: Provide low voltage power systems as documented.

6.1.2 System description

Network supply
General: Liaise with the Network Distributor and provide network connection as documented.
Programme: Schedule the works and statutory inspections to suit the construction programme.

Distribution system
General: Provide power distribution system elements as documented.

Isolating Padmount Substation
Supply and install a complete isolating padmount substation to TfNSW Standard EP 17 00 00
11 SP. Provide supply authority metering, 415V/415V isolation transformer and DSMSB in the
padmount enclosure. Refer to TfNSW drawings EL 0282072, EL 0494646, EL 0480479 for
further details.
Retail: Provide metering to the requirements TfNSW, the selected electricity retailer and the
network distributor.
Private: Provide private metering as documented.

Design
Design responsibilities: Refer to the definition of ‘provide’ in the General requirements
worksection.
Design parameters: As documented.
Fault protection: Automatic disconnection to AS/NZS 3000 clause 2.4.
Maximum demand: Calculation method to AS/NZS 3000 Appendix C.

6.1.3 Cross references

General
General: Conform to the General requirements worksection.
Associated worksections
Associated worksections: Conform to the following:
- Electrical general requirements.
- Cable support and duct systems.

6.1.4 Standards

General
General: To SAA HB 301.
Electrical equipment: To AS/NZS 3100.
Fire and mechanical performance classification: To AS/NZS 3013.
Selection of cables: To AS/NZS 3008.1.1.
Distribution cables: To AS/NZS 4961.

Testing
Standard: To AS/NZS 3017.

6.1.5 Interpretations

Definitions
Extra-low voltage: Not exceeding 50 V a.c. or 120 V ripple-free d.c.
Low-voltage: Exceeding extra-low voltage, but not exceeding 1000 V a.c. or 1500 V d.c.
High voltage: Exceeding low-voltage.

6.1.6 Submissions

Samples
General: Submit samples of all visible accessories and equipment.

Technical data
General: Submit the following information for each main, submain and final subcircuit for which calculation is the responsibility of the contractor.
- Single line diagram.
- Fault Levels at switchboards.
- Maximum demand calculations.
- Cable and conductor cross sectional area and insulation type.
- Cable operating temperature at design load conditions.
- Voltage drop calculations at design load conditions.
- Protective device characteristics, e.g. curves, Iₚ.
- Discrimination and grading of protective devices.
- Prospective short circuit current automatic disconnection times.
- Earth fault loop impedance calculations for testing and verification.
- Certify compliance with AS/NZS 3000, for electrical services.

Final subcircuits: May be treated as typical for common route lengths, loads and cable sizes.

**Shop drawings**

General: Submit shop drawings of the following:

- Layout drawings showing the extent of the low voltage power system

### 6.2 Products

#### 6.2.1 Wiring systems

**General**

Selection: Provide wiring systems appropriate to the installation conditions and the function of the load.

#### 6.2.2 Power cables

**Standard**

Polymeric insulated cables: To AS/NZS 5000.1.

Aerial cables: To AS 1746.

**Cable**

General: Select multi-stranded copper cable generally,

Default insulation: V-90HT.

Minimum size:

- Lighting sub-circuits: 2.5 mm².
- Power sub-circuits: 2.5 mm².

Voltage drop: Select final subcircuit cables within the voltage drop parameters dictated by the route length and load.

Fault loop impedance: Select final subcircuit cables selected to satisfy the requirements for automatic disconnection under short circuit and earth fault/touch voltage conditions.

Underground residential distribution systems: Select cables according to AS/NZS 4026.
Distribution cables: To AS/NZS 4961.

Colours
Cables: For fixed wiring, provide coloured conductor insulation. If this is not practicable, slide at least 150 mm of close fitting coloured sleeving on to each conductor at the termination points.
Active conductors in single phase circuits: Red.
Active conductors in polyphase circuits:
- A phase: Red.
- B phase: White.
- C phase: Blue.
Sheath: White.

6.2.3 Accessories

General purpose socket outlets
Standard:
- General: To AS/NZS 3112.
- Industrial: To AS/NZS 3123.
Socket outlet switches: Required.
Pin arrangement: Mount outlets with the earth pins at the 6 o'clock position.

Plugs – 240/415 volt
General: Provide plugs with integral pins of the insulated type to AS/NZS 3112.

Installation couplers
Standard: to AS/NZS 61535.

Permanently connected equipment
General: Provide final subcircuit to permanently connected equipment, as documented.
Isolation: Provide isolating switch adjacent to equipment.
Coordination: Coordinate with equipment supplier.
Wall/ceiling mounted equipment: Conceal final cable connection to equipment.

Isolating switches
Standard: To AS/NZS 3133.

Emergency stop switches
Standard: To IEC 60947-5-5.
3-phase outlets
Construction: Surface mounted type of high-impact resistant plastic, with flap lid on the outlet.
Pin arrangement: Five round pins mounted with earth pins at the 6 o'clock position, neutral pins in the centre and the red, white and blue phases in a clockwise sequence when viewed from the front of the outlet.
Plug: Provide a matching plug top for each outlet.

Appliances
General: Provide appliances, as documented.
Connection: Shorten lead to minimum length for plug connections.

6.3 Execution

6.3.1 Power cables
General
Standard: Classifications to AS/NZS 3013.
Handling cables: Report damage to cable insulation, serving or sheathing.
Stress: Ensure that installation methods do not exceed the cable's pulling tension. Use cable rollers for cable installed on tray/ladders or in underground enclosures.
Straight-through joints: Unless unavoidable due to length or difficult installation conditions, run cables without intermediate straight-through joints.
Cable joints: Locate in accessible positions in junction boxes and/or in pits.
Extra-low voltage circuits: Individual wiring of extra-low voltage circuits: Tie together at regular intervals.

Tagging
General: Identify multi core cables and trefoil groups at each end with stamped non-ferrous tags clipped around each cable or trefoil group.

Marking
General: Identify the origin of all wiring by means of legible indelible marking.

6.3.2 Fire-rated (other than mims)
Protection
General: If exposed to mechanical damage, provide protection to AS/NZS 3013.
6.3.3 Copper conductor terminations

General
General: Other than for small accessory and luminaire terminals, terminate copper conductors to equipment, with compression-type lugs of the correct size for the conductor. Compress using the correct tool or solder.

Within assemblies and equipment
General: Loom and tie together conductors from within the same cable or conduit from the terminal block to the point of cable sheath or conduit termination. Neatly bend each conductor to enter directly into the terminal tunnel or terminal stud section, allowing sufficient slack for easy disconnection and reconnection.

Alternative: Run cables in UPVC cable duct with fitted cover.

Identification: Provide durable numbered ferrules fitted to each core, and permanently marked with numbers, letters or both to suit the connection diagrams.

Spare cores: Identify spare cores and terminate into spare terminals, if available. Otherwise, neatly insulate and neatly bind the spare cores to the terminated cores.

6.3.4 Accessories

Installation couplers
Standard: To AS/NZS 3000 and AS/NZS 61535.
Location: Accessible.

6.3.5 Completion tests

Site tests
Inspection: Visually inspect the installation to AS/NZS 3000 before testing. Submit record on a checklist.

Test and verify the installation to AS/NZS 3000 Section 8 using the methods outlined in AS/NZS 3017. Record and submit the results of all tests.

Dummy load tests
General: Where electrical tests are required and the actual load is not available, provide a dummy load equal to at least 75% of the design load.
### 6.4 Selections

#### 6.4.1 Network supply

**Network supply connection schedule**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal supply voltage</td>
<td>240/415 V</td>
</tr>
<tr>
<td>Number of phases</td>
<td>3</td>
</tr>
<tr>
<td>Frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Number of wires – system</td>
<td>4</td>
</tr>
<tr>
<td>Earthing system</td>
<td>MEN</td>
</tr>
</tbody>
</table>

#### 6.4.2 Design

**Design schedule**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage drop in final subcircuits</td>
<td>2%</td>
</tr>
<tr>
<td>Spare capacity for future use</td>
<td>25%</td>
</tr>
<tr>
<td>Export metering</td>
<td>N/A</td>
</tr>
<tr>
<td>Neutral sizing</td>
<td>100%</td>
</tr>
<tr>
<td>Harmonic loads</td>
<td>5%</td>
</tr>
</tbody>
</table>

#### 6.4.3 Accessories

**Accessory selections schedule**

<table>
<thead>
<tr>
<th>Component</th>
<th>Manufacture</th>
<th>Catalogue or reference</th>
<th>Description/rating</th>
<th>Other/IP rating</th>
<th>Special</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 phase outlets</td>
<td>Clipsal</td>
<td>Industrial</td>
<td>10A or greater</td>
<td>IP66</td>
<td></td>
</tr>
<tr>
<td>Isolating switches</td>
<td>Clipsal</td>
<td>C2000i Seris / WHB series</td>
<td>External and plant areas</td>
<td>IP66</td>
<td></td>
</tr>
<tr>
<td>Socket outlets</td>
<td>Clipsal</td>
<td>C2000i series</td>
<td>10A, 15A, 20A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outdoor socket outlets</td>
<td>Clipsal</td>
<td>WSCF228</td>
<td>10A Flush mounting</td>
<td>IP54</td>
<td></td>
</tr>
<tr>
<td>Wall boxes</td>
<td>Clipsal</td>
<td>To suit outlets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Captive Outlets</td>
<td>Clipsal</td>
<td>Clipsal 56 series</td>
<td>15A/20A</td>
<td>IP66</td>
<td></td>
</tr>
</tbody>
</table>
7. Switchboards - Custom

7.1 General

7.1.1 Aims

Responsibilities
General: Provide switchboards as follows and as documented.

7.1.2 Cross references

General
General: Conform to the General requirements worksection.

Associated worksections
Associated worksections: Conform to the following:
- Electrical general requirements.
- Low voltage power systems.
- Switchboard components.

7.1.3 Standard

General
Standards: To AS/NZS 3439.1.

7.1.4 Interpretations

Abbreviations
General: For the purposes of this worksection the abbreviations given below apply.
- TTA: Type tested assemblies.
- NTTA: Non-type tested assemblies.
- PTTA: Partially type tested assemblies.

Definitions
General: For the purposes of this worksection the definitions given below apply.
- Custom-built assemblies: Low voltage switchgear and controlgear assemblies manufactured to order.
There are a number of proprietary modular systems which can be configured to suit individual projects. For the purposes of this worksection, these assemblies can be regarded as custom-built assemblies.

- Rated currents: Rated currents are continuous uninterrupted current ratings within the assembly environment under in-service operating conditions.
- Rated short-circuit currents: Maximum prospective symmetrical root mean square (r.m.s.) current values at rated operational voltage, at each assembly incoming supply terminal, excluding effects of current limiting devices.

7.1.5 Tests

Routine tests
Standard: To AS 3439.1.
Assemblies: Electrical and mechanical routine function tests at the factory using externally connected simulated circuits and equipment.
Dielectric testing: NTTAs and PTTAs: 2.5 kV r.m.s. for 15 s.

7.1.6 Inspection

Notice
Inspection: Give sufficient notice so inspection may be made of the following:
- Assembly ready for routine testing.
- Assembly installed prior to connection.
- Assembly installed and connected.

7.1.7 Submissions

Calculations
General: Submit detailed certified calculations verifying design characteristics.
Standard: To AS 3865 and AS 4388.

Type test data
General: Submit type test certificates for components, functional units and assemblies. Verify that type tests and internal arcing-fault tests, if any, were carried out at not less than the designated fault currents at rated operational voltage.
Alterations to TTAs: Submit records of alterations made to assemblies since the tests.

Routine tests
General: Submit reports.
Technical data
Calculations: Submit design calculations of non-type tested and non-proprietary busbar assemblies.

Shop drawings
General: Submit shop drawings showing:
- Types, model numbers and ratings of assemblies.
- Component details, functional units and transient protection.
- Detailed dimensions.
- Shipping sections, general arrangement, plan view, front elevations and cross-section of each compartment.
- Projections from the assembly that may affect clearances or inadvertent operation, such as handles, knobs, arcing-fault venting flaps and withdrawable components.
- Fault level and rated short circuit capacity characteristics.
- IP rating.
- Fixing details for floor or wall mounting.
- Front and back equipment connections and top and bottom cable entries.
- Door swings.
- External and internal paint colours and paint systems.
- Quantity, brand name, type and rating of control and protection equipment.
- Construction and plinth details, ventilation openings, internal arcing-fault venting and gland plate details.
- Terminal block layouts and control circuit identification.
- Single line power and circuit diagrams.
- Details of mains and submain routes within assemblies.
- Busbar arrangements, links and supports, spacing between busbar phases and spacing between assemblies, the enclosure and other equipment and clearances to earthed metals.
- Dimensions of busbars and interconnecting cables in sufficient detail for calculations to be performed.
- Form of separation and details of shrouding of terminals.
- Labels and engraving schedules.
7.2 Products

7.2.1 General

7.2.2 Custom-built switchboard construction

General
General: Provide custom-built switchboards as documented.

Separation
IMSB: Form 2b.
Standard DB's: Form 1.

Metering
Refer Low voltage power systems.

Spare capacity
Default spare poles: ≥ 25%.

Surge diversion
General: Required.

Earthing
General: Make provision for connection of communications systems CET at switchboard earth bar to AS/ACIF S009.

IP rating
Default rating: IP42 minimum.
Weatherproof: IP56 minimum.

Supporting structure
Assemblies:
- Wall mounted: ≤ 2 m².
- Floor mounted: > 2 m².

Ventilation
General: Required to maintain design operating temperatures at full load.

Layout
General: Position equipment to provide safe and easy access for operation and maintenance.
Group devices according to function.
Connection: Front connected.
Equipment on doors: Set out in a logical manner in functional unit groups, so it is accessible without the use of tools or keys.

Segregation
General: Segregate BCA emergency equipment from non-emergency equipment by means of metal partitions designed to prevent the spread of a fault from non-emergency equipment to emergency equipment.

Enclosure materials
General: Fabricate from sheet metal of rigid folded and welded construction. Obtain approval for non-welded forms of construction.
Material: Metallic-coated sheet steel to AS 1397.
Material thickness:
- Diagonal dimension:
  - < 900 mm: ≥ 1.6 mm.
  - ≥ 900 mm: ≥ 2.0 mm.
Coating class:
- Indoor assemblies: Z200.
- Outdoor assemblies: Z450.

Insect proofing
General: Cover ventilation openings with non-combustible and corrosion resistant 1 mm mesh.

Equipment mounting panels
General: To support the weight of mounted equipment.
Metallic panels: Construct from ≥ 3 mm thick metal with heavy metal angle supports or plates bolted or welded to enclosure sides.
Non-metallic panels: Provide non-metallic panels selected to suit the weight of the mounted equipment and design the mounting structure for stability and stiffness.
Non-metallic boards: To IEC 60893-1.

Equipment fixing
Spacing: Provide 50 mm minimum clearance between the following:
- Busbars for lifts, fire services and building emergency services.
- General installation services, busbars and equipment.
Mounting: Bolts, set screws fitted into tapped holes in metal mounting panels, studs or proprietary attachment clips. Provide accessible equipment fixings which allow equipment changes after assembly commissioning.
Installation: For lightweight equipment, provide combination rails and proprietary clips.

**Earth continuity**

General: Strip painted surfaces and coat with corrosion resistant material immediately before bolting to the earth bar. Provide serrated washers under bolt heads and nuts at painted, structural metal-to-metal joints.

**Construction**

Lifting provisions: For assemblies with shipping dimensions exceeding 1800 mm high x 600 mm wide, provide fixings in the supporting structure and removable attachments for lifting.

Supporting structure: Provide concealed fixings or brackets to allow assemblies to be mounted and fixed in position without removing equipment.

Floor-mounting: Provide mild steel channel plinth, galvanized to class Z600, with toe-out profile, nominal 75 mm high x 40 mm wide x 6 mm thick, for mounting complete assemblies on site. Drill M12 clearance holes in assembly and channel and bolt assemblies to channel. Prime drilled holes with zinc rich organic primer to AS/NZS 3750.9.

Ventilation: Provide ventilation to maintain design operating temperatures at full load.

### 7.2.3 Cable entries

**General**

General: Provide cable entry facilities within assembly cable zones for incoming and outgoing power and control cabling. Provide sufficient clear space within each enclosure next to cable entries to allow incoming and outgoing cables and wiring to be neatly run and terminated, without undue bunching and sharp bends.

**Cover and gland plates**

Cover plates: Provide 150 mm maximum width cover plates butted together and covering the continuous cable entry slot.

Gland plates: Provide removable gland plates fitted with gaskets to maintain the degree of protection.

Materials: 1.5 mm thick steel, 5 mm thick composite material or laminated phenolic. 6 mm thick brass for MIMS cables and cable glands.

### 7.2.4 Doors and covers

**General**

Provide lockable doors with a circuit card holder unless enclosed in cupboards.

**Door layout**

Maximum width: 900 mm.
Minimum swing: At least 90°.

Door stays: Provide stays to outdoor assembly doors.

Adjacent doors: Space adjacent doors to allow both to open to 90° at the same time.

Door construction

Protection: Provide single right angle return on all sides and fit suitable resilient sealing rubber to provide the documented IP rating and prevent damage to paintwork.

Hinges: Provide corrosion-resistant pintle hinges or integrally constructed hinges to support doors. For removable doors, provide staggered pin lengths to achieve progressive engagement as doors are fitted. Provide 3 hinges for doors higher than 1000 mm. Provide restraining devices and opposed hinges for non lift-off doors.

Door hardware: Provide the following:

- Corrosion resistant lever-type handles, operating a latching system with latching bar and guides strong enough to withstand explosive force resulting from fault conditions within the assembly.
- Dual, edge mounted, corrosion resistant T handles with provision for key locking cylinder.
- Captive, corrosion resistant knurled thumb screws.

Locking: Incorporate cylinder locks in the latching system. Key alike, 2 keys per assembly.

Door mounted equipment: Protect or shroud door mounted equipment and terminals to prevent inadvertent contact with live terminals, wiring, or both.

Earthing: Maintain earth continuity to door mounted indicating or control equipment with multi-stranded, flexible earth wire, or braid of equal cross-sectional area, bonded to the door.

Covers

Maximum dimensions: 900 mm wide and 1.2 m² surface area.

Fixing: Fix to frames with at least 4 fixings. Provide corrosion-resistant acorn nuts if the cover exceeds 600 mm in width. Rest cover edges on the cubicle body or on mullions. Do not provide interlocked covers.

Handles: Provide corrosion resistant D type handles.

Escutcheons

General: For doors enclosing circuit breakers, provide escutcheon plates as barriers between operating mechanisms and live parts.

Escutcheon plates

General: Provide plates or removable covers with neat circuit breaker toggle cut-outs allowing interchangeability of 1, 2 and 3 pole circuit breakers. Provide corrosion-resistant lifting handles or knobs. Provide unused circuit breaker toggle cut-outs with blanking in-fill pole covers.
Maximum dimensions: 900 mm wide and 1.2 m² surface area.

7.2.5 Factory finishes

General

Standard: To AS 2700.

Extent: Apply protective coatings to internal and external metal surfaces of assembly cabinets including covers, except to stainless steel, galvanized, electroplated, or anodised surfaces and to ventilation mesh covers.

Finish coats: Thermoset powder coating to AS 4506 or two-pack liquid coating of AS/NZS 3750.13 primer and proprietary or epoxy acrylic full gloss spray finish to Factory finishes schedule.

Factory finishes schedule

<table>
<thead>
<tr>
<th>Mounting structure (brackets)</th>
<th>To match enclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclosure</td>
<td>Indoor assemblies: Orange X15</td>
</tr>
<tr>
<td></td>
<td>Outdoor assemblies: Avocado green G34</td>
</tr>
<tr>
<td></td>
<td>Assembly interior: White</td>
</tr>
<tr>
<td>Escutcheons</td>
<td>Removable equipment panels: Off white Y35</td>
</tr>
<tr>
<td>Doors</td>
<td>To match enclosure</td>
</tr>
<tr>
<td>Plinths</td>
<td>Black</td>
</tr>
</tbody>
</table>

7.2.6 Busbars

General

General: Provide main circuit supply busbars within assemblies, extending from incoming supply terminals to the line side of protective equipment for outgoing functional units and for future functional units.

Standards: To AS 3768, AS 3865 and AS 4388.

Definitions

Incoming busbars: Busbars connecting incoming terminals to line side terminals of main switches.

Main circuit supply busbars: Busbars connecting incoming functional unit terminals, or incoming busbars where no main switches are included, to outgoing functional unit terminals or outgoing functional unit tee-offs.

Tee-off busbars: Busbars connecting main busbars to incoming terminals of outgoing functional units.
Custom-built busbar construction
Material: Hard-drawn high-conductivity electrolytic tough pitched copper alloy bars, designation 110.
Temperature rise limits - active and neutral conductors:
- Maximum rated current temperature rise limits: 65 ± 1.5°C by type test or calculation to AS 3768 or AS 4388.
Maximum short-circuit withstand current temperature rise limits: 160°C by calculation to AS 3865.
Cross section: Rectangular with radiused edges.
Supports: Sufficient to withstand thermal and magnetic stresses due to maximum prospective fault currents.
Support material: Non-hygroscopic insulation capable of holding busbars at 105°C.

Proprietary busbars
Type: Multi-pole proprietary insulated busbar assemblies or busbar systems, verified for short circuit capacity and temperature rise-limits by type tests.

Phase sequence
General: For main busbars and connections to switching devices, set-out phase sequence for phases A, B and C, from left-to-right, top-to-bottom and front-to-back when viewed from the front of the assembly.

Colour coding
General: Provide 25 mm minimum width colour bands permanently applied to busbars at 500 mm maximum intervals with at least one colour band for each busbar section within each compartment.
Active busbars: Red, white and blue respectively for the A, B and C phase.
Neutral busbar: Black.
MEN link: Green-yellow and black.
Protective earth busbar: Green-yellow.
Restrictions: Do not provide adhesive type colour bands.

Current carrying capacity
Active conductors: Take into account thermal stresses due to short circuit current, assuming magnetic material enclosures located indoors in well-ventilated rooms and 90°C final temperature.
Neutral conductors: Size to match incoming neutral conductor current carrying capacity.
Protective earth conductors: Size for at least 50% of the rated short circuit withstand current for 100% of the time duration.

**Tee-off busbars current rating**

For individual outgoing functional units: Equal to maximum frame size rating of the functional unit.

For multiple functional units: Equal to the diversity factors of AS 3439.1, based on frame size rating.

**MEN links**

MEN links > 10 mm² in cross-section: Bolted removable busbar links stamped MEN LINK, located in the incoming compartment, between neutral and earth busbars.

**Busbar links**

General: For current transformers, provide removable busbar links ≤ 450 mm long.

**Cable connection flags**

General: Provide and support busbar flags for equipment with main terminals too small for cable lugs. Provide flags sized to suit cable lug termination, with current rating of at least the maximum equipment frame size.

Phase isolation: Provide phase isolation between flags where the minimum clearance distances phase-to-phase and phase-to-earth are below the component terminal spacing.

**Custom-built busbar insulation**

Active and neutral busbars and joints: Select from the following:

- Polyethylene: At least 0.4 mm thick with dielectric strength of 2.5 kV r.m.s for 1 minute, applied by a fluidised bed process in which the material is phase coloured and directly cured onto the bars.
- Close fitting busbar insulation mouldings at least 1 mm thick.
- Heat shrink material: Only on rounded edge busbars.

Taped joints: Apply non-adhesive stop-off type tape, coloured to match adjacent insulation and half lapped to achieve a thickness at least that of the solid insulation.

Damaged insulation: Repair damaged insulation before energising.

**7.2.7 Neutral links and earth bars**

**Terminals**

General: Provide terminals for future circuits.
Links
Assembly capacity > 36 poles: Provide neutral links and earth bars at the top and bottom of the circuit breaker section.

Assembly capacity ≤ 36 poles: Provide links and bars at the point of entry of incoming supply cables.

Mounting: Mount neutral links on an insulated base.

Control circuits: Provide separate neutral links and earth bars.

Labels: Provide labels for neutral and earth terminals.

Cables > 10 mm²: Provide bolts or studs.

Communications earth: Make provision for connection of communications systems earth at switchboard earth bar to AS/ACIF S009.

7.2.8 Internal wiring

Wiring
General: Cable type: 0.6/1 kV copper cables. Provide V-90HT insulation where directly connected to active and neutral busbars.

Cable interconnections
General: For the main circuit supply, provide cable interconnections as follows:

- ≥ 1.5 mm² internal cables, with minimum V90 insulation rating with stranded copper conductors rated to AS/NZS 3008.1.1. Provide cables with current ratings suitable for the internal assembly ambient air temperature and for temperature rise limits of equipment within the assembly.

- Run cables clear of busbars and metal edges.

- Provide cables capable of withstanding maximum thermal and magnetic stresses associated with relevant fault level and duration.

- Run cables neatly. Provide slotted trunking sized for future cables or tie at 150 mm maximum intervals with ties strong enough to withstand magnetic stresses created at the specified fault current. Do not provide adhesive supports.

- Ensure wiring for future equipment can be installed without removal of existing equipment.

- Identify power and control cables at both ends with neat fitting ring type ferrules agreeing with record circuit diagrams. Mark to AS/NZS 4383.

- Terminate control cables and motor control circuits in tunnel terminals or, if necessary, provide suitable palm type lugs and correct crimp tool.

- For equipment mounted on hinged doors run cables on the hinge side to avoid restricting the door opening. Bundle cables with spiral wrap PVC and secure to door.
- If recommended by device manufacturers, provide shielded wiring.

Adjacent circuit breakers: If suitable proprietary multi-pole busbar assemblies are available to link adjacent circuit breakers, do not provide cable interconnections.

Cables > 6 mm²

Terminations:
- Tunnel terminals: Single cables.
- Other connection points or terminals: ≤ 2 cables.

Doors: Do not run cables to hinged doors or removable panels.

Supports:
- Spacing at enclosure: ≤ 200 mm from a termination.
- Spacing generally: ≤ 400 mm.
- Strength: Capable of withstanding forces exerted during fault conditions.

Single core cables rated ≥ 300 A: Do not provide ferrous type metal cable saddles.

Terminals marked: Terminate marked cables for connection to external controls in corresponding marked terminals within the assembly.

Control and indication circuits

General: Provide conductors sized to suit the current carrying capacity of the particular circuit.

Minimum size: 1 mm² with 32/0.2 stranding.

Cable colours

General: Colour code wiring as follows:
- A phase: Red.
- B phase: White.
- C phase: Blue.
- Neutral: Black.
- Earthing: Green-yellow.

7.2.9 Terminiations

Submains, light and power circuits

General: Connect direct to the control equipment terminals.

Shipping breaks: Provide terminal blocks for interconnecting wiring on each side of shipping breaks.
7.3 Execution

7.3.1 Assembly installation

Fixing
General: Before making inter-panel connections, fix assemblies and metering equipment enclosures into position, level and plumb.

7.3.2 Assembly entries

Cable entries
General: Neatly adapt one or more cable entry plates, if fitted, to accept incoming cable enclosure. Provide the minimum number of entry plates to leave spare capacity for future cable entries. Do not run cables into the top of weatherproof assemblies.

Single core cables rated > 300 A: Pass separately through non-ferrous gland plates. Do not use metal saddles.

Cable enclosures
General: Continue cable enclosures to or into assemblies and fit cable entry plates so that the IP rating of the assembly and the fire rating of the cable are maintained.

Cable supports
General: Support or tie mains and submains cables within 200 mm of terminations. Provide cable supports suitable for stresses resulting from short circuit conditions.

Bus trunking system entry
General: Provide entry plates with close tolerance cut-out to accommodate busbars, fitted with a flange bolted and sealed to assembly enclosure to maintain assembly IP rating. Earth busway enclosure to assembly protective earth conductor. Fit busway flanges at assembly manufacturer’s premises and retain for transportation.

7.3.3 Marking and labelling

General
General: Label the switchboard assembly in conformance with AS/NZS 3439.1 including the following:
- Size and type of all incoming and outgoing mains and submains.
- Emergency operating procedures.

7.3.4 Completion

Maintenance
Standard: To AS 2467.
General: Carry out the following:

- Rectify faults, make adjustments and replace consumable and faulty materials and equipment within 24 hours of notification.
- Monthly inspections and maintenance work to maintain the assembly, including battery systems.

### 7.4 Selections

#### 7.4.1 Custom Switchboards

<table>
<thead>
<tr>
<th>Assembly designation</th>
<th>IMSB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Switch Room</td>
</tr>
<tr>
<td>Fault level</td>
<td>20kA</td>
</tr>
<tr>
<td>Special service conditions</td>
<td>-</td>
</tr>
<tr>
<td>Form of separation</td>
<td>2b</td>
</tr>
<tr>
<td>Future bus bar extension required</td>
<td>No</td>
</tr>
<tr>
<td>Future circuits required</td>
<td>Yes</td>
</tr>
<tr>
<td>Surge diversion required</td>
<td>Yes</td>
</tr>
<tr>
<td>Supporting structure</td>
<td>Floor Standing</td>
</tr>
<tr>
<td>Protection (IP rating)</td>
<td>IP42</td>
</tr>
<tr>
<td>Bus bar rated current (minimum)</td>
<td>300A</td>
</tr>
<tr>
<td>Main isolator rated current (minimum)</td>
<td>300A</td>
</tr>
<tr>
<td>Surge diversion required</td>
<td>Yes</td>
</tr>
<tr>
<td>Metering</td>
<td>-</td>
</tr>
<tr>
<td>Provision for control equipment</td>
<td>As required</td>
</tr>
</tbody>
</table>
8. Switchboards – Proprietary

8.1 General

8.1.1 Aims

Responsibilities
General: Provide switchboards as follows and as documented.

8.1.2 Cross references

General
General: Conform to the General requirements worksection.

Associated worksections
Associated worksections: Conform to the following:
  • Electrical general requirements.
  • Switchboard components.

8.1.3 Standards

General
Standards: To AS/NZS 3439.3.

8.1.4 Interpretations

Definitions
General: For the purposes of this worksection the definitions given below apply.
  • Proprietary assemblies: Low voltage switchgear and controlgear assemblies available as a catalogue item, consisting of manufacturer's standard layouts and equipment.
  • Rated currents: Rated currents are continuous uninterrupted current ratings within the assembly environment under in-service operating conditions.
  • Rated short-circuit currents: Maximum prospective symmetrical root mean square (r.m.s.) current values at rated operational voltage, at each assembly incoming supply terminal, excluding effects of current limiting devices.

8.1.5 Submissions

Product data for proprietary assemblies
General: Submit the following:
8.2 Products

8.2.1 General

Enclosure
Default material: Metallic coated sheet steel.

Separation
Default: Form 1.

Metering
Refer Low voltage power systems.

Busbars
General: Incorporate proprietary insulated busbar systems for the interconnection of isolators, circuit breakers and other circuit protective devices.

Spare capacity
Default spare poles: ≥ 25%.

Surge diversion
General: Required.
Earthing
General: Make provision for connection of communications systems CET at switchboard earth bar to AS/ACIF S009.

Doors
General: Provide lockable doors with a circuit card holder unless enclosed in cupboards or in an area which is not readily accessible to the public.

IP rating
Default rating: IP42 minimum.
Weatherproof: IP56 minimum.

Finishes
Interior: White.
Exterior: Installed in cupboards, switchrooms and plant rooms: Manufacturers standard powder coated finish.
Exterior: Installed elsewhere: To non-standard selected powder coated colour.

Supporting structure
Assemblies:
- Wall mounted: ≤ 2 m².
- Floor mounted: > 2 m².

Ventilation
General: Required to maintain design operating temperatures at full load.

8.3 Execution

8.3.1 General

Fixing
General: Before making inter-panel connections, fix assemblies and metering equipment enclosures into position, level and plumb.

Cable entries
General: Neatly adapt one or more cable entry plates, if fitted, to accept incoming cable enclosure. Provide the minimum number of entry plates to leave spare capacity for future cable entries. Do not run cables into the top of weatherproof assemblies.

Single core cables: Pass separately through non-ferrous gland plates. Do not provide metal saddles. Provide glands for all single core cables.
Cable enclosures
Cable enclosures: Continue cable enclosures to or into assemblies and fit cable entry plates so that the IP rating of the assembly and the fire rating of the cable are maintained.

Cable supports
Cable supports: Support or tie mains and submains cables within 200 mm of terminations. Provide cable supports suitable for stresses resulting from short circuit conditions.

8.3.2 Maintenance

General
Standard: To AS 2467.

8.4 Selections

8.4.1 Proprietary switchboards

<table>
<thead>
<tr>
<th>Assembly designation</th>
<th>Location</th>
<th>Special service condition</th>
<th>Enclosure material</th>
<th>Bus bar rated current (minimum)</th>
<th>Rated short-circuit current (minimum)</th>
<th>Form of separation (minimum)</th>
<th>Main isolator rated current (minimum)</th>
<th>Future circuits required</th>
<th>Minimum number of poles (excluding main isolator)</th>
<th>Surge diversion required</th>
<th>Metering</th>
<th>Provision for control equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>As show on the drawings</td>
<td>-</td>
<td>Metallic-coated sheet steel</td>
<td>160A</td>
<td>10kA</td>
<td>Form 1</td>
<td>As shown on drawings</td>
<td>≥ 20% spare poles</td>
<td>As shown on drawings</td>
<td>Yes</td>
<td>N/A</td>
<td>As required</td>
</tr>
</tbody>
</table>
9. Switchboard Components

9.1 General

9.1.1 Aims

Responsibilities
General: Provide switchboard components as follows and as documented.

9.1.2 Cross references

General
General: Conform to the General requirements worksection.

Associated worksections
Associated worksections: Conform to the following:
- Electrical general requirements.
- Switchboards – proprietary.
- Switchboards – custom-built.

9.1.3 Design

Statutory authority’s equipment
General: Liaise with the supply authority with regard to the installation and coordinate with their protective and control equipment.

9.1.4 Submissions

Technical data
General: Submit technical data for all components.

9.2 Products

9.2.1 General

General
Selection: To comply with the requirements of AS/NZS 3000 clause 1.7 and Section 2.
Rated duty: Uninterrupted.
Rated making capacity (peak): ≥ 2.1 x fault level (RMS) at assembly incoming terminals.
Utilisation category: To AS 60947.1 clause 4.4.

- Circuits consisting of motors or other highly inductive loads: At least AC-23.
- Other circuits: At least AC-22.

Coordination: Select and adjust protective devices to discriminate under over-current, and earth faults.

Enclosure: IP4X minimum.

9.2.2 Switch-isolator and combination fuse-switch units

General
Standard: To AS 60947.1 and AS/NZS 3947.3.

Poles: 3.

Operation: Independent manual operation including positive ON/OFF indicator.

Shrouding: Effective over range of switch positions.

Rated breaking capacity: ≥ rated full load current.

Fuse-switch units

Operation: Provide an extendable operating handle.

Fuse links: To be isolated when switch contacts are open. Provide 3 phase sets of high rupturing capacity (HRC) fuse links.

9.2.3 Moulded case and miniature circuit breakers

General

Moulded case breakers: To AS 60947.1, AS 2184 and AS 60947.2.

Miniature circuit breakers: To AS/NZS 60898.1 or AS 3111.

Operation: Independent manual operation including positive ON/OFF indicator.

Trip type:
- Moulded case breakers: Adjustable thermal, fixed magnetic.
- Miniature circuit breakers: Fixed thermal, fixed magnetic.

Current limiting:
- Moulded case breakers: Required.

Isolation facility: Required.

Mounting: Mount circuit breakers so that the ON/OFF and current rating indications are clearly visible with covers or escutcheons in position. Align operating toggles of each circuit breaker in the same plane.
Utilisation category: Moulded case breakers:
- Final subcircuits category: Category A.
- Mains and submains: Category B.
Trip settings: Set as documented, seal, and label.
Trip units: Connect interchangeable and integrally fused trip units so that trip units are not live when circuit breaker contacts are open.

9.2.4 Residual current operated circuit breakers (RCBO)
Standard: To AS/NZS 3190.
Integral non-overload protection type: To AS/NZS 61008.1.
Integral overload protection type: To AS/NZS 61009.1.
Modular type: To AS 60947.2.
Default tripping current: 30 mA.

9.2.5 Circuit breaker integral protective relays
General: Provide integral protective relays which provide for tripping in the event of relay operation, and for manually resetting. Provide operation indicators with a set of change over voltage free alarm contacts, for connection to an alarm circuit.
Mounting: Integral type: Readily accessible for viewing and adjustment with doors and covers in position.
Mounting: External type: Flush.

9.2.6 Transient protection
Standards
Assemblies connected to the MEN earthing system: To AS 4070 Category II.

Primary protection
General: Provide shunt connected metal oxide varistors at assembly incoming supply terminals, on the line side of incoming functional units.
Visual indicator: Provide visual indication of status of transient detection.
Alarm contacts: Provide one set of normally closed ‘dry’ contacts indicating occurrence of a surge transient.
Secondary protection
General: Provide metal oxide varistors or zener diode surge protection to assembly in-built equipment and to semi-conductor components which are not able to withstand transient overvoltages exceeding primary protection let-through residual levels.

9.2.7 Current transformers (metering)

Standard
Measurement current transformers: To AS 60044.1.

Test links
General: Provide test links for connection of calibration instruments and meters and for shorting of current transformer secondaries.
Energy meters, maximum demand meters, ammeters and protection relays: Provide with rail-mounted links consisting of screw-clamped slide links and an earth link.

Test studs
General: For energy and demand meters provide rail-mounted potential test studs or plug connections next to associated current transformer links. Provide at least one set of test studs for each compartment.

Accuracy classification
Energy measurements: Class 0.5.
Indicating instruments: Class 3.

Ratings
Rated short time current: At least the short time withstand current equivalent of the circuit in which the transformer is installed.
Rated primary current: At least equal to the current rating of the functional unit.
Secondary windings: Rated at 5 A, burden of 0.4 Ω (10 VA) with star point earthed.

Type
General: If practicable, cast resin encapsulated window-type with busbar clamping devices. Otherwise wound-primary type with mounting feet.

Installation
General: Install transformers to permit easy removal.
Removable links: Provide removable links of minimum length for transformers fitted on busbar systems.
**Labels**
General: If associated exclusively with one phase, label meters *RED, WHITE, or BLUE* as applicable.

**Protection devices**
Meter potential protection devices: Group together behind associated meter cover or hinged door, preferably next to current transformer test links.

**Accessories**
General: Mount next to associated instruments, inside cabinets.

**9.2.8 Contactors**
Standard: To AS 60947.4.1.
Type: Enclosed, block type, air break, electro-magnetic.
Poles: 3.
Rated operational current: The greater of:
- Full load current of the load controlled.
- \( \geq 16 \) A.
Mechanical durability: 10 million cycles to AS 60947.4.1.
Electric durability: \( \geq 1 \) million operations at AC-22 to AS 60947.4.1.
Mounting: Mount with sufficient clearance to allow full access for maintenance, removal and replacement of coils and contacts, without the need to disconnect wiring or remove other equipment.
Auxiliary contacts: Provide auxiliary contacts with at least one normally-open and one normally-closed separate contacts with rating of 6 A at 240 V a.c., utilisation category: AC-1.
Slave relay: If the number of auxiliary contacts exceeds the number which can be accommodated, provide separate slave relays.

**9.2.9 Control devices and switching elements**

**Standards**
General: To AS 60947.1 and AS 60947.5.1.

Switching elements:
- Electrical emergency stop device with mechanical latching function: To AS 60947.5.4.
- Electromechanical control circuit devices: To AS 60947.5.1.
- Proximity switches: To AS 60947.5.2.
Rotary switches
General: Cam operated type with switch positions arranged with displacement of 60°.
Off position: Locate at the 12 o’clock position. Test positions must spring return to off position.
Rated operational current: At least 6 A at 240 V a.c.
Escutcheon plates: Provide rectangular plates securely fixed to the assembly panel. Identify switch position and function.

Time switches
Operation: 365 day operation.
Mains failure operation: 100 hour minimum operating capacity.
Contact rating: ≥ 16 A at 240 V a.c.
Construction: Provide readily accessible means of adjustment. Provide operational settings which are clearly visible when switch cover is fitted.
Dial: Digital with hour and minute display.
Override switch (manual): Required.

Control relays
Standards: To AS 60947.5.1.
Operation: Suitable for continuous operation. Provide relays selected in conformance with the Control relay selection table.
Construction: Plug-in types. Receptacle bases with captive clips which can be operated without using tools.
Contact elements: Electrically separate, double break with silver alloy, non-welding contacts.
Configuration: For standard relays, provide assemblies with ≥ 2 sets of contacts and expandable to 8 sets of contacts in the same assembly. Provide at least one normally-open and one normally-closed contact.
On site conversion: Provide contact blocks readily convertible to either normally-open or normally-closed contacts.

Control relay selection table

<table>
<thead>
<tr>
<th>Relay type</th>
<th>Minimum mechanical life (million operations)</th>
<th>Base</th>
<th>Minimum contact rating</th>
<th>Inter-changeable</th>
<th>Minimum number of contact elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>Plug-in</td>
<td>1.25Iₘ</td>
<td>Yes</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>Plug-in</td>
<td>5 A at 240 V</td>
<td>Yes</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>Fixed mounting</td>
<td>5 A at 240 V</td>
<td>Yes</td>
<td>4</td>
</tr>
</tbody>
</table>
Time delay relays
Adjustable range: Adjustable over the full timing range with timing repeatability within ± 12.5% of nominal setting.
Electronic relays: Incorporate light emitting diodes indicating energisation states of relays.

Phase failure relays
General: Provide separate solid-state phase failure relays which release at the following:
- < 85% of normal voltage.
- Single phase failure.
- Reverse phase sequence after an appropriate time delay.
Sensing circuit: To reject induced voltage spikes and disturbances with frequencies other than 50 Hz.
Back-up protection: Provide high rupturing capacity fuses to each phase.

Push-buttons
Type: Oil-tight, minimum 22 mm diameter, or 22 x 22 mm.
Rated operational current: At least 4 A at 240 V a.c.
Emergency stop devices with mechanical latching: To AS/NZS 3947.5.5.
Marking: Identify functions of each push-button. For latched STOP or EMERGENCY STOP push-buttons, provide label with instructions for releasing latches.

9.2.10 Control and protective switching devices or equipment
General
Standard: AS 60947.6.2.

9.2.11 Indicator lights
Standard
General: To AS 60947.5.1.
Incandescent indicators
Type: Incandescent oil tight type minimum 22 mm diameter or 22 x 22 mm.
Lamps: Changeable from front of panel without removing the holder.
Lamp rating: 1.2 to 5 W.
**Neon indicators**
General: 240 V, 12 mm diameter with in-built resistor.

**LED indicators**
General: 12 or 24 V as necessary, in corrosion-resistant bezel, nominal 5 mm diameter.

**Press-to-test**
Compartments/subsections with < 5 indicating lights: Provide each indicating light with a fitted integral press-to-test lamp actuator.
Compartments/subsections with ≥ 5 indicating lights: Provide a common press-to-test lamp push-button.

9.2.12  Indicating counters

**General**
General: Provide the following:
- At least 6 digits.
- Digits at least 3.5 mm high.
- Continuous duty rated.
- Non-reset type.
- 500 V surge diverters.

9.3  Execution

9.3.1  Marking and labelling

**General**
General: Provide labels including control and circuit equipment ratings, functional units, notices for operational and maintenance personnel, incoming and outgoing circuit rating, sizes and origin of supply and kW ratings of motor starters.

Lettering heights: Include the following requirements:
- Isolating switches: ≥ 5 mm.
- Switchboards, main assembly designation: ≥ 25 mm.
- Switchboards, outgoing functional units: ≥ 8 mm.
- Switchboards, sub assembly designations: ≥ 15 mm.

**Labels on assembly exteriors**
Manufacturer's name: Required.
Assemblies: Label with essential markings.

Designation labels: For other than main assemblies, provide designation label stating source of electrical supply. Identify separate sections of enclosures.

Assembly controls: Label controls and fault current limiters, including the following:
- Circuit designation for main switches, main controls and submains controls.
- Details of consumers mains and submains.
- Incoming busbar or cable rating to first tee-off.
- Fuse link size.

Labels on assembly interiors
General: Provide labels for equipment within assemblies. Locate so that it is clear which equipment is referred to, and so that lettering is not obscured by equipment or wiring.

Moulded case circuit breakers: If circuit breaker manufacturer's markings are obscured by operating handle mechanisms or motor operators, provide additional markings open to view on, or next to, the circuit breaker.

Arrestors: Label each group of primary arrestors, stating their purpose and the necessary characteristics.

Danger, warning and caution notices
Busbars: If polymer membrane coating is used without further insulation, provide warning notices on the front cover near the main switch or local main switch and on rear covers, indicating that busbars are not insulated.

Fault current limiters: In assembly sections containing fault current limiter fuses provide caution notices fixed next to the fault current limiters, stating that replacement fuse links are to match the installed fuse link ratings, make and characteristics. Provide separate label stating make and fault current limiting fuse ratings.

Externally controlled equipment: To prevent accidental contact with live parts, provide warning notices for equipment on assemblies not isolated by main switch or local main switch.

Stand-by power: Provide warning notices stating that assemblies may be energised from the stand-by supply at any time.

Anti-condensation heaters: To prevent accidental switching off, provide caution notices for anti-condensation heaters.

Insulation and shrouding: For insulation or shrouding requiring removal during normal assembly maintenance, provide danger notices with appropriate wording for replacement of insulation shrouding before re-energising assemblies.

Positioning: Locate notices so that they can be readily seen, next to or, if impracticable, on busbar chamber covers of functional units and behind the front cover of functional units. Provide
circuit identification labels in the cabling chamber of each functional unit, located next to external terminations.

Schedule cards
General: For general light and power distribution assemblies, provide schedule cards of minimum size 200 x 150 mm, with typewritten text showing the following as-installed information:

- Submain designation, rating and short-circuit protective device.
- Light and power circuit numbers and current ratings, cable sizes and type and areas supplied.
- Mounting: Mount schedule cards in a holder fixed to the inside of the assembly or cupboard door, next to the distribution circuit switches. Protect with hard plastic transparent covers.

Single-line diagrams
Main and submain assemblies: Provide single-line diagrams.
Format: Non-fading print, at least A3 size, showing the situation as installed.
Mounting: Enclose in a non-reflective PVC frame and wall mount close to assembly.

Marking cables
General: Identify the origin of all wiring by means of legible indelible marking.
Identification labels: Provide durable labels fitted to each core and sheath, permanently marked with numbers, letters or both to suit the connection diagrams.
Multicore cables and trefoil groups: Identify multicore cables and trefoil groups at each end with durable non-ferrous tags clipped around each cable or trefoil group.
10. UPS System

The Contractor shall supply and install:
An Uninterruptible Power System (hereinafter referred to as UPS system) rated to support the load.

- The UPS shall be rated to a minimum 20kVA and shall be positioned within the main switch room.
- The contractor shall be responsible for all associated works to be carried out for the system to be fully operational.

Any deviations or exceptions to the minimum requirements must appear in the offer.
Where no exceptions are shown, the requirements of the present specifications will be considered as accepted.
All associated equipment shall be sourced from the same manufacturer, including batteries, wrap-around bypass etc.

10.1 Standards

The choices, engineering developments, choice of materials and components and the construction of the equipment must comply with current legislation, directives and standards.

Some of the laws, regulations, directives and standards are listed below to provide a minimum frame of reference. The list is intended as a guideline only and is not exhaustive.

In the event of conflict of laws, it is agreed that the most restrictive law, regulation or standard will apply.

10.1.1 Legislation, directives and standards

AS/NZS 3000:2007
Electrical installations (known as the Australian/New Zealand Wiring Rules)

UPS Standards

AS 62040.1
Uninterruptible Power Systems (UPS)
"General and safety requirements for UPS used in restricted access locations"

AS62040.2
Uninterruptible Power Systems (UPS)
"Electromagnetic compatibility (EMC) requirements"

AS62040.3
Uninterruptible Power Systems (UPS)
"Performance requirements and test methods"

10.1.2 Battery Standards
AS 2676.1
Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings - Vented cells
AS 2676.2
Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings - Sealed cells
AS 3011.1
Electrical installations - Secondary batteries installed in buildings - Vented cells
AS 3011.2
Electrical installations - Secondary batteries installed in buildings - Sealed cells

ISO 9001
Quality systems
Model for quality assurance in Design, Development, Production, Installation and Servicing.

ISO 14001
Environmental Systems
Environmental management system for sales, distribution, configuration, installation, commissioning and service of Uninterruptible Power Supply units.

10.2 UNINTERRUPTIBLE POWER SYSTEM TECHNICAL DATA / SCHEDULES

- Rating 20kVA - 16kW
- Runtime – 30 minutes based on a constant load of 16kW at end of life.
- Battery life – 10 years minimum
- Input wiring – 3 phase + N + PE (415V)
- Frequency – In/out 50Hz
- Output wiring – 3 phase + N + PE
- Nominal Voltage rating – 240/415V
- Connectivity – Modbus, Web/SNMP
- By Pass - Rotary Switch Type (Wrap Around or Change Over)
### 10.3 AS 62040.3 UPS FACTORY AND SITE TESTING SCHEDULE

<table>
<thead>
<tr>
<th>TEST DESCRIPTION (AS 62040.3)</th>
<th>AS62040 sub-clause #</th>
<th>ROUTINE (AS62040) TEST</th>
<th>OPTIONAL (AS62040) TEST</th>
<th>TEST Required Factory, Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interconnection cable check</td>
<td>6.6.1</td>
<td>X</td>
<td></td>
<td>Factory &amp; Site</td>
</tr>
<tr>
<td>Test specifications (conditions)</td>
<td>6.6.2</td>
<td>X</td>
<td></td>
<td>Factory &amp; Site</td>
</tr>
<tr>
<td>Light load test</td>
<td>6.6.3</td>
<td>X</td>
<td></td>
<td>Factory &amp; Site</td>
</tr>
<tr>
<td>UPS auxiliary device(s) test</td>
<td>6.6.4</td>
<td>X</td>
<td></td>
<td>Site</td>
</tr>
<tr>
<td>AC input failure test</td>
<td>6.6.6</td>
<td>X</td>
<td></td>
<td>Factory &amp; Site</td>
</tr>
<tr>
<td>AC input return test</td>
<td>6.6.7</td>
<td>X</td>
<td></td>
<td>Factory &amp; Site</td>
</tr>
<tr>
<td>Transfer test</td>
<td>6.6.9</td>
<td>X</td>
<td></td>
<td>Factory &amp; Site</td>
</tr>
<tr>
<td>Full load test</td>
<td>6.6.10</td>
<td>X</td>
<td></td>
<td>Site</td>
</tr>
<tr>
<td>UPS efficiency test</td>
<td>6.6.11</td>
<td>X</td>
<td></td>
<td>Site</td>
</tr>
<tr>
<td>Balanced load test</td>
<td>6.6.13</td>
<td>X</td>
<td></td>
<td>Site</td>
</tr>
<tr>
<td>Rated stored energy time test</td>
<td>6.6.15</td>
<td>X</td>
<td></td>
<td>Site</td>
</tr>
</tbody>
</table>
11. Lighting

11.1 General

11.1.1 Aims

Responsibilities
General: Provide a complete operational lighting system, tested and commissioned.

11.1.2 Project requirements

Proprietary equipment
General: The requirements of this specification for lamps, ballasts and luminaire control equipment over-ride the specifications inherent in the selection of a particular make and model of luminaire.

Minimum energy performance standards (MEPS)
General: To AS/NZS 4783.2 and AS/NZS 4782.2.
Self ballasted lamps: To AS/NZS 4847.2 (Int).

11.1.3 Cross references

General
General: Conform to the General requirements worksection.

Associated worksections
Associated worksections: Conform to the following:
- Electrical general requirements.
- Low voltage power systems.

11.1.4 Standards

Standards
EMC compliance: To AS/NZS CISPR 15.
Energy efficiency for ballasts and lamps: To AS/NZS 4783.2.
Fixed general purpose luminaires: To AS/NZS 60598.2.1.
Floodlights: To AS/NZS 60598.2.5.
Harmonic limits: AS/NZS 61000.3.2.
Luminaires, general requirements and tests: To AS/NZS 60598.1.
Luminaires: To AS/NZS 60598.1.
Luminaires with built-in transformers for filament lamps: To AS/NZS 60598.2.6.
Recessed luminaires: To AS/NZS 60598.2.2.
Road lighting luminaires: To AS/NZS 1158.6.
Radio interference luminaires: To AS/NZS CISPR 15.

11.1.5 Minimum energy performance standards
General: To AS/NZS 4783.2 and AS/NZS 4782.2.

11.1.6 Lamps
Lamps: Provide all luminaires complete with lamps and accessories.
Verify operation: Install lamps in all luminaries and verify correct operation
Standards:
- Fluorescent: To AS 4782.1.

11.2 Emergency Lighting

11.2.1 Standards
General
System design, installation and operation: AS 2293.1.
Inspection and maintenance: To AS/NZS 2293.2.
Provide a complete operational, emergency evacuation lighting system, tested and commissioned in accordance with AS/NZS 2293.1 and as documented.

11.2.2 Single-point system luminaires
Visual indicator lights: Provide a red indicator, readily visible when the luminaire is in its operating location, which indicates that the battery is being charged.
Inverter system: Provide protection of the inverter system against damage in the event of failure, removal or replacement of the lamp, while in normal operation.
Local test switches: Provide a momentary action test switch, accessible from below the ceiling, on each luminaire to temporarily disconnect the mains supply and connect the battery to the lamp.
Common test switches: Provide a common test switch on the kitchen distribution board which disconnects main supply to the luminaries and tests for discharge performance, after testing, this switch must automatically revert to normal operating mode.

11.2.3 Batteries
Type: Lead-acid or nickel-cadmium batteries capable of operating each lamp at its rated output continuously at least 2 hours during final commissioning, pre-practical completion tests and 1.5 hours during subsequent tests.
Battery life: At least 3 years when operating under normal conditions at an ambient temperature of 25°C and subjected to charging and discharging at 6 monthly intervals.
Marking: Indelibly mark each battery with its date of manufacture.

11.2.4 Power supply to single-point systems
General: Provide an unswitched active supply to each luminaire and exit sign, originating from the test switch control panel.

11.3 Accessories
Lighting outlets
Pin arrangement: Standard: 3 flat pin with looping terminal.

Lighting switches
General: Provide light switches as documented.
Standard: To AS/NZS 3133.
Minimum: 10 A, 240 V a.c.

Dimmer switches
General: Provide integral dimmer/switch units as documented.

Daylight switches
General: Provide integral photo electric switch units as documented.
Performance: Adjustable between 50 and 1000 lux.
Time delay: > 2 minutes.
Illumination differential: > 50 lux.

Motion detector switches
General: Provide movement detectors which cover designated areas as documented.
Timer: variable 'on' timer adjustable between 1 minute up to 2 hours maximum (generally set to 20 minutes).
Standard: To AS 2201.3.
Type: Passive infra-red.

11.4 Execution

11.4.1 Supports.

General
General: Install luminaires on proprietary supports by means of battens, trims, noggings, roses and packing material.

Installation
Supports: Mount luminaires on proprietary supports by means of battens, trims, noggings, roses or packing material to suit location.

Lighting poles
Provide proprietary light poles for pole mounted light fittings. Allow to mount to concrete footings.

Surface mounted luminaires
General: Fit packing pieces to level luminaires and prevent distortion of luminaire bodies. Provide packing strips to align end to end luminaires.
Fixing: Provide 2 fixings at each end of fluorescent luminaires. A single fixing at each end in conjunction with 1.6 mm backing plates may be used for narrow luminaires.

11.4.2 Completion

General
Prior to practical completion carry out the following:
• Verify the operation of all luminaires.
• Adjust aiming and controls for all luminaires under night time conditions.
• Replace lamps which have been in service for a period greater than 50% of the lamp life as published by the lamp manufacturer.
11.5 Selections

11.5.1 Schedules

Luminaire schedule
Refer to legend of symbols
Lamps shall be 4000k unless noted otherwise.
12. Communications

12.1 General

12.1.1 Aims

Responsibilities
Provide a complete operational telecommunications cabling system, tested and commissioned in accordance with AS/NZS 3080, AS/ACIF S009, SAA HB 29 and as appropriate SAA HB 252.

Provide accommodation for telecommunications cabling infrastructure complying with AS/NZS 3084 including the detailed requirements of Appendix ZA, ZB and ZC. Include the following as documented:
- Building distributors (MDF).
- Horizontal cabling.
- Telecommunications outlets.
- Fly leads.

12.1.2 System description

Network connection
General: Notify the authority of the new connection and provide a network connection path as documented.

Building distributor
General: Provide building distributor as documented.

Telecommunications outlets
General: Provide telecommunications outlets as documented.

Patching
General: Provide patching of telecommunications outlets and equipment as documented.

System performance
Application class to AS/NZS 3080 clause 6.3: E.
Balanced system to AS/NZS 3080 clause 7 (data): Category 6.
Balanced system to AS/NZS 3080 clause 7 (voice): Category 6.
Warranty (years): 20/20 years minimum.
12.1.3 Cross references

General
General: Conform to the General requirements worksection.

Associated worksections
Associated worksections: Conform to the following:
- Electrical general requirements.
- Cable support and duct systems.

12.2 Products

12.2.1 Equipment racks
Equipment racks in the equipment room shall be provided as part of this contract.
- Equipment Racks shall be 19" 45RU Floor standing 1000mm deep.
- 2 x 20A switched, captive power socket on dedicated UPS circuit installed adjacent the racks.
- Provide horizontal patch panels and patch cord managers (cable management, 1 per patch panel, and an additional 2 for switches.
- Provide 2 x 15A 15 way 10A power distribution units to each rack.

12.2.2 Modular connector patch panels
Terminations: Terminate directly to the modular connector.
Patch cords: Terminate cord ends with appropriate registered jacks.

12.2.3 Patch cords
General: Provide terminated patch cords for 100% of the total incoming and outgoing ports used.

12.2.4 Telecommunications outlets
Outlets: Provide RJ45 8 way modular jacks except where documented otherwise.
Pinouts: The pinouts vary with the application. Determine required pinouts before making cable terminations.

12.2.5 Fly leads
General: Provide fly leads to 100% of the outlets installed.
12.3 Execution

12.3.1 Installation
Crossover: Install cables neatly and without crossovers between cables.
Loom size: Loom cables into groups not exceeding 50 cables, and hold looms in place using reusable cable ties at least 20 mm wide. Do not exert compressive force on the cables when installing cable straps.

12.3.2 Cable separation
Low voltage cables: Separate telecommunications cables not enclosed in conduits or ducts from low voltage services by at least 150 mm.
Electromagnetic interference (EMI): Provide clearance to minimise the effect of EMI where communications cables are installed parallel and adjacent to power cables carrying loads in excess of 200 A.

12.3.3 Records
Record book: Provide a record book at each cross connect.
Records in pencil: Complete the records in pencil for each termination and jumper, providing origin and destination and type of service.
Location: Secure log books in each distribution frame records holder.
Identification and labelling, and record documentation: To AS/NZS 3085.1.

12.3.4 Earthing system
Communication earth system (CES): Provide a communications earth terminal (CET) associated with the local protective earth (PE) system adjacent to the communication racks.

12.3.5 Labels
Labelling
Telecommunications cables: Label cross-connects and outlets in accordance with the requirements of AS/NZS 3080 and SAA HB 29 Figures 5 – 18.
Cables: Label to indicate the origin and destination of the cable.
Outlets: Label to show the origin of the cross-connect, the workstation or outlet number and the port designation.

Label type table

<table>
<thead>
<tr>
<th>Component</th>
<th>Label scheme</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cables</td>
<td>Origin and destination</td>
<td>Self adhesive – wrap on</td>
</tr>
<tr>
<td>Component</td>
<td>Label scheme</td>
<td>Type</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Cross-connects</td>
<td>Port Number</td>
<td>Proprietary</td>
</tr>
<tr>
<td>Outlets</td>
<td>SAA HB 29 Fig 5-18</td>
<td>Engraved plate</td>
</tr>
<tr>
<td>Wall boxes</td>
<td>SAA HB 29 Fig 5-18</td>
<td>Engraved adhesive label</td>
</tr>
<tr>
<td>Patch cords</td>
<td>Type of service</td>
<td>Colour code</td>
</tr>
</tbody>
</table>

12.3.6 Testing

Standards

Testing of balanced cabling systems: To AS/NZS IEC 61935.1.

Testing of patch cords: To AS/NZS IEC 61935.2.

See AS/NZS 3080 Annexes B and C for testing, both of which are Normative i.e. integral parts of the standards. AS/ACIF S009 has little to say on tests, except regarding telecommunications reference conductors. For field tester measurement procedures, see AS/NZS 3087.

General: Carry out 100% permanent link tests.

If active network equipment is included in the works specify the network tests required.

Tests: To AS/NZS 3080 in conformance with SAA HB 29. Include the following:

- Basic Link and Channel transmission tests including the following:
  - Wire map.
  - Length.
  - Attenuation.
  - NEXT.
  - ACR.
  - Propagation delay.
  - Delay skew.
  - Power sum NEXT.
  - Power sum ACR.
  - ELFEXT.
  - Power sum ELFEXT.
  - Return loss.
  -
13. Access Control

13.1 Access Control

13.1.1 General
General: Provide a complete operational access control system, tested and commissioned in accordance with AS/NZS 2053 and AS/NZS 2201.1, AS 2201.3 and AS/NZS 2201.5, as applicable.

The system shall be compatible with the standard TfNSW system and interface remotely.

13.1.2 Processors or panels
Capacity: Provide separate entry/exit control modules for each designated door.

Users: Program the system to match the number of authorised users with unique access codes.

Time zones: At least 4 per day, with provision for weekends and public holidays.

13.1.3 Door control devices
General: Provide electric strikes, electric locks, drop bolts, or similar devices to suit door construction and hardware.

Fail-safe: Connect door control devices in a fail-safe mode to permit egress in the event of power failure.

Authorised products: Provide equipment listed in the ActivFire Register of Fire Protection Equipment.

Glass doors: Provide tumbler, drop bolts or magnetic holders.

Double leaf doors (solid frame): Provide an electric strike or lock on the fixed leaf, connected to the door frame by concealed flexible wiring.

13.1.4 Activation
General: Provide keypads, card readers or other activation devices, and locate next to entry points.

External: Provide weatherproof (IP56) hoods or housings for external units.

Default mounting height: 1100 mm from floor level.

13.1.5 Interconnection to other services
General: Provide card readers or other devices to allow the interconnection to other systems as required. Provide and connect wiring to the designated services.
14. Public Address and Hearing Augmentation

14.1 General

14.1.1 Public Address

Provide a complete public address system in accordance with TfNSW standard "Enhanced Public Address System Design and Installation Guideline" F2010/22647 D2010/52646.

- Provide all ancillary items required for the complete and functioning system in accordance with F2010/22647 D2010/52646.
15. Completion

15.1 Operation and maintenance manuals

- Provide maintenance manuals including the following:
  
  a) Installation description: General description of the installation.
  
  b) Systems descriptions: Technical description of the systems installed, written to ensure that TfNSW staff fully understand the scope and facilities provided. Identify function, normal operating characteristics, and limiting conditions.
  
  c) Systems performance: Technical description of the mode of operation of the systems installed.
  
  d) Equipment descriptions:
     - Manufacturers' technical literature for equipment installed, assembled specifically for the project, excluding irrelevant matter. Mark each product data sheet to clearly identify specific products and component parts used in the installation, and data applicable to the installation.
     - Supplements to product data to illustrate relations of component parts. Include typed text as necessary.
  
  e) Operation procedures:
     - Safe starting up, running in, operating and shutting down procedures for systems installed. Include logical step-by-step sequence of instructions for each procedure.
     - Control sequences and flow diagrams for systems installed.
     - Legend for colour-coded services.
     - Schedules of fixed and variable equipment settings established during commissioning and maintenance.
  
  f) Maintenance procedures:
     - Schedule of normal consumable items, local sources of supply, and expected replacement intervals up to a running time of 40 000 hours. Include lubricant and lubrication schedules for equipment.
     - Instructions for use of tools and testing equipment.
     - Emergency procedures, including telephone numbers for emergency services, and procedures for fault finding.
     - Material safety data sheets (MSDS).
  
  g) Certificates:
     - Copies of test certificates for the installation and equipment used in the installation.
     - Test reports.
  
  h) Drawings:
     - Single line diagrams.
• Service route layouts.
• Switchgear and controlgear assembly circuit schedules including electrical service characteristics, controls and communications.

15.2 Record drawings
a) Show dimensions, types and location of the services in relation to permanent site features and other underground services. Show the spatial relationship to building structure and other services. Include all changes made during commissioning and the maintenance period.
b) Drawings: Include all documented shop drawings.
c) Extensions and/or changes to existing: If a drawing shows extensions and/or alterations to existing installations, include sufficient of the existing installation to make the drawing comprehensible without reference to drawings of the original installation.

15.3 Commissioning

15.3.1 Circuit protection
• Confirm that circuit protective devices are sized and adjusted to protect installed circuits.

15.3.2 Controls
• Calibrate, set and adjust control instruments, control systems and safety controls.

15.3.3 Notice
• Give sufficient notice for inspection to be made of the commissioning of the installation.

15.3.4 Reports
• Submit reports indicating observations and results of tests and compliance or non-compliance with requirements.

15.4 Cleaning
• At practical completion hand over the following in a clean state:
a) Insides of switchgear and controlgear assemblies.
b) Luminaires.
c) Switchgear and contactors, and other electrical contacts.
15.5 Completion tests

15.5.1 General
- Test the works under the contract to demonstrate compliance with the documented performance requirements.

15.5.2 Functional checks
- Carry out functional and operational checks on energised equipment and circuits and make final adjustments for the correct operation of safety devices and control functions.

15.5.3 Proprietary equipment
- Submit type test reports confirming compliance of proprietary equipment.

15.5.4 Sound pressure level measurements
   a) Correction for background noise: To AS/NZS 2107 Table B1.
   b) External: To AS 1055.1.
   c) Internal: To AS/NZS 2107.
   d) Measurement positions: If a test position is designated only by reference to a room or space, do not take measurements less than 1 m from the floor, ground or walls.
   e) Sound pressure level analysis: Measure the sound pressure level and the background sound pressure level over the full range of octave band centre frequencies from 31.5 Hz to 8 kHz at the designated positions.
   f) Sound pressure levels: Measure the A-weighted sound pressure levels and the A-weighted background sound pressure levels at the designated positions.

15.5.5 Test instruments
- Use instruments calibrated by a registered testing authority.

15.6 Training

15.6.1 General
   a) Duration: Instruction to be available for the whole of the commissioning and running-in periods.
   b) Format: Conduct training at agreed times, at system or equipment location. Also provide seminar instruction to cover all major components.
c) Operation and maintenance manuals: Use items and procedures listed in the final draft operation and maintenance manuals as the basis for instruction. Review contents in detail with TfNSW staff.

d) Certification: Provide written certification of attendance and participation in training for each attendee. Provide register of certificates issued.

15.6.2 Demonstrators
- Use only qualified manufacturer’s representatives who are knowledgeable about the installations.

15.6.3 Maintenance
- Explain and demonstrate TfNSW staff the purpose, function and maintenance of the installations.

15.6.4 Operation
- Explain and demonstrate to TfNSW staff the purpose, function and operation of the installations.

15.7 Maintenance

15.7.1 General
- Warrant the whole of the Contract Works, for the Defects Liability Period, against defective workmanship and materials and against non-compliance of equipment and/or complete system with specified performance and operation. The Defects Liability Period shall continue for a period of 12 months after the date of issue of Practical Completion. During this period, the electrical contractor shall be responsible for making good with all possible speed, defects arising from the defective materials or workmanship, including the replacement of any failed items of equipment. Maintenance shall be provided during the warranty period to maintain warranty conditions. Maintenance shall comply with the current regulatory requirements.
  a) General: During the maintenance and defects liability periods, carry out periodic inspections and maintenance work as recommended by manufacturers of supplied equipment, and promptly rectify faults.
  b) Emergencies: Attend emergency calls promptly.

15.7.2 Maintenance program
- Submit details of maintenance procedures and program, relating to installed plant and equipment, 6 weeks before the date for practical completion. Indicate dates of service visits. State contact telephone numbers of service operators and describe arrangements for emergency calls.
15.7.3 Maintenance records

a) Submit, in binders which match the manuals, loose leaf log book pages designed for recording completion activities including operational and maintenance procedures, materials used, test results, comments for future maintenance actions and notes covering the condition of the installation. Include completed log book pages recording the operational and maintenance activities performed up to the time of practical completion.

b) Include test and approval certificates.

c) Prior to the date of completion, submit certificates stating that each installation is operating correctly.

d) The greater of 100 pages or enough pages for the maintenance period and a further 12 months.

e) If referenced documents or technical worksections require that log books or records be submitted, include this material in the maintenance records.

f) Record comments on the functioning of the systems, work carried out, items requiring corrective action, adjustments made and name of service operator. Obtain the signature of TfNSW designated representative.

15.7.4 Spares

a) Provide 10% spare fluorescent lamps for each lamp source used.

b) Provide 10 off spare MCCB circuit breakers
Contents

1. Project Information 4
   1.1 Definitions 4
   1.2 The Project 4
   1.3 Specification Objectives 4
   1.4 Obligations of Installer 4
   1.5 Required Submissions 5
   1.6 Quality Assurance 6

2. General 7
   2.1 Extent of Works 7
   2.2 Scope of Works 7
   2.3 Associated Works 8
   2.4 Cross references 9
   2.5 Inspection 10
   2.6 Submissions 10

3. Execution 12
   3.1 Installation 12
   3.2 Painting, finishes and marking 14
   3.3 Cold and Heated Domestic Water 14
   3.4 Sanitary plumbing and drainage 16
   3.5 Guttering and Downpipes 17
   3.6 Rainwater Collection and Storage Systems 17

4. Completion 20
   4.1 Testing 20
   4.2 Completion 20
   4.3 Charging 20
   4.4 Operation and maintenance manuals 20
   4.5 Training 22
5. Schedules
   5.1 Samples Schedule
   5.2 Schedule of Equipment
   5.3 Piping Schedule
   5.4 Sanitary Fixtures Schedule
1. Project Information

1.1 Definitions

Client - TFNSW
Consulting Engineer - GHD
Works - Hydraulic Services as described in Section 2
Hydraulic Contractor - The company contracted to undertake the works

1.2 The Project

This project involves the Easy access upgrade to the existing Railway Station at Cardiff, NSW. This specification covers the hydraulic works and Construction of the Hydraulic Services for the new extension of the Cardiff Station Building.

1.3 Specification Objectives

The intent of this Specification and the associated documents is:

- To provide a clear statement of contractual requirements against which compliance can be assessed.
- To provide documentation for the Client to demonstrate what is being bought.
- To define the expectations upon the Contractor by the Consulting Engineer.
- To define the roles of the parties involved with the works.
- To define the requirements of the installer with respect to Quality Assurance.

1.4 Obligations of installer

In writing this specification the Consulting Engineer expects and relies upon the tenderers' possessing specialist trade expertise necessary to complete the works in accordance with the documentation.

In addition, the installer has the following obligations:

- To raise in good time, issues requiring design intent or clarification from the Consulting Engineer, particularly in respect to:
  1. Interpretation of the design intent specification or drawings.
  2. Problems in complying with the specification.
  3. Omissions from the tender documents.
- To certify compliance with contract documents, including all variation instructions, at Practical Completion.
- To certify compliance with Authority requirements, as far as he/she can ascertain.
• To implement procedures to ensure that only competent tradesmen are used for the works.
• To be cognisant of the role of all relevant parties during the construction phase of the project and to assist them in the conduct of their duties wherever possible.
• To contribute, in the spirit of partnering, towards the successful execution of the contract.
• To provide manufacturer’s and construction drawings.
• To make final equipment selections to meet the requirements listed.

1.5 **Required Submissions**
- The Main Contractor shall provide a program, in good time to allow review without impediment.
- Certified schedule of compliance for all equipment, prior to placing orders.
- Certified schedule of competency for all tradesmen intended to work on the project.
- Copies of all correspondence to local Utility Authority, which are required to finalise the works.
- Factory test results where applicable.
- All product data, performance test and commissioning results required by this specification.
- Shop drawings for fabrication and installation of all equipment and items supplied.
- Inspection and test plans for every section of the works. Detail the procedure of how to complete the task, the skill or competency of the person undertaking the works, the review or testing procedure to assure satisfactory completion of the task, the person within the installer’s organisation authorised to sign-off the task as accepted.
- Client handover/training proposals.
- Record and installation drawings: Record all changes to equipment and services layouts, wiring and any other items during the construction period, which may have been incorporated into these works.
- Operating and Maintenance manuals.
- Certifications for compliance with project specific Code/Design requirements of the completed works.
- Maintenance and servicing during the defects liability period.
- Fully developed functional descriptions, written in simple sentences, of each system including but not limited to start up, normal running, shut down, fire mode operation, operation in fault conditions, alarms, safety controls and manual over-ride provisions.
- Control schematics or diagrams illustrating control logic, valve and damper sequences, external interlocks, and interfaces.
- Details of connections to external interfaces and components outside the automatic control system.
- When requested, provide manuals, data sheets and other explanatory information needed to interpret the material submitted.
- Test reports: Submit a report showing the test results. Carry out necessary modifications and re-test.
- Samples of fixtures and tapware and all exposed elements and as required by the lead architect
- Data sheets for each item of hydraulic plant, type of controller and other hardware component.
Technical data
Submit:
- Filters
- UV disinfection
- All pumps and types
- RPZD

1.6 Quality Assurance
A Quality Assurance plan shall be provided in order to propose, establish, maintain, monitor and document a quality assurance system covering all aspects of the design, purchase, fabrication, installation and completion of the works. The plan shall be in accordance with ISO 9001:2008 (as appropriate).
2. General

2.1 Extent of Works
The extent of work comprises the supply, installation, testing, commissioning, maintenance and defects liability service, of materials, labour and equipment for the complete Hydraulic Services installation. The work shall include all necessary minor and incidental work required to implement the intent and meaning of this specification.
Whether or not the words "supply and install" appear in this specification, unless clearly excluded, all items of equipment for the complete installation are required and shall be supplied and installed.

2.2 Scope of Works

2.2.1 General Description
General: Provide hydraulic services systems subject to the site and other constraints below.
Sanitary plumbing and drainage
• Connect the new sanitary drainage system to existing site infrastructure.
• Provide a new sanitary installation to cater for all fixtures, fittings and equipment.
Cold water services
• Connect the existing cold water supply system and existing site infrastructure through a stop valve.
• Provide site containment to Authority requirements.
• Provide the cold water installation to the draw-off points or connections to other services, within the new station building.
Hot water services
• Provide hot water unit.
• Provide the hot water installation from the cold water connection points to the draw-off points or connections to other services.
Rainwater Collection
• Provide rainwater collection system to cater for all roof gutters to discharge into the new in-ground tank.
• Provide a new in-ground rainwater tank and overflow to discharge into the stormwater system on site.
• Provide first flush diverter for the collected rainwater before discharging into the new in-ground tank.
Recycled Water
• Provide a new recycled water system to cater for all fixtures requiring recycled water.
• Provide a pre-treatment facility required to supply safe recycled water throughout the site.

Authority submissions
• Make submissions (including notices) to authorities relating to the works. Liaise with all authorities required to confirm new flows and loads of the building. Pay all fees and charges, where applicable.

Selections
• As documented.

2.2.2 Constraints
The following site and other constraints apply to the hydraulic services on this project:
Existing services: Existing services located within the proposed building footprint to be traced and diverted, temporarily if necessary, prior to excavation.
Temporary services: Take all necessary measures to allow the station to remain operational throughout the construction programme.
Conform to all TfNSW construction standards during the project.

2.3 Associated Works

2.3.1 Works by Builder
Builder is to provide penetrations and any structural support, concrete slabs and the like.
Builder is to provide all statutory signage on service doors, enclosures and the like.
The hydraulic contractor is to liaise with the builder and provide all pertinent information in good time and in a professional manner.

2.3.2 Works by Electrical Trade
The Electrical contractor is to supply power to hydraulic appliances where required. These appliances are though not being limited to:
• Pumps
• Back wash filters
• BHWU
• UV disinfection unit
• Solenoid valves
• Hot water units
All equipments (pumps, filters, hot water unit, etc) are to be powered from electrical distribution boards, either existing or new, depending on the site and location of equipment.
The Hydraulic contractor is to liaise with the Electrical contractor and provide all pertinent information in good time and in a professional manner.
Electrical contractor shall confirm available electrical capacity within distribution board for the hydraulic systems, and provide isolators within 1.5m of all equipment for connection by the Hydraulic contractor.
2.3.3 Works in connection with Mechanical Trade
All tundishes, gullies and the like for mechanical services equipment are to be provided by the Hydraulic contractor.
The Mechanical contractor is to liaise with the Hydraulic contractor and provide all pertinent information and requirements in good time and in a professional manner.

2.3.4 Works in connection with Civil Trade
The Civil contractor is to provide connection from the rainwater tank overflow and the first flush diverter to the civil stormwater system.
The Civil contractor is to liaise with the Hydraulic contractor and provide all pertinent information and requirements in good time and in a professional manner.

2.3.5 Design
Extent: Provide all additional design work necessary to complete the documented hydraulic services.
Qualification: Use only appropriately experienced and qualified persons to undertake hydraulic design work. If requested, provide documents verifying the qualification and experience.

2.4 Cross references
2.4.1 General
General: Conform to the General requirements worksection.

2.4.2 Associated worksections
Associated worksections: Conform to the following:
Service trenching.
Roofing for roof plumbing.
Hydraulic general requirements.
Mechanical Services.
Electrical Services.
Stormwater Drainage.

2.4.3 Standards
Plumbing, drainage: To AS/NZS 3500.0, AS/NZS 3500.1, AS/NZS 3500.2, AS/NZS 3500.3 and AS/NZS 3500.4 and the Plumbing Code of Australia.
Authorised products: Listed in the WaterMark Product Database, unless otherwise required by the Network Utility Operator.
Copper pipe and fittings-installation and commissioning: To AS 4809.
Microbial control: To AS/NZS 3666.1 and AS/NZS 3666.2.
The Building Code of Australia.
TNSW Standards.
2.4.4 Labelling

Water efficiency labelling: Provide only products conforming to and labelled to the Water Efficiency Labelling Scheme (WELS).

2.4.5 Interpretation

Abbreviations

General: For the purposes of this work section the abbreviations given below apply.

- NP: non potable

Definitions

General: For the purposes of this work section the definitions given below apply.

- Network Utility Operator: A person who undertakes the piped distribution of drinking water or natural gas for supply or is the operator of a sewerage system or a stormwater system.
- Hot dip galvanized: Zinc coated after fabrication to AS/NZS 4680 with coating thickness and mass to AS/NZS 4680 Table 1.

2.5 Inspection

Notice

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

- Excavated surfaces.
- Concealed or underground services.

2.6 Submissions

2.6.1 Drawings

General: Minimum A1 drawing size.

Standard: To AS 1100 Parts 101, 201, 301, 401 and 501 as applicable.

Drawings: Submit the following:

- Building work drawings showing all building work required to complete the hydraulic services.
- Detailed drawings, at 1:100 scale or larger, showing:
  - Pipework and equipment layout and sections showing the work to be installed in strata, that is, shown at the level that the services are installed. Do not submit ‘glass floor’ drawings.
  - Location, type, grade and finish of piping, fittings, valves, meters, pipe supports, access openings, cover plates, valve boxes and access pits.
  - Location, type and other relevant details of sanitary ware, appliances and water heaters.
  - Long sections of below ground drainage.
  - Piping schematic drawings.

Copy of submission drawings required by authorities and copies of approvals.

Inclusions: Include the following on the drawings:
Relevant survey levels, site and floor set out points.

2.6.2 Execution details
General: Before starting the respective portions of the installation, submit the following:
Embedded services: Proposed method for embedding services in concrete walls or floors or chasing into concrete or masonry walls.
Fixing of services: Typical details of locations, types and methods of fixing of services to structure.
Inaccessible services: If services will be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.
Proposals for location of exposed piping.
Workshop drawings.

2.6.3 Samples
General: Provide samples listed in the Samples schedule.

2.6.4 Technical data
Certification: Submit certification that the plant and equipment submitted meets the requirements and capacities of the contract documents except for departures that are identified in the submission.
Submissions: Submit technical data for all items of plant and equipment.
3. Execution

3.1 Installation

3.1.1 Accessories

General: Provide the accessories and fittings necessary for the proper functioning of the systems, including taps, valves, outlets, pressure and temperature control devices, strainers, gauges and pumps.

Isolating valves: In addition to valves required to meet statutory requirements, provide valves so that isolation of parts of the system for safe isolation of the system in the event of leaks or maintenance causes a minimum of inconvenience to building occupants.

3.1.2 Arrangement

Locate and arrange so that:

- Failure of plant and equipment (including leaks) does not create a hazard for the building occupants and causes a minimum or no damage to the building, its finishes and contents.
- Inspection and maintenance operations can be carried out in a safe and efficient manner, with a minimum of inconvenience and disruption to building occupants and without damaging adjacent structures, fixtures or finishes.

3.1.3 Embedded pipes

Do not embed pipes that operate under pressure in concrete or surfacing material.

3.1.4 Penetrations and fixing

If non-structural building elements are not suitable for fixing equipment and services to, fix directly to structure and trim around holes or penetrations in non-structural elements.

If it is proposed to penetrate or fix to the following, submit details of the methods proposed to maintain the required structural, fire and other properties:

- Structural building elements including external walls, fire walls, fire doors and access panels, other tested and rated assemblies or elements, floor slabs and beams.
- Membrane elements including damp-proof courses, waterproofing membranes and roof coverings. If penetrating membranes, provide a waterproof seal between the membrane and the penetrating component.
- Pipe sleeves: If piping or conduit penetrates building elements, provide metal or PVC-U sleeves formed from oversize pipe sections.

Seal penetrations with a system shall conform to AS 4072.1 and tested to AS1530.4-1997.

The integrity of any penetrated building element shall be maintained at all time. If the building element is weatherproof, acoustic rated or subject to pressure, maintain the rating.

Seal penetrations around conduits and sleeves. Seal around cables within sleeves. If the building element is acoustically rated, maintain the rating.

If piping or conduit penetrates building elements, provide metal or PVC-U sleeves formed from oversize
pipe sections.
Do not penetrate, or chase the following without approval:

- Structural building elements including external walls, core walls, fire walls, floor slabs, beams or columns.
- Acoustic barriers
- Other building services
- Membrane elements, including damp-proof courses, waterproofing membranes and roof coverings

If approval is given to penetrate membranes, provide a waterproof seal between the membrane and the penetrating compound.

3.1.5 Piping
Piping shall be installed in straight lines, plumb and to uniform grades. Arrange and support the piping so that it remains free from vibration and water hammer, while permitting movement in both structure and services. Keep the number of joints to a minimum. Prevent direct contact between incompatible metals.

If practicable, piping and fittings requiring maintenance or servicing shall be concealed so that they are accessible within non-habitable enclosed spaces such as roof spaces, subfloor spaces and ducts. Pipelines in subfloor spaces shall be kept at least 150 mm above ground and ensure access can be provided throughout for inspection. Provide at least 25 mm clearance between adjacent pipelines (measured from the piping insulation where applicable).

Where exposed piping emerges from wall, floor or ceiling finishes, cover plates of stainless steel or non-ferrous metal finished shall be provided to match the piping.

If the geotechnical site investigation report predicts differential movements between buildings and the ground in which pipes are buried, provide movement control joints in the pipes.

Pipe support materials shall be the same as the piping or galvanized or non-ferrous metals, with bonded PVC or glass fibre woven tape sleeves where needed to separate dissimilar metals.

3.1.6 Pits
Internal dimensions of pits shall give 300 mm clear space all around the fittings in the pit.
Concrete shall be of grade N20 to AS 1379, 100 mm thick, reinforced with F82 fabric.

Pit covers shall be to AS 3996.

Pit floors shall be graded to a point on one side and drain to the stormwater drainage system. Pit walls shall be carried up to 50 mm above finished ground level and shall be cast in the pit cover frame flush with the top. Trowel the top smooth.

3.1.7 Valve boxes
Underground isolating valves shall be installed in cast-iron valve boxes with removable covers. Cast-iron sluice valve covers shall be provided for access to sluice valves.

Box covers shall be marked with the name of the service and shall be appropriately rated to a loading class matching the surrounding surface.
3.2 Painting, finishes and marking

3.2.1 Exceptions
Do not paint chromium or nickel plating, anodised aluminium, glass reinforced plastic, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces.

3.2.2 Finishes
Exposed piping, including fittings and supports shall be finished as follows:
- In internal locations such as toilet and kitchen areas: Chrome plate copper piping to AS 1192 service condition 2, bright.
- Externally and steel piping and iron fittings internally: Paint.
- In concealed but accessible spaces (including cupboards and non-habitable enclosed spaces): Leave copper and plastic unpainted except for identification marking. Prime steel piping and iron fittings.
Valves shall receive finish to match connected piping.

3.2.3 Marking and labelling
Mark services and equipment to provide a ready means of identification.
- Locations exposed to weather: Provide durable materials.
- Pipes, conduits and ducts: Identify and label to AS 1345.
Label and mark equipment using a consistent scheme across all services elements of the project.

3.2.4 Pipeline identification
Lay detectable plastic warning tape printed with the name of the service, 300 mm above buried piping, for the full length of the piping.
If pipes have grade or class identification markings install so that the markings are visible for inspection.

3.3 Cold and Heated Domestic Water

3.3.1 Fittings and accessories
Provide the fittings necessary for the proper functioning of the water supply system, including taps, valves, backflow prevention devices, pressure and temperature control devices, strainers, gauges and automatic controls and alarms.

3.3.2 Heated water temperature
To AS/NZS 3500.4.

3.3.3 Line strainers
- Low resistance, Y-form bronze bodied type, with screen of dezincification resistant brass, stainless steel or monel.
- Screen perforations: 0.8 mm maximum.
3.3.4 Pressure control valves
Provide reduction valves, pressure limiting valves or ratio valves, which produce the necessary reduction in pressure.

3.3.5 Piping insulation
- To AS/NZS 3500.4 Section 8.
- Fit insulation tightly to piping surfaces without gaps. Minimise number of joints. Insulate fittings for the same thermal resistance as the piping insulation. Install the insulation on unions and other items requiring service so that it is readily removable. Provide supports formed to fit around the insulation so the insulation thickness is reduced by < 10%.
- Select from the following:
  - Polyester in moulded tubular sections faced with factory bonded aluminium foil laminate or integral polyester scrim.
  - Polyolefin foam: Cross linked closed cell polyolefin foam faced with factory bonded aluminium foil laminate.
  - Elastomeric foam insulation: Chemically blown closed cell nitrile rubber in tubular sections to ASTM C534. Use only solvent-based adhesive supplied by insulation manufacturer and designed specifically for the material being used.

3.3.6 Tapware
- Provide the tapware as documented on drawings and as per architectural details.
- All hose taps shall be vandal proof.
- Provide brass fittings or suitably bushed to prevent electrolysis and growth.
- Provide break-resistant fittings of a compact nature, to prevent fracture and exposure of jagged or rough edges.
- Locate hot tap to the left of or above, the cold tap. If there is sufficient space, install with valve spindles vertical.
- Vandalproof or anti-tampering devices shall be provided for the designated types.
- Provide water efficient tapware as follows:
  - Shower heads: To AS/NZS 3662 and suitable for the pressures and pressure differences of the supplied water.
  - Water efficient tapware: Tested and labelled with their water efficiency rating to AS/NZS 6400.

3.3.7 Thermostatic mixing valves
Water temperature shall be regulated by a single hand control, capable of delivering water at the temperature of either of the supply systems and at any temperature in between and suitable for controlling single or multiple outlets, as appropriate and incorporating the following:
  - A temperature sensitive automatic control, which maintains temperature at the pre-selected setting and rapidly shuts down the flow if either supply system fails or if the normal discharge water temperature is exceeded.
  - A hot water flush facility
The control shall be installed in a ready accessible location within a stainless steel wall box.
3.3.8 Water heaters
Water heaters shall be provided as documented and installed in accordance with AS 3500.4 Section 5 and Section 6.
Standard
- Electric water heaters to AS/NZS 4692.1
- Minimum energy performance: To AS/NZS 4692.2.

3.4 Sanitary plumbing and drainage
Provide complete soil and waste drainage system to cater for all fixtures, fittings and equipment as required, throughout the entire development.

3.4.1 Location
General: Verify location and invert of piping before commencing installation. Make sure that location of piping will not interfere with other services and building elements not yet installed or built. Subject to the preceding and documented layouts, follow the most direct route with the least number of changes in direction.
Ducts: If installed in ducts, locate and fix stacks, wastes and pipes independently of other services. Arrange so they are easily accessible and removable throughout their entire length.
Piping: Conform to the Piping Schedule.

3.4.2 Discharge from air handling systems
Trays, sumps and plumbing: To AS/NZS 3666.1.

3.4.3 Thermal movement
General: Arrange piping to accommodate thermal expansion. Provide proprietary expansion joints in copper and plastic pipes where pipe flexibility is not sufficient to absorb movement. Make sure that movement does not strain branch connections.

3.4.4 Vent pipes
General: Staying to roof: If fixings for stays penetrate the roof covering, seal the penetrations and make watertight.
Terminations: Provide bird-proof vent cowls of the same material and colour as the vent pipe. Coordinate final location with architect and paint to match surrounding roof.

3.4.5 Wet area floors
General: Where drainage connections pass through wet area floors, terminate 4 mm below the substrate surface.

3.4.6 Sanitary fixtures
Provide sanitary fixtures complete with all accessories necessary for correct installation and use.
3.5 Guttering and Downpipes

3.5.1 General

Standard: To AS/NZS 3500.3.

General: Provide the flashings, gutters, rainwater heads, outlets and downpipes necessary to complete the roof system. Connect to on-site rainwater tank or civil stormwater system as indicated on drawings.

3.5.2 Materials

Metal rainwater goods: To AS/NZS 2179.1.
PVC rainwater goods and accessories: To AS/NZS 3500.3.

3.5.3 Proprietary flashings and cappings

Standard: To AS/NZS 2904.

Material and colour: Match roof sheeting.

Rib notching: Match roof sheeting.

3.5.4 Eaves gutters

Product: Colourbond

Type: 150mm Half Round

Material and colour: Match roof sheeting.

Matching fascia/barge: If the selected eaves gutter is a proprietary high front pattern forming part of a combined system of gutter, fascia and barge, provide the matching proprietary fascias and barge cappings to roof verges and edges.

3.5.5 Downpipes

Product: Colourbond

Material: Zincalume

Colour: Paint to match roof sheeting.

Profile: Round

Size: As indicated on drawings

3.6 Rainwater Collection and Storage Systems

3.6.1 Standards

- Design and installation: To the recommendations of SAA HB 230.
- Tanks: To ATS 5200.026.
- Tank marking: Display the WaterMark symbol and other marking required by ATS 5200.026.
- Other marking: If rainwater is not treated to potable quality, label rainwater piping and outlets to AS/NZS 3500.1.
- Cleaning: Flush the rainwater system. Wash and flush tanks to remove manufacturing and other contaminants.
3.6.2 Rainwater tank
- Tank shall be watertight.
- Provide the accessories needed to complete the installation, including inlet and outlet connections, and overflow.
- Materials
  - Concrete
- Include the following:
  - Flap valves at every opening to the tank.
  - Calmed inlet to the tank to prevent stirring sediment.
- Structural support shall be provided to withstand the mass of the tank when full without deformation or excessive settling.
- Connecting piping shall be supported independently of the tank. Provide a 300 mm long section of reinforced flexible hose to prevent piping exerting a load on the tank.
- Restrain the tank to prevent movement,
- A level base with gaps shall be provided not exceeding 10 mm, free of sharp projections and projecting beyond the edge of the tank at all points.
- Connections shall be reinforced to the tank wall so that connected piping is rigid.
- Provide a manufacturer's warranty on the tank.

3.6.3 First flush diverter
- Provide a first flush diverter. Arrange to drain completely.
- Corrosion resistant and compatible with the rainwater plumbing and tank.
- Design and installation: To the recommendations of SAA HB 230.
- Provide the accessories needed to complete the installation, including inlet and outlet connections, and overflow.
- Discharge waste water from the first flush diverter to the stormwater installation.
- Install first flush strictly to tank manufacturer's guidelines and requirements.
- Provide a manufacturer's warranty.

3.6.4 Overflow
- Strictly install overflow to tank manufacturer's guidelines.
- Overflow shall discharge away from the tank to civil stormwater system.
- Overflow must allow the unrestricted flow of rainwater to the stormwater outlet.

3.6.5 Recycled water Pumps
General: Provide pumps as documented.

3.6.6 Installation
- During construction, use temporary covers to openings and keep the system free of debris.
• Lay pipelines with the spigot ends in the direction of flow.
• Turn up drain branch pipelines to finish 50 mm above finished ground or pavement level.

3.6.7 Commissioning
Cleaning: Flush the rainwater system. Wash and flush tanks to remove manufacturing and other contaminants.

3.6.8 Maintenance
• Annual maintenance: Provide the annual maintenance to SAA HB 230 Table 10.1 at the following times:
  • If the defects liability period is less than 12 months: Within one month before the end of the end of the defects liability period.
  • If the defects liability period is 12 months or longer: Annually.
4. Completion

4.1 Testing
- Do not install insulation until the piping has been tested. Pressure test cold and hot water services to AS/NZS 3500.1 Section 16. Include pipe joints, valve seats, tap washers and strainers. Repair as necessary, replace if damaged and retest.
- Carry out verification tests and measurements to demonstrate compliance with the documents.
- Submit reports indicating observations and results of tests and compliance or non-compliance with requirements.

4.2 Completion
- Hot warm and domestic cold water services shall be completely and thoroughly flushed using water and be left clean.
- Stormwater and wastewater services shall be completely and thoroughly flushed using water and be left clean.

4.3 Charging
On completion of installation, commissioning, testing and disinfection, fill the hot, warm and cold water systems with water, turn on control and isolating valves and the energy supply and leave the water supply system in full operational condition.

4.4 Operation and maintenance manuals
General: Provide written operating and maintenance instructions containing:
- Contractor's contact details for service calls.
- Manufacturer's maintenance and operation literature.
- Manufacturer's warranty certificates if the manufacturer's warranty period is greater than the defects liability period.
- Description of day-to-day operation.
- Schedule of recommended maintenance.
- Heated water systems: Maintenance instructions to AS/NZS 3666.2.
- Recommendations for the operation, care and maintenance of appliances, storage tanks, valves, and their associated fittings.
- Installation description: General description of the installation. Include definitions of terms used in the manuals.
- Systems descriptions: Technical description of the systems installed, written to ensure that the operating and maintenance personnel fully understand the scope and facilities provided. Identify function, normal operating characteristics and limiting conditions.
- Equipment descriptions:
  - Manufacturers' technical literature for equipment installed, assembled specifically for the project, excluding irrelevant matter. Mark each product data sheet to clearly identify specific products and component parts used in the installation, and data applicable to the installation.
  - Supplements to product data to illustrate relations of component parts. Include typed text as necessary.
- Operation procedures:
  - Safe starting up, running-in, operating and shutting down procedures for systems installed. Include logical step-by-step sequence of instructions for each procedure.
  - Legend for colour-coded services.
- Schedules of fixed and variable equipment settings established during commissioning and maintenance.
- Maintenance procedures:
  - Schedule of normal consumable items, local sources of supply, and expected replacement intervals up to a running time of 40,000 hours. Include lubricant and lubrication schedules for equipment.
  - Schedule of maintenance work including frequency and manufacturers' recommended tests.
  - Instructions for use of tools and testing equipment.
  - Emergency procedures, including telephone numbers for emergency services and procedures for fault finding.
  - Material safety data sheets (MSDS).
  - A list of special safety devices and their set points.
  - Instructions for complying with the periodic testing and maintenance requirements of AS 2896.
- Certificates:
  - Copies of signed test certificates to AS 2896.
  - All other testing and commissioning results.
- Record drawings
  - Provide a drawing of the system as installed. Include all shop drawings. Show dimensions, types and location of the services in relation to permanent site features and other underground services. Show the spatial relationship to building structure and other services. Include all changes made during commissioning and the maintenance period.
  - Domestic cold water or fire mains shall show the pressure available at the initial connection point and the pressure available at the most disadvantaged location on each major section of the works.
  - Diagrams shall be included of each system.
  - Where pipes and fittings are below ground show the depth and dimensioned references that
will allow the future location of the service for maintenance or expansion.

4.5 Training

General: Explain and demonstrate to the principal's staff the purpose, function and operation of the installations.
5. Schedules

5.1 Samples Schedule
The contractor shall provide samples in good time and prior to any installation as listed below:

<table>
<thead>
<tr>
<th>Sample required</th>
<th>Physical Sample</th>
<th>Technical Details / Sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sink</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Tundish</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Hot water unit</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Boiling water unit and tundish</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Recycled water pump</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Back wash filters</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>UV - Disinfection</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>RPZD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First flush diverter</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>In-ground rainwater tank</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>TMV</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

5.2 Schedule of Equipment

<table>
<thead>
<tr>
<th>Item</th>
<th>Technical Data</th>
<th>Make / Model</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiling water unit</td>
<td>P = 1.7kW</td>
<td>Zip Hydroboil Hydro Tap BC60/85</td>
<td>With sleep mode.</td>
</tr>
<tr>
<td>RPZD</td>
<td></td>
<td>M.A. Griffith</td>
<td>Complete with in-wall tundish and wall box</td>
</tr>
<tr>
<td>Hot water unit</td>
<td>V = 50L P = 3 x 3.6kW</td>
<td>Rheem 613 050</td>
<td>Installed complete with controller</td>
</tr>
<tr>
<td>First flush diverter</td>
<td></td>
<td>Waterflow Control WFC 1000600 Volume Filter VF6</td>
<td>Install within inspection chambers.</td>
</tr>
<tr>
<td>In-ground rainwater tank</td>
<td>V = 10,000L</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Recycled water pump

<table>
<thead>
<tr>
<th>Q = 1 L/s</th>
<th>H = 40m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable speed, pressure controlled.</td>
<td>Dual pump station to be sized to 2 x 50% capacity with automatic change over.</td>
</tr>
</tbody>
</table>

- **Back wash filter 1st stage**: 90 microns, BWT infinity, With anti scale screen, electronic timer, connection module & pressure gauges.
- **Bag filter 2nd stage**: 50 microns, WFC FSI X100, Polypropylene housing with internal bag filter and pressure gauges.
- **UV-disinfection**: 4.50m³/h, BWT 80W80/11 LC 316 S/S, Including isolation valves, bypass valves and controller.
- **TMV**: Enware Aquablend TMV 1500, Complete with stainless steel wall box.

### 5.3 Piping Schedule

<table>
<thead>
<tr>
<th>System</th>
<th>Pipe material and nominal size</th>
<th>Grade or class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold water</td>
<td>PP-R or polyethylene pipe, DN15-20 (alternative material: Pe-X for in-wall installation or rough-ins)</td>
<td>PN12 below ground</td>
</tr>
<tr>
<td>Hot water</td>
<td>PP-R or polyethylene pipe, DN15-25 fibre composite (alternative material: Pe-X for in-wall installation or rough-ins)</td>
<td>PN12 below ground</td>
</tr>
<tr>
<td>Recycled water</td>
<td>PP-R lilac to Authorities requirements DN15-20 (alternative material: Pe-X for in-wall installation or rough-ins)</td>
<td>PN12 below ground</td>
</tr>
<tr>
<td>Sanitary plumbing and drainage</td>
<td>PVC-U DN65-DN100</td>
<td>DWV</td>
</tr>
<tr>
<td>Down pipes (visible)</td>
<td>Refer to architectural details</td>
<td></td>
</tr>
<tr>
<td>Rainwater collection</td>
<td>PVC-U DN100-DN200</td>
<td>U-PVC DWV</td>
</tr>
</tbody>
</table>

### 5.4 Sanitary Fixtures Schedule

Provide sanitary fixtures complete with all accessories necessary for correct installation and use. Refer to architectural drawings/specification for details.

<table>
<thead>
<tr>
<th>Item</th>
<th>Technical Data</th>
<th>Make / Model</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Technical Data</td>
<td>Make / Model</td>
<td>Additional Comments</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>Wall tundish</td>
<td>Stainless steel</td>
<td>Stainless Metal</td>
<td>For indoor location. Final location to be coordinated with architect.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Craft TU-RE-2</td>
<td></td>
</tr>
<tr>
<td>Floor waste</td>
<td>Stainless steel</td>
<td>SPS</td>
<td></td>
</tr>
</tbody>
</table>
This document is and shall remain the property of GHD. The document may only be used for the purposes for which it was commissioned and in accordance with the Consultancy Agreement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

**Document Status**

<table>
<thead>
<tr>
<th>Rev No.</th>
<th>Author</th>
<th>Reviewer</th>
<th>Approved for Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Name</td>
<td>Signature</td>
</tr>
<tr>
<td>A – 60% issue</td>
<td>R. Oechsle</td>
<td>I. Krakov</td>
<td>IK*</td>
</tr>
<tr>
<td>B – Tender issue</td>
<td>Y. Kwan</td>
<td>I. Krakov</td>
<td>IK*</td>
</tr>
<tr>
<td>C – Revised Tender Issue</td>
<td>R. Oechsle</td>
<td>I. Krakov</td>
<td>IK*</td>
</tr>
</tbody>
</table>
EXHIBIT D – PLANNING APPROVAL

The Planning Approval comprises the following documents:

Review of Environmental Factors, Cardiff Station Upgrade – Stages 2 & 3, Version 1.0 dated 28 April 2011 (including REF Determination and Conditions of Approvals)
Review of Environmental Factors

Cardiff Railway Station Accessibility Upgrade – Stages 2 & 3
# Document History

<table>
<thead>
<tr>
<th>Version</th>
<th>Author</th>
<th>Issued</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>Jarred Kramer</td>
<td>2010</td>
<td>Draft at concept stage</td>
</tr>
<tr>
<td>0.2</td>
<td>Lesley Corkill</td>
<td>March 2011</td>
<td>Draft at 30% design</td>
</tr>
<tr>
<td>0.3</td>
<td>Lesley Corkill</td>
<td>21 April 2011</td>
<td>Draft at 60% design</td>
</tr>
<tr>
<td>1.0</td>
<td>Lesley Corkill</td>
<td>28 April 2011</td>
<td>Final REF</td>
</tr>
</tbody>
</table>
## Contents

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Project Description &amp; Scope of Works</td>
<td>4</td>
</tr>
<tr>
<td>1.1</td>
<td>Project Description and Scope of Work:</td>
<td>5</td>
</tr>
<tr>
<td>1.2</td>
<td>Reason and justification for the project</td>
<td>6</td>
</tr>
<tr>
<td>1.3</td>
<td>Construction Methodology</td>
<td>7</td>
</tr>
<tr>
<td>1.4</td>
<td>Current Environment</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>Statutory Planning and Approval</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Community and Authority Consultation</td>
<td>13</td>
</tr>
<tr>
<td>4</td>
<td>Potential Environmental Impacts</td>
<td>14</td>
</tr>
<tr>
<td>4.1</td>
<td>Land contamination and disposal of excavated material</td>
<td>14</td>
</tr>
<tr>
<td>4.2</td>
<td>Noise</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>EPBC Matters of NES &amp; EP&amp;A Regulation Clause 228 Factors</td>
<td>22</td>
</tr>
<tr>
<td>5.1</td>
<td>EPBC Act and Matters of NES</td>
<td>22</td>
</tr>
<tr>
<td>5.2</td>
<td>EP&amp;A Regulation Clause 228 Factors</td>
<td>23</td>
</tr>
<tr>
<td>6</td>
<td>Risk Assessment of the Project's Environmental Impacts</td>
<td>26</td>
</tr>
<tr>
<td>7</td>
<td>Project Justification</td>
<td>36</td>
</tr>
<tr>
<td>8</td>
<td>REF Determination and Conditions</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>ASSESSOR DECLARATION</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>DETERMINER DECLARATION &amp; APPROVAL</td>
<td>37</td>
</tr>
</tbody>
</table>

**Appendix A:** Mine Subsidence District Map  
**Appendix B:** EPBC Act Search  
**Appendix C:** Aboriginal Sites Search  
**Appendix D:** Geotechnical report  
**Appendix E:** Hazardous Materials Register for Cardiff Railway Station (at 9 March 2011)  
**Appendix F:** NSW Natural Resource Atlas (at 16 March 2011)  
**Appendix G:** Architectural drawings
# Project Description & Scope of Works

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>Cardiff Railway Station Accessibility Upgrade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Manager:</td>
<td>Cindy Yearn, Joe Dundovic</td>
</tr>
<tr>
<td>Location Name:</td>
<td>Cardiff Railway Station</td>
</tr>
<tr>
<td>Location Details:</td>
<td>The station is situated on the eastern edge of the suburb of Cardiff, and is located within the local government area of Lake Macquarie City Council. Three streets bound the site namely Main Road to the north, which continues pass the station and becomes an overpass crossing the train tracks, Mary Street to the west and Thomas Street to the south.</td>
</tr>
</tbody>
</table>

## Project Timeframe:

<table>
<thead>
<tr>
<th>Commencement date:</th>
<th>June 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of construction activities:</td>
<td>1 to 2 years</td>
</tr>
<tr>
<td>Timing of construction work:</td>
<td></td>
</tr>
<tr>
<td>Day:</td>
<td>Monday to Friday 7:00am to 6:00pm Saturday 8:00am to 1:00pm</td>
</tr>
<tr>
<td>Weekends:</td>
<td>Works permitted on weekends only during possessions (and during normal business hours on Saturday 8:00am to 1:00pm)</td>
</tr>
<tr>
<td>Nights/Evenings:</td>
<td>Works permitted at evenings/night only during weekend possessions</td>
</tr>
</tbody>
</table>

| Duration and frequency of operational activities: | The easy access facilities will be permanent and continuous, and will operate within the working hours of the station. |
1.1 Project Description and Scope of Work:

The project involves the following works:

<table>
<thead>
<tr>
<th>Station accessibility and the platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. New lift (3 stop), linking lower carpark, upper carpark level and the pedestrian footbridge, and the associated landings, awnings, weather protection enclosures, accessible paths, and services.</td>
</tr>
<tr>
<td>2. New lift (2 stop), linking the pedestrian footbridge and platform, and the associated landings, awnings, weather protection enclosures, accessible paths, and services.</td>
</tr>
<tr>
<td>3. New footbridge extension, including all balustrades and anti throw screens (Up side).</td>
</tr>
<tr>
<td>4. Regraded ramp entry from the Main Road to the footbridge (Dn side).</td>
</tr>
<tr>
<td>5. Regraded ramp/footpath access from the City side of the Main Road to the upper carpark level (Up side).</td>
</tr>
<tr>
<td>6. Shared Access on the upper carpark level (Up side)</td>
</tr>
<tr>
<td>7. New stair access between the lower carpark, upper carpark level and footbridge level (Up side).</td>
</tr>
<tr>
<td>8. New bike rack (upper carpark level)</td>
</tr>
<tr>
<td>9. Platform extension to achieve 200m length platform, at 'Level Access' and compliant cross fall.</td>
</tr>
<tr>
<td>10. Platform raising (of existing platform) to achieve 'Level Access' and compliant cross fall.</td>
</tr>
<tr>
<td>11. Compliant accessible paths on platform, (and removal of seat shelter).</td>
</tr>
<tr>
<td>12. New platform, stair, ramp, landing tactile indicators</td>
</tr>
<tr>
<td>13. Removal of existing seating shelter due to low height and narrow accessible path (up side)</td>
</tr>
<tr>
<td>15. New fire rated storage space beneath platform stairs.</td>
</tr>
<tr>
<td>16. Demolish and rebuild main station building</td>
</tr>
<tr>
<td>17. New wind screening within the new platform canopies.</td>
</tr>
<tr>
<td>18. Provide and/or modify all required services (PA, CCTV, lighting, power, provision for other services, etc), furniture (seats, bins, etc), fencing and signage to the platform.</td>
</tr>
<tr>
<td>19. Allowance to be made for pits and inspection openings.</td>
</tr>
<tr>
<td>20. Provide platform drainage to suit platform extension and platform raising.</td>
</tr>
<tr>
<td>21. Modify the existing station building awning to achieve the required height clearance.</td>
</tr>
<tr>
<td>22. General repairs and improvements to the platform as required.</td>
</tr>
<tr>
<td>23. Temporary booking office during construction works</td>
</tr>
<tr>
<td>24. Underground water tank to be provided and connected to services</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Footbridge and stair works</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. New broom finish concrete landings to new lifts.</td>
</tr>
<tr>
<td>2. Removal of existing stairs between footbridge and upper carpark level.</td>
</tr>
<tr>
<td>4. Modification to existing balustrades to accommodate new lift landings.</td>
</tr>
<tr>
<td>5. Anti throw screens to full extent of footbridge.</td>
</tr>
<tr>
<td>6. Localised repairs, including any painting, to existing footbridge, stair structure, balustrades and handrails.</td>
</tr>
<tr>
<td>7. Tactiles to top and bottom of stairs, ramps and lift lobbies.</td>
</tr>
<tr>
<td>8. New pre-cast concrete stair treads to all stairs complete with AS1428 compliant nosing.</td>
</tr>
<tr>
<td>9. Make good existing structures as required</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Street level works</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. New retaining wall at lower carpark level to accommodate lift, lift and stair landings, stairs and footpath.</td>
</tr>
<tr>
<td>2. New and/or altered footpath at lower carpark level to accommodate lift, lift and stair landings, and stairs.</td>
</tr>
<tr>
<td>3. New and/or altered drainage at lower and upper carpark levels.</td>
</tr>
<tr>
<td>4. Road and civil works to suit new and/or altered works.</td>
</tr>
<tr>
<td>5. Modifications, relocations, and/or demolition of existing structures (fencing, lighting, paths, roads, crossings, signs, landscaping etc) to suit new and/or altered works.</td>
</tr>
<tr>
<td>6. Removal of redundant structures and services, and making good.</td>
</tr>
<tr>
<td>7. Provision of a bin enclosure.</td>
</tr>
</tbody>
</table>

Author: Lesley Corkill – Projects Division, Environment Unit
Determinate: Richard Mumford – Projects Division, Stations and Buildings
8. Minor landscaping in open areas.
9. Three new disabled car spaces in lower carpark
10. Removal of two (2) trees in lower carpark

**Services**

1. Containment and cabling for electrical/lighting supply, new PA system, phones and lift stop alarm.
2. Upgrade electrical supply downstream of Distribution Supply Main Switchboard (DSMSB).
3. Power to the lifts.
4. Lighting to lift shaft/pit/car/entries/foyers, paths, stairs, walkways, bridge, and any connecting walkway.
5. Lighting to the platform.
6. Power and lighting to the station building modifications.
7. Containment and cabling for CCTV, extending from new CCTV cameras back to the CCTV rack (existing) located in the Station Building.
8. All/any subsoil, water, sewer, stormwater and drainage services, including all/any relocations, diversions and/or disconnections, in conjunction with the lift shaft/pit/awnings/foyers etc.
9. Tidy up and rationalisation of services/fixtures/boards in the station booking office and building.
10. Security system, alarm panel, remote locking to be provided in the station booking office and building.
11. RailCorp Infrastructure (OHW, Signals, Track) works (both design & construction) in conjunction with the platform extension.

The following works are outside the scope of the project:

- New platform canopies are under construction under a separate RailCorp project and REF. These new platform canopies have been designed/constructed to take into account future platform raising.
- Construction of temporary stairs connecting the upper and lower carpark, including the removal of two (2) trees and trimming of another tree in the lower carpark. This work will be carried out under Stage 1 of the project, which is subject to a separate REF due to earlier scheduling of the works.

**1.2 Reason and justification for the project**

RailCorp is committed to providing accessibility upgrades across the rail network. Cardiff Railway Station has been identified as requiring accessibility upgrading and is listed as a high priority project. The upgrade works will help integrate the station and associated facilities within the surrounding context and establish Cardiff Railway Station as an address and gateway for Cardiff.

Another aim of the project is to reduce the safety incidences of passenger risk resulting from a short platform and improve the accessibility of the station, which is currently listed as high for safety incidents. These improvements are expected to enhance public safety and provide better disability access, and provide comfortable, safe, complying and attractive environment for all users.

This REF is for Stages 2 & 3 of the Cardiff Railway Station Accessibility Upgrade Project. Stage 1 of the project involved enabling works including the installation of temporary stairs, removal of 2 native trees and trimming of another tree in the lower car-park. The environmental impact of Stage 1 was assessed under an earlier REF due to the construction schedule. Stages 2 and 3 of the project have been assessed separately in this REF to allow for further resolution of the design, thereby ensuring that environmental impacts are assessed to the fullest extent. Control measures have been nominated in this REF for Stages 2 & 3, and were also incorporated into the separate REF for Stage 1, to ensure that potential cumulative environmental impacts of the accessibility upgrade project are addressed.
1.3 Construction Methodology

The work will involve the following main construction activities:

- Site set-up including erection of hoarding around construction areas;
- Delivery of construction materials and equipment;
- Excavation and demolition/removal of existing structures where required;
- Temporary stockpiling and removal of construction waste;
- Installation and fit-out of new structures/items; and
- Site restoration and cleanup.

The work is to be undertaken in line with the following staging:

- Stage 2 – Easy Access Works (including lift, bridge extension, stairs, part platform extension for lift only, platform raising (of existing platform) and replacement of the existing platform building.
- Stage 3 – Platform Extension Works (excluding the part platform extension for the lift only).

It is expected that construction phase of the project will include intermittent bored piling for the lift and stair structures, delivery of concrete by concrete pump trucks, concrete saw-cutting, use of a 200 tonne crane, hammering, breaking and handling of materials and waste, use of backhoes, bobcats and excavators, waste collection and bin drop-off by waste trucks, delivery of construction materials by heavy and light vehicles and the operation of power tools.

Construction activity is not expected to significantly increase traffic movements in the vicinity of Cardiff Railway Station. The majority of heavy vehicles used during the construction period will primarily consist of delivery trucks, waste trucks, concrete trucks, a 200 tonne crane, backhoes, bobcats and excavators. The total number of truck deliveries expected during normal working hours would be 5 in and 5 out per day. The likely route for construction traffic will be via Main Road.

The volume of excavation for the platform extension and lift installation is estimated to be up to 1000 cubic metres. Waste from the demolition of the existing platform building is estimated to be about 80 cubic metres.

1.4 Current Environment

Cardiff Railway Station is located in the suburb of Cardiff, New South Wales on the Newcastle and Central Coast Line. The station has one island platform that serves the Up and Down mains. There is a footbridge at the City (northern) end. The station office consists of a single storey building of brick and fibro construction with metal roof. There are two commuter carparks located on the western side of the station, benched over two levels with a height difference of about 3.0m. A railway yard abuts to the upper carpark to the south.

The site is situated on undulating to rolling terrain. Surrounding ground surface slopes down to the south-west at an average angle of about 10 degrees. The railway station is situated about 6m below Main Road to the north east and about the same level as the upper carpark to the south west. The lower carpark further to the south west of the station is situated at Mary Street level.1 Main Road passes over the railway station to the north and features reasonably high traffic flow.

The lower carpark, which is owned by Lake Macquarie Council, is in close proximity to low density residential housing on Mary Street. The side boundary of the car park directly adjoins a residential property. Traffic noise from Myall Road is also audible in the lower carpark.

1 GeoEnviro Consultancy Pty Ltd (2009) Geotechnical Investigation Proposed Station Upgrade – New Canopies Cardiff Railway Station Main Road, Cardiff, NSW
On the eastern side of the station there is mixture of two storey commercial and residential buildings. Construction noise complaints about a previous RailCorp project at Cardiff Station were received from a resident on Main Road on this side of the station.

The railway line is used by freight trains, which emit higher noise levels than standard passenger trains.

The project site is located in the Hunter-Central River catchment area. There are a number of stormwater drainage inlets on site, particularly in the lower and upper carpark areas. It is likely that that project site drains eventually to Winding Creek, which is located about 300 metres away.

The project site is predominantly sealed or gravelled or ballasted areas. The acid sulphate soils risk maps for Cardiff indicate that no acid sulfate soils are likely to exist at the site (see Appendix F).

There are a number of native trees in the lower carpark area.

There are no state or local heritage listings affecting the project site. There are reportedly no Aboriginal sites recorded within 200 metres of the site according to Department of Environment Climate Change and Water’s Aboriginal Heritage Information Management System (see Appendix C).

The project site is located in the Lake Macquarie Mine Subsidence District (see Appendix A). Mine subsidence districts indicate conflict between mine subsidence and new development. Subsidence is the lowering or settling of the land’s surface after underground mining has taken place. It is unclear whether there is any chance of actual mine subsidence at the site and this needs to be clarified with the Mine Subsidence Board.

Access to the work areas exist from three points namely the end of Mary Street (to the lower carpark), driveway off Main Road leading to the upper carpark and western side of the station, and Main Road passing the eastern side of the station. There is a locked compound area at the southern end of the upper carpark.

The 1:250,000 Geological map of Newcastle indicates the site to be underlain by Newcastle Measures consisting of shale, sandstone, conglomerate, tuff, chert and coal seams. A geotechnical investigation by GeoEnviro Consultancy Pty Ltd (2009) identified that bedrock at the site is expected to be deep, greater than 10 metres. The site investigation revealed the station platform to be underlain by a 25mm to 30mm thick layer of asphalt concrete overlying poorly compacted fill, overlying natural clay at depths of between 1.4 and 1.6 metres below the existing platform level. In the yard at the southern end of the upper carpark, natural soil was encountered beneath the fill at a depth of about 2.4m below existing ground surface. Neither groundwater nor rock were encountered during the investigation despite one bore depth of up to 10.6 metres. The investigation did not extend to the lower carpark area. A copy of the geotechnical report is provided as Appendix D.

The Hazardous Materials Register (see Appendix E) for Cardiff Station indicates that the main station building on platform 1 contains the following hazardous materials, all of which are recommended for removal prior to refurbishment/demolition:

- Hot water unit in the kitchen
- 200m² of SMF insulation in the ceiling space
- Hot water unit in ceiling space
- 200m² of sarking in ceiling space

---

2 GeoEnviro Consultancy Pty Ltd (2009) Geotechnical Investigation Proposed Station Upgrade – New Canopies Cardiff Railway Station Main Road, Cardiff, NSW
Figure 1: Aerial photograph of Cardiff Railway Station (image source: Department of Lands, Spatial Information Exchange). Closest residential receivers circled blue.

Site Photos (Taken 16 Feb 2011):

Figure 2: View of the lower car park, standing on the upper car park level looking south west

Figure 3: View of the lower car park, looking west
Cardiff Railway Station Accessability Upgrade – Stages 2 & 3
Review of Environmental Factors

Figure 4: View of the lower car park, looking north east towards the existing footbridge

Figure 5: Native trees at the edge of the lower carpark, looking east

Figure 6: View of the existing bike rake along the driveway into the upper car park, looking north towards Main Road

Figure 7: View of the upper car park, looking south east

Figure 8: View of the existing footbridge, standing in the upper car park, looking north towards Main Road

Figure 9: View of the northern end of the platform, looking north east

2 trees to be removed in background

Locked compound
Figure 10: View of the station platform, looking south from the existing footbridge.

Figure 11: View of the station platform from the upper car park, looking south east.
2 Statutory Planning and Approval

2.1 Planning considerations

State Environmental Planning Policy (Major Development) 2005
This SEPP identifies certain developments which are deemed major projects under Part 3A of the Environmental Planning and Assessment Act 1979 (EP&A Act) and are determined by the Minister for Planning. The project does not meet the criteria listed in Schedule 1, Section 23 (Rail and related transport facilities). As such, it is not subject to Part 3A assessment under the EP&A Act.

State Environmental Planning Policy (Infrastructure) 2007
State Environmental Planning Policy (Infrastructure) 2007 commenced on 1 January 2008. The Infrastructure SEPP aims to assist in the effective delivery of public infrastructure across the State by improving certainty and regulatory efficiency through consistent planning assessment and approvals regime for public infrastructure and services and through the clear definition of environmental assessment and approval process for public infrastructure and services facilities. Under Division 15 Clause 79 (1) of the SEPP:

"Development for the purpose of a railway or rail infrastructure facilities may be carried out by or on behalf of a public authority without consent on any land."

Hence, the activity is assessed under Part 5 of the EP&A Act.

State Environmental Planning Policy No. 14 – Coastal Wetlands
The proposed works do not impact on any SEPP 14 wetlands and as such, the SEPP is not relevant to the proposed works.

State Environmental Planning Policy No. 26 – Littoral Rainforests
The proposed works do not impact on littoral rainforest and as such, the SEPP is not relevant to the proposed works.

State Environmental Planning Policy No. 55 – Remediation of Land
SEPP 55 provides for a consistent State-wide planning approach to the remediation of contaminated land. The policy states that land must not be developed if it is unsuitable for a proposed use because it is contaminated. If the land is unsuitable, remediation must take place before the land is developed. As this project is being conducted within the existing rail corridor, does not involve a change of land use and does not involve remediation of land the SEPP is not relevant to the proposed works.

Local Environment Plan
The permissibility of the proposed work under the local council LEP is not relevant as SEPP (Infrastructure) 2007 overrides local controls.

Environment Protection Licence
RailCorp holds Environment Protection Licence 12208 for ‘railway systems activities’ in accordance with the Protection of the Environment Operations Act 1997 (POEO Act). The project does not meet the definition of ‘railway systems activities’ nor does it trigger any other premises-based licensing requirements under the POEO Act.

2.2 Appropriate consent mechanism

This activity is "permitted with consent" under the SEPP (Infrastructure) 2007 and has been assessed and determined in accordance with Part 5 of the EP&A Act. RailCorp is both the Proponent and approval authority.
## 3 Community and Authority Consultation

<table>
<thead>
<tr>
<th>Who have you consulted?</th>
<th>When did you consult them?</th>
<th>Summary of comments raised</th>
<th>Outline how comments have been addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Macquarie City Council</td>
<td>To be carried out 21 days prior to works commencing on-site</td>
<td>Traffic and Pedestrian Management Plan for the entry/egress to the site during the construction phase</td>
<td>To be determined</td>
</tr>
<tr>
<td>Jason McKenzie, Asset Inspector - Natural Areas, Lake Macquarie City Council</td>
<td>26 Feb 2011</td>
<td>Council recommended new planting in the lower car park and on top of the crib wall to off-set removal of 2 trees (plus removal of 2 additional trees and trimming of another tree under Stage 1, covered by a separate REF) in the lower car-park</td>
<td>Landscaping will be carried out by RailCorp as per the landscaping plan for the project with consideration of planting recommendations by Council. Council has been forwarded a copy of the landscaping plan for approval.</td>
</tr>
<tr>
<td>Peter Semple, Environmental Specialist Biodiversity, RailCorp</td>
<td>16 Mar 2011</td>
<td>Copy of the preliminary proposed landscape plan (Ref 21-20144-SK) and Council's comments about planting forwarded. Peter advised that the landscaping proposal was satisfactory.</td>
<td>Landscaping will be carried out as per the approved landscaping plan.</td>
</tr>
<tr>
<td>Commuters using the site</td>
<td>Via local newspaper advertisement and leaflets delivered prior to works commencing</td>
<td>Initial advice regarding the work commencement and expected completion timeframes</td>
<td>Notification only</td>
</tr>
<tr>
<td>Residents and other sensitive receivers near the site</td>
<td>5 days prior to noisy or out-of-hours works commencing</td>
<td>Notification only</td>
<td>Notification only</td>
</tr>
<tr>
<td>Paul Gray District Supervisor Subsidence Board, Newcastle District Office</td>
<td>12 April 2011 the project</td>
<td>Cardiff Railway station is not undermined and unlikely to be mined in the future. Plans stamped.</td>
<td>No further action required</td>
</tr>
<tr>
<td>Hunter Water Corporation</td>
<td>3 March 2011</td>
<td>Various requirements relating to the relocation of the sewer main</td>
<td>Design plans will be submitted by RailCorp's Project Manager for a 'Major Works' assessment prior to construction commencing</td>
</tr>
</tbody>
</table>
4 Potential Environmental Impacts

The works will not be carried out in critical habitat of an endangered species, population or ecological community (identified under the Threatened Species Conservation Act 1995 or the Fisheries Management Act 1994).

The works will not be carried out in a wilderness area (identified under the Wilderness Act 1987).

The works will not be carried out in a contaminated site as specified under the Contaminated Land Management Act, 1997.

4.1 Land contamination and disposal of excavated material

Existing environment and Potential Impacts

Previous investigations of other railway land in the Cardiff area indicate that there is a potential risk for soil contamination at the site. In order to carry out the an extension to the platform and the lift / stair installation/s, excavation to a depth of 2 to 3 metres covering an area of 475 square metres will be carried out resulting in approximately 1000 cubic metres of spoil for off-site disposal. The majority of this spoil will be generated from the installation of the lift and stairs connecting the upper and lower car-park areas, and is likely to comprise fill material potentially containing contaminants.

Mitigation measures

The potential impacts of land contamination and subsequent disposal of excavated material generated from the project works will be minimised by implementing a number of mitigation measures, which include:

- Preparation of a preliminary waste classification and contamination assessment to accurately define the nature and extent of contamination at the site, for the purpose of disposal and potential on-site reuse of excavated material. Where contaminated soils are identified, specific strategies and control measures must be formulated via an Environment Management Plan (EMP) in order to manage any risks posed by the identified contamination to site workers, the public and the environment during the site works.

- Work shall cease immediately if unknown area(s) of potentially contaminated materials are encountered during excavation works. It is likely that the following actions will then be carried out:
  - Storage of potentially contaminated materials separately on an impermeable surface, and covered to protect against wind and rain. The stockpiled material will not be placed near any stormwater inlets or waterways.
  - Testing of the stockpiled material for contaminants and advice sought from a suitably qualified environmental specialist on the management of the contaminated material.
  - All identified contaminated material to be disposed off-site will be classified in accordance with the Waste Classification Guidelines (DECCW, 2009) and transported to a licensed landfill site for disposal.
  - If the potentially contaminated materials include asbestos containing material (ACM), it is likely that the following additional actions will be carried out:
    - Advice sought from a qualified Occupational Hygienist as to whether the ACM is bonded or friable.
    - ACM removed by a WorkCover licensed asbestos removalist under the supervision of the Occupational Hygienist, following the preparation of an Asbestos Removal and Management Plan.
    - ACM removal carried out strictly in accordance with Code of Practice for the Management and Control of Asbestos in the Workplace [NOHSC: 2018 (2005)] published by the NOHS Commission, as in force from time to time.
4.2 Noise

The project does not involve extending the NSW rail network. The project does not involve track duplication in a residential area. The project does not involve construction of a cross-over, siding, turnout, yard, loop, refuge, relief line or reopening a disused line, where it will result in significant noise impacts on residents.

4.2.1 Operational Noise

Existing Environment and Potential Impacts

A new enhanced PA system will be installed at Cardiff Railway Station as part of this project in accordance with the RailCorp (2010) Enhanced Public Address System Design and Installation Guideline. No complaints have been recorded by RailCorp in the past 12 months about environmental noise from the existing older style PA system at Cardiff Station. However, over the past few months, only about 2 speakers have been in operation (one at each end of the platform) as a result of the canopy replacement project and subsequent removal of some of the speakers. Announcements generally start after 6am each day and conclude at about 7:15 weekdays and 7:40pm on weekends. Station staff trigger pre-recorded announcements during this period and can make individual announcements about train scheduling.

Acoustic studies carried out at other stations following installation of the new enhanced PA system have shown that it produces less environmental noise spill than the older systems. The new systems generally run live public address and automated DVA announcements from first to last train in accordance with the Disability Discrimination Act. This means that the first morning announcement at Cardiff Station will be at about 2:51am and the last at 1:55am at Cardiff Station according to the current timetable. Assuming correct installation and setup of the new enhanced PA system at Cardiff Station, there should result in no or minimal noise impact to residents nearby during the day-time. It is possible that noise from the system in the early morning and late evening/night could cause a noise nuisance.

Mitigation measures

The potential impacts of noise from the operation of the new enhanced PA system will be minimised by implementing a number of mitigation measures, which include:

- Post-installation testing and commissioning of the system will be carried out in accordance with section 18 of the RailCorp (2010) Enhanced Public Address System Design and Installation Guideline.
- An acoustic specialist will be engaged post commissioning of the new system to assess the environmental noise impact of the PA system announcements at the nearest residential receivers. The assessment will involve noise measurements ($L_{A15\min}$ and short-term background noise monitoring) between 7:00pm and the latest train, plus the earliest train to 6:00am (as shown in the CityRail timetable). The specialist will make recommendations (if necessary) in order to meet the noise goal of less than or equal to background plus 5dB(A) at the nearest residential receivers.
4.2.2 Construction Noise

The construction phase of the project may cause noise impacts to sensitive receivers as a result of demolition and construction works such as intermittent bored piling for lift and stair structures, delivery of concrete by concrete pump trucks, concrete saw-cutting, use of a 200 tonne crane, hammering, breaking and handling of materials and waste, use of backhoes, bobcats and excavators, waste collection and bin drop-off by waste trucks, delivery of construction materials by heavy and light vehicles and the operation of power tools.

It is likely that a temporary work compound will be established at the site in the upper carpark area to receive deliveries and store waste for collection. Any necessary permission will be sought from the Lake Macquarie Council to establish suitable times for vehicles to access the work sites.
### Construction Noise Assessment

<table>
<thead>
<tr>
<th>Distance to nearest sensitive receiver (m)</th>
<th>Approx. construction noise level at 7m, dB(A)</th>
<th>Noise screening or barriers</th>
<th>Ambient noise environment at receiver</th>
<th>Timing of construction work</th>
<th>Duration of construction work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note 1</td>
<td>Note 2</td>
<td>Note 3</td>
<td>Note 4</td>
<td>Category</td>
<td>Rating</td>
</tr>
<tr>
<td>&lt;10</td>
<td>-10</td>
<td>110</td>
<td>-10 Quiet, rural or isolated</td>
<td>-35</td>
<td>0 &lt;1hr</td>
</tr>
<tr>
<td>10-25</td>
<td>-16</td>
<td>90</td>
<td>-55 Urban or near busy roads or industrial activity</td>
<td>20 Night-time (2200 - 0700 weekdays, 2200 - 0800 weekends / public holidays)</td>
<td>1 week</td>
</tr>
<tr>
<td>25-50</td>
<td>-18</td>
<td>80</td>
<td>-55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-100</td>
<td>-22</td>
<td>80</td>
<td>-55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100-200</td>
<td>-28</td>
<td>80</td>
<td>-55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200-600</td>
<td>-34</td>
<td>80</td>
<td>-55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>500-1000</td>
<td>-40</td>
<td>80</td>
<td>-55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;1000</td>
<td>-46</td>
<td>80</td>
<td>-55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratings</td>
<td>-10</td>
<td>100</td>
<td>-55</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Score</td>
<td>65</td>
<td>65</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

**Impact/Risk Level Ranges**

- **Low**: <25 (highly likely that noise mitigation will not be required, other than those identified above and if complaints “hot spots” have been considered)
- **Moderate**: >25 and 35 (consider mitigation other than those identified above, inform community)
- **High**: >35 (inform community, implement all practical means to mitigate, seek specialist advice if >50)

**NOTE**: The above construction noise assessment is based on a worse case scenario of the noisiest works happening at night for longer than half a year, however not all works will be carried.
Existing Environment and Potential Impacts

The locality is generally suburban to urban with an acoustic environment that is affected by continuous traffic flows along Main Road, which passes over the railway station to the north. The railway line is used by freight trains, which emit higher noise levels than standard passenger trains. Traffic noise from Myall Road is also audible in the lower car park area.

The timing of construction works for the project is:

| Day               | Monday to Friday 7:00am to 6:00pm  
|                   | Saturday 8:00am to 1:00pm          |
| Weekends:         | Works permitted on weekends only during possessions (and during normal business hours on Saturday 8:00am to 1:00pm) |
| Nights/Evenings:  | Works permitted at evenings/night only during weekend possessions |

Nearby sensitive receivers to the project site include:

- On the western side of the station there are residences buildings located directly next to and opposite the lower car park on Mary Street (about 30 metres away).
- On the eastern side of the station, there is mixture of two storey commercial and residential buildings (about 30 metres away).

Typical equipment to be utilised to complete the work have the following range of A-weighted sound pressure levels at 30m:

<table>
<thead>
<tr>
<th>Plant Description</th>
<th>A-weighted sound power levels $L_{WA}$ (mid-point) dB ref. $10^{-12}$ W*</th>
<th>Predicted A-weighted sound pressure levels $L_{PA}$ (mid-point) dB at 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backhoe</td>
<td>104</td>
<td>66</td>
</tr>
<tr>
<td>Concrete saw</td>
<td>117</td>
<td>79</td>
</tr>
<tr>
<td>Concrete pump truck</td>
<td>108</td>
<td>70</td>
</tr>
<tr>
<td>Mobile crane</td>
<td>104</td>
<td>66</td>
</tr>
<tr>
<td>Excavator</td>
<td>107</td>
<td>69</td>
</tr>
<tr>
<td>Generator (diesel)</td>
<td>99</td>
<td>61</td>
</tr>
<tr>
<td>Piling (bored)</td>
<td>111</td>
<td>73</td>
</tr>
<tr>
<td>Truck (&gt;20 tonne)</td>
<td>107</td>
<td>66</td>
</tr>
<tr>
<td>Truck (dump)</td>
<td>117</td>
<td>79</td>
</tr>
<tr>
<td>Vehicles (light commercial)</td>
<td>106</td>
<td>68</td>
</tr>
</tbody>
</table>

* Table from Appendix A1 of AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites

The rating background level (RBL) for Cardiff Railway Station is likely to be between 40-45 dBA during evening/night and 55-60dBA during the day. The results above indicate that goal of background noise level (RBL) + 5dBA will be exceeded for the majority of day, evening and night works. It is therefore anticipated that noise from the proposed works will impact sensitive receivers around Cardiff Railway Station, with the closest residential receiver being within 30 metres of the site on Mary Street.

For night works, sleep disturbance should be considered. The DECCW (2010) Noise Guide for Local Government recommends that an $L_{A1, 1min}$ should not exceed the background noise by more than 15dBA external to a bedroom window between 10:00pm and 7:00am. Furthermore the EPA (1999) Environmental Criteria Road Traffic Noise (ECTRN), concludes:
- Maximum internal noise levels below 50-55dBA are unlikely to cause awakening reactions; and
- One or two noise events per night, with maximum internal noise levels of 65-70dBA, are not likely to affect health and well-being significantly.

Hence, given the likely sound pressure levels at 30 metres as calculated above, it is possible that the construction works may cause some sleep disturbance to nearby residential receivers if these works are undertaken between 10:00pm and 7:00am.

The DECCW (2010) *Interim Construction Noise Guideline* recommends that restrictions be applied to the hours of construction where activities will generate noise at residences above the 'highly noise affected' noise management level (ie 75dBA or greater). In addition, noisy works should only be carried out outside of normal business hours (ie Monday to Friday 7:00am to 6:00pm and Saturday 8:00am to 1:00pm) where there is strong justification, reasonable and feasible work practices are applied and community negotiation is potentially carried out.

It is possible that impulsive or intermittent vibration may originate from various construction activities at the project site such as occasion loading and unloading, passing heavy vehicles and occasional dropping of heavy equipment.

**Possible Mitigation Measures**

The potential impacts of noise and vibration from the project works will be minimised by implementing a number of mitigation measures, which include:

- Preparation of a Construction and Vibration Noise Management Plan (CNVMP) as a sub-plan of the Construction Environment Management Plan (CEMP) for the project. The CNVMP must include, but need not be limited to:
  - identification of sensitive receivers identified within the impacted zone(s);
  - detailed summary of expected noise and vibration impacts at these receivers (where, when and for how long etc);
  - clear descriptions of the hours of work to balance noise and vibration impacts on receivers (including justifications);
  - detailed examination of what feasible and reasonable practices are available to minimise noise and vibration impacts including, but not limited to the noise control measures outlined in the table below, and an estimation of approximate noise reduction when possible;
  - commitment to what feasible and reasonable practices will be applied to manage noise and vibration (including reasoning and justifications);
  - how complaints will be handled (description of readily accessible contact point, complaints process, maintaining a complaints register etc);
  - monitoring and reporting procedures, including regular internal checks by project team; and
  - how often the plan will be reviewed and updated to continuously apply best practice noise and vibration management for the duration of the project.
  - commitment to what feasible and reasonable practices will be applied to manage noise and vibration (including reasoning and justifications);
  - how complaints will be handled (description of readily accessible contact point, complaints process, maintaining a complaints register etc);
  - monitoring and reporting procedures, including regular internal checks by project team; and
  - how often the plan will be reviewed and updated to continuously apply best practice noise and vibration management for the duration of the project.
<table>
<thead>
<tr>
<th>Possible Construction Noise Control Measures</th>
<th>Construction Noise Control Measures to be implemented during construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximising the offset distance between noisy plant items and nearby residential receivers</td>
<td>Yes</td>
</tr>
<tr>
<td>Avoid the simultaneous operation of two or more noisy plant items in close vicinity and adjacent to residential receivers</td>
<td>No</td>
</tr>
<tr>
<td>Schedule the noisiest activities during normal business hours (7am and 6pm Monday to Friday and 8am and 1pm Saturday), or where this is not possible, to less sensitive times of day</td>
<td>Yes</td>
</tr>
<tr>
<td>Provide periods of quiet if activities occur for extended periods during the night</td>
<td>No</td>
</tr>
<tr>
<td>Minimise consecutive night time activities in the same locality</td>
<td>Yes</td>
</tr>
<tr>
<td>Orient equipment away from residential receivers</td>
<td>No</td>
</tr>
<tr>
<td>Carry out loading and unloading away from residential receivers</td>
<td>Yes</td>
</tr>
</tbody>
</table>

- **Maximising the offset distance between noisy plant items and nearby residential receivers**: Fixed site location. Position any noisy plant items as far as practical from residential receivers.

- **Avoid the simultaneous operation of two or more noisy plant items in close vicinity and adjacent to residential receivers**: Stage the use of plant and equipment to avoid the simultaneous operation of two (2) or more noisy plant items in close vicinity and adjacent to residential receivers.

- **Schedule the noisiest activities during normal business hours (7am and 6pm Monday to Friday and 8am and 1pm Saturday), or where this is not possible, to less sensitive times of day**: Where possible, conduct noisy activities during normal business hours. Schedule noisiest works for early in the evenings or in the middle of the day during weekend possessions. Noisy works involving the use of concrete cutters, concrete pumps and piling rigs are to be completed before 10pm. Notify any residents and other sensitive receivers of any works that are to be conducted outside normal business hours and/or are likely to be noisy at least 5 days prior to those works being carried out.

- **Provide periods of quiet if activities occur for extended periods during the night**: Limit the use of noisy plant and equipment to 3 consecutive hours if carried out during the evening/night as part of a weekend possession, and provide minimum respite period of 1 hour between each block. There is a possibility of night-works during weekend possessions. Local residents must be notified of such works 5 days in advance and periods of quiet that will be provided to reduce impacts.

- **Minimise consecutive night time activities in the same locality**: Evening/night works are only permitted during weekend possessions, and are therefore limited to no more than 3 consecutive nights.

- **Orient equipment away from residential receivers**: Fixed site location. Where possible, position equipment away from residential receivers.

- **Carry out loading and unloading away from residential receivers**: Fixed site location. Carry out loading and unloading activities where practical during business hours and away from residential receivers.
### Possible Construction Noise Control Measures

<table>
<thead>
<tr>
<th>Possible Construction Noise Control Measures</th>
<th>Construction Noise Control Measures to be implemented during construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position site access points and roads as far as possible away from residential receivers</td>
<td>□ No</td>
</tr>
<tr>
<td>Use structures to shield residential receivers from noise</td>
<td>□ No</td>
</tr>
<tr>
<td>Plan for and conducting night time activities in ways that eliminate or minimise the need for audible warning alarms</td>
<td>□ No</td>
</tr>
<tr>
<td>Notify residents of any proposed activities which are to be conducted outside normal business hours and which are likely to create offensive noise</td>
<td>□ No</td>
</tr>
<tr>
<td>Carry out works in a competent and considerate manner</td>
<td>□ No</td>
</tr>
</tbody>
</table>
5 EPBC Matters of NES & EP&A Regulation Clause 228 Factors

5.1 EPBC Act and Matters of NES

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) aims to:

- provide for the protection of the environment, especially matters of national environmental significance
- conserve Australian biodiversity
- provide a streamlined national environmental assessment and approvals process
- enhance the protection and management of important natural and cultural places
- control the international movement of plants and animals (wildlife), wildlife specimens and products made or derived from wildlife
- promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources

Matters of national environmental significance (NES) are protected under the Act and these matters:

- World Heritage properties
- National Heritage places
- wetlands of international importance
- listed threatened species and ecological communities
- migratory species protected under international agreements
- Commonwealth marine areas
- nuclear actions (including uranium mines)

A search of the EPBC Act for a 0.2 km radius around the project site indicated the following matters of NES were within the area (See Appendix B for EPBC listing search results).

- 0 World Heritage Properties;
- 0 National Heritage Places;
- 1 Wetland of International Significance (RAMSAR Site);
- 0 Commonwealth Marine Areas;
- 0 Threatened Ecological Communities;
- 16 Threatened Species; and
- 14 Migratory Species

There are no matters of national environmental significance that would be affected as a result of this project.

A search of the NSW Government threatened species database identifies 125 threatened species in the Hunter Catchment Management Authority (CMA) sub-region, which includes the subject site. The database does not provide a more focused search function for this locality.

The likelihood of disturbing actual or potential habitats associated with the threatened species and matters of NER are considered to be low as the works will be confined to the project site and associated assess points. There are no threatened species known to occur on the site.

No commonwealth land would be affected, either directly or indirectly, as a result of this project.
### 5.2 EP&A Regulation Clause 228 Factors

<table>
<thead>
<tr>
<th>CLAUSE 228 FACTORS</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Any Environmental Impact On A Community?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>During the construction phase, the residential community near the site may be impacted by increased noise levels. Control measures will be nominated as part of the project's risk assessment to minimise this impact on the community. The operational phase of the project is expected to positively influence the community as it will provide greater accessibility to the station and train services.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Any Transformation Of A Locality?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Transformation of the locality will occur as the proposed works involve construction of new infrastructure facilities, which will significantly improve the station facilities and amenities. The development may alter the views of the station though is not anticipated to impact on the consistency of character of the railway corridor. It is not expected to cause additional light reflection or shadowing. During evening and night-time works carried out during weekend possessions, lighting towers will illuminate work areas which may cause temporary nuisance for adjoining residents. Sensitive areas for light spill from evening/night time works include all residential areas where property adjoins the work site. No or minimal operational light spill is expected. Control measures will be nominated as part of the project's risk assessment to ensure that these potential risks to the locality are controlled.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Any Environmental Impact On the Ecosystems of the Locality?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>d. Any Reduction of the Aesthetic, Recreational, Scientific or Other Environmental Quality or Value of a Locality?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>e. Any Effect on A Locality, Place Or Building Having Aesthetic, Anthropological, Archaeological, Architectural, Cultural, Historical, Scientific Or Social Significance Or Other Special Value For Present Or Future Generations?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>f. Any Impact On The Habitat Of Protected Fauna (Within The Meaning Of The National Parks And Wildlife Act 1974)?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>g. Any Endangering Of Any Species Of Animal, Plant Or Other Form Of Life Whether Living On Land, In Water Or In The Air?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>h. Any Long Term Effects On The Environment?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Author: Lesley Corkill – Projects Division, Environment Unit
Determiner: Richard Mumford – Projects Division, Stations and Buildings
<table>
<thead>
<tr>
<th>CLAUSE 228 FACTORS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Any Degradation Of The Quality Of The Environment?</td>
<td>☑ Yes ☑ No</td>
</tr>
<tr>
<td>j. Any Risk To The Safety Of The Environment?</td>
<td>☑ Yes ☑ No</td>
</tr>
<tr>
<td>There is a risk to the safety of the environment, particularly during the construction phase of the project. This could include injury from physical hazards, worker movements and the use of plant and machinery. The site is currently used by commuters. Temporary fencing will be constructed around active work areas to protect pedestrians and customers from the construction works, and works staged to minimise disturbance to station operations and commuters. Other matters that may affect the safety of the environment are discussed below under ‘Any Pollution of the Environment?’. Control measures will be nominated as part of the project’s risk assessment to ensure that these potential risks to the safety of the environment are controlled.</td>
<td></td>
</tr>
<tr>
<td>k. Any Reduction In The Range Of Beneficial Uses Of The Environment?</td>
<td>☑ Yes ☑ No</td>
</tr>
<tr>
<td>l. Any Pollution of the Environment?</td>
<td>☑ Yes ☑ No</td>
</tr>
<tr>
<td>There is a risk of pollution arising, particularly arising during the construction phase of the project. For instance, there is potential for pollution of waters from the use and wash out of concrete, inappropriate transport and disposal of waste, and dust and noise from demolition and construction activities. Control measures will be nominated as part of the project’s risk assessment to ensure that these potential pollution risks are controlled.</td>
<td></td>
</tr>
<tr>
<td>m. Any Environmental Problems Associated with the Disposal of Waste?</td>
<td>☑ Yes ☑ No</td>
</tr>
<tr>
<td>Large quantities of demolition and construction waste will be generated from the site as part of the project. Control measures will be nominated as part of the project’s risk assessment to ensure that potential waste transport and disposal issues are controlled.</td>
<td></td>
</tr>
<tr>
<td>n. Any Increased Demands on Resources (Natural or Otherwise) that are or are Likely to Become in Short Supply?</td>
<td>☑ Yes ☑ No</td>
</tr>
<tr>
<td>o. Any Cumulative Environmental Effect with Other Existing or Likely Future Activities?</td>
<td>☑ Yes ☑ No</td>
</tr>
<tr>
<td>This REF is for Stages 2 &amp; 3 of the Cardiff Railway Station Accessibility Upgrade Project. Stage 1 of the project involved enabling works including the installation of temporary stairs, removal of 2 native trees and trimming of another tree in the lower car-park. The environmental impact of Stage 1 was assessed under an earlier REF due to the construction schedule. Stages 2 and 3 of the project have been assessed separately in this REF to allow for further resolution of the design, thereby ensuring that environmental impacts are assessed to the fullest extent. Control measures have been nominated in this REF for Stages 2 &amp; 3, and were also incorporated into the separate REF for Stage 1, to ensure that potential cumulative environmental impacts of the accessibility upgrade project are addressed.</td>
<td></td>
</tr>
<tr>
<td>CLAUSE 228 FACTORS</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>Any Impact on Coastal Processes and Coastal Hazards, including those under Projected Climate Change Conditions?</td>
</tr>
</tbody>
</table>

Cardiff Railway Station Accessability Upgrade – Stages 2 & 3
Review of Environmental Factors
# 6 Risk Assessment of the Project's Environmental Impacts

<table>
<thead>
<tr>
<th>Consequence:</th>
<th>MINOR:</th>
<th>MODERATE:</th>
<th>MAJOR:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood:</td>
<td>Minimal environmental impact / community concern, or Short term duration.</td>
<td>Moderate environmental impact, community concern or complaints, or duration of more than one month.</td>
<td>Major adverse environmental/ community impact, breach of legislation, or notable impacts to sensitive areas/receivers, extended duration.</td>
</tr>
<tr>
<td>LIKELY: in most cases</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>POSSIBLE: at some time</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>UNLIKELY to ever occur</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
</tr>
</tbody>
</table>

## Impacts, Cause, and Control Measures

<table>
<thead>
<tr>
<th>Impact Category</th>
<th>Cause(s)</th>
<th>Risk H/M/L</th>
<th>Control Measure(s)</th>
<th>Risk after control H/M/L</th>
<th>Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air:</td>
<td>Dust</td>
<td>M</td>
<td>The project site must be maintained in a proper and efficient condition. The project site must be maintained in a condition which minimises or prevents the migration of dust off-site. Loads of waste transported from the project site by vehicles must be adequately covered. Stabilise all disturbed areas as soon as possible to prevent wind blown dust. If required, use a water spray cart to dampen exposed areas and stockpiles of excavated materials to suppress dust. Carry out all demolition work in accordance with the provisions of relevant Australian Standards, including AS2601-2001 Demolition of structures. Ensure that the demolition is carried out with due consideration of all hazardous materials identified in RailCorp's Hazardous Materials Register for Cardiff Railway Station.</td>
<td>L</td>
<td>Principal Contractor/ Project Manager</td>
</tr>
<tr>
<td></td>
<td>Odour &amp; Fumes</td>
<td>X</td>
<td>Air: Dust generated from demolition and construction activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Smoke</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Greenhouse Gases</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Author: Lesley Corkill – Projects Division, Environment Unit
Determine: Richard Mumford – Projects Division, Stations and Buildings

© RailCorp
Page 26 of 46
## Review of Environmental Factors

<table>
<thead>
<tr>
<th>Impact Category</th>
<th>Cause(s)</th>
<th>Risk H/M/L</th>
<th>Control Measure(s)</th>
<th>Risk after control H/M/L</th>
<th>Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor</th>
</tr>
</thead>
</table>
|                 | Plant and equipment generated atmospheric pollutants/greenhouse gases | L | All plant and equipment installed at and for the project or used in connection with the project:  
(a) must be maintained in a proper and efficient condition; and  
(b) must be operated in a proper and efficient manner.  
Plant and equipment must be switched off when not in use.  
Plant and equipment must be maintained in good operating condition including regular servicing in accordance with manufacturers specifications. | L | Principal Contractor/ Project Manager |
| Water: | General demolition and construction works causing pollution of waters | M | The Project must comply with section 120 of the Protection of the Environment Operations Act 1997. | L | Principal Contractor/ Project Manager |
|     | Spills of fuel, oil or other chemical substances | M | All fuels, oil or other chemical substances must be stored in an area has a secondary containment system (eg bunding) that will minimise the risk of pollution from liquid spills and leaks. The secondary containment system must have sufficient capacity to hold 110% of volume of the largest container stored or, for facilities where where only small containers are stored, 95% of the total volume of stored product.  
All fuels and other hazardous substances must be stored at least 40 metres from watercourses.  
Hazardous materials must be used and stored in accordance with relevant Material Safety Data Sheets (MSDS).  
Appropriate equipment and absorbent material must be provided and maintained in a prominent position in order to combat any spill at the project sites. | L | Principal Contractor/ Project Manager |
<table>
<thead>
<tr>
<th>Impact Category</th>
<th>Cause(s)</th>
<th>Risk H/M/L</th>
<th>Control Measure(s)</th>
<th>Risk after control H/M/L</th>
<th>Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Soil, mud or sediment entering and polluting waterways due to washing or cleaning equipment/tools</td>
<td>M</td>
<td>All wash-down of soil, mud or sediment from equipment/ tools must be carried out within designed wash-down areas located away from drainage lines and stormwater pits. Wash-down areas shall utilise geotextile fabric to catch sediments laid over a ditch/depression (or a water tight skip bin). The depression shall have sufficient capacity to contain all wash-down water for percolation through the fabric without overflowing the depression. Captured sediment must be transported off-site for disposal at a waste facility that can lawfully receive that type of waste.</td>
<td>L</td>
<td>Principal Contractor/ Project Manager</td>
</tr>
<tr>
<td></td>
<td>Concrete residues and wastes entering waterways and causing pollution due to washing concrete-delivery trucks, on-site mixing, washing tools/equipment, hosing/cleaning surfaces and saw-cutting</td>
<td>M</td>
<td>Carry out concreting works in accordance with the Department of Environment and Conservation NSW (2004) <em>Environmental Best Practice Guideline for Concreting Contractors</em>. This should include as a minimum: 1. Establishing and using a concrete wash-down area on site; and 2. Managing concrete run-off waste in a manner that prevents stormwater pollution.</td>
<td>L</td>
<td>Principal Contractor/ Project Manager</td>
</tr>
<tr>
<td></td>
<td>Polluted run-off from stockpiles of materials entering the stormwater drainage system</td>
<td>M</td>
<td>Locate stockpiles away from waterways, roads, slopes steeper than '0%', and areas of concentrated water flow. Prevent runoff from washing through storage areas by locating stockpiles high on the site or diverting runoff around the site or the stockpile areas. Place sediment controls or bunding down the slope from stockpiles and provide weatherproof covering where possible.</td>
<td>L</td>
<td>Principal Contractor/ Project Manager</td>
</tr>
<tr>
<td></td>
<td>Discharge of sediment laden water from dewatering footings and excavations to the stormwater drainage system</td>
<td>M</td>
<td>Any dewatering of excavations or footings of sediment laden water resulting from the ingress of rainwater or groundwater shall be managed in accordance with <em>The Blue Book - Managing Urban Stormwater: Soils and Construction</em> - Volume 1, 4th Edition (Landcom).</td>
<td>L</td>
<td>Principal Contractor/ Project Manager</td>
</tr>
<tr>
<td>Impact Category</td>
<td>Cause(s)</td>
<td>Risk</td>
<td>Control Measure(s)</td>
<td>Risk after control</td>
<td>Person Responsible for ensuring the implementation of Controls</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------</td>
<td>------</td>
<td>--------------------</td>
<td>-------------------</td>
<td>-----------------------------------------------------------</td>
</tr>
<tr>
<td>Land:</td>
<td>Damage to sewer main during relocation works</td>
<td>M</td>
<td>Consult with Hunter Water Corporation and comply with any conditions that they impose resulting from their assessment of the design drawings for relocation of the sewer main.</td>
<td>L</td>
<td>Principal Contractor/Project Manager</td>
</tr>
<tr>
<td></td>
<td>Demolition and construction work may result in sediment being washed into stormwater drains</td>
<td>M</td>
<td>Establish effective sediment control measures for any works resulting in land disturbance in accordance with <em>The Blue Book - Managing Urban Stormwater: Soils and Construction - Volume 1, 4th Edition</em> (Landcom), so to prevent sediment and/or building materials being carried or washed onto the footpath, gutter, road or into the stormwater drainage system. These should include as a minimum: 1. stabilising entry and exit points to the work areas where possible; 2. diverting surface runoff around the works areas where necessary; 3. placing sediment barriers downslope of works areas and waste stockpiles; 4. placing sediment barriers around any stormwater drains/pits; 5. undertaking regular inspections of all sediment control structures; and 6. immediately adjusting or reinstating any structure found to be ineffective. Hardstand areas must be reinstating as soon as possible.</td>
<td>L</td>
<td>Principal Contractor/Project Manager</td>
</tr>
<tr>
<td></td>
<td>Vehicles tracking sediment onto roads</td>
<td>M</td>
<td>Ensure vehicles are clean prior to leaving the project site. If sediment is tracked onto road, ensure it is swept up immediately and disposed of lawfully. Water is not to be used to wash any material into stormwater drains.</td>
<td>L</td>
<td>Principal Contractor/Project Manager</td>
</tr>
<tr>
<td></td>
<td>Spills causing contamination of soil</td>
<td>M</td>
<td>Immediately contain and clean up any spills, excavate any contaminated soil and ensure that no contamination is left in situ, and transport the waste to a place that can lawfully received it.</td>
<td>L</td>
<td>Principal Contractor/Project Manager</td>
</tr>
</tbody>
</table>
### Cardiff Railway Station Accessibility Upgrade – Stages 2 & 3

#### Review of Environmental Factors

<table>
<thead>
<tr>
<th>Impact Category</th>
<th>Cause(s)</th>
<th>Risk H/M/L</th>
<th>Control Measure(s)</th>
<th>Risk after control H/M/L</th>
<th>Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor</th>
</tr>
</thead>
</table>
|                 | Encountering contaminated material during excavation works | H           | Prepare a preliminary waste classification & contamination assessment to accurately define the nature and extent of contamination at the site, for the purpose of disposal and potential on-site reuse of excavated material. Where contaminated soils are identified, specific strategies and control measures must be formulated via an EMP in order to manage any risks posed by the identified contamination to site workers, the public and the environment during the site works. Work must cease immediately should previously unknown area(s) of potentially contaminated materials be encountered during excavation works. It is likely that the following actions will then be required:  
- Store potentially contaminated materials separately on an impermeable surface, and cover to protect against wind and rain. The stockpiled material must not be placed near any stormwater inlets or waterways.  
- Test the stockpiled material for contaminants and seek advice from a suitably qualified environmental specialist on the management of the contaminated material.  
- All identified contaminated material to be disposed off-site must be classified in accordance with the Waste Classification Guidelines (DECCW, 2009) and transported to a licensed landfill site for disposal.  
- If the potentially contaminated materials include asbestos containing material (ACM), it is likely that the following additional actions will be required:  
  o Seek advice from a qualified Occupational Hygienist as to whether the ACM is bonded or friable.  
  o Ensure that the ACM is removed by a WorkCover licensed asbestos removalist under the supervision of the Occupational Hygienist, following the preparation of an Asbestos Removal and Management Plan.  
  o ACM removal is to be carried out strictly in accordance with Code of Practice for the Management and Control of Asbestos in the Workplace [NOHSC: 2018 (2005)] published by the NOHS Commission, as in force from time to time.  
  o Temporary storage on site (if off-site disposal cannot take place immediately) must be in an environmentally safe manner, in quantities less than 5 tonnes at any time, and removed at the earliest opportunity.  
  o An asbestos clearance certificate for the site must be prepared by a suitably qualified Occupational Hygienist at the completion of the removal works. | M           | Principal Contractor/ Project Manager |
### Noise and Vibration

**Cause(s):**
- Vehicle movements and use of construction equipment (possibly including concrete saws, piling, jackhammers, hammers, drilling and cutting hand tools).

**Control Measure(s):**
- Work must only be conducted between the approved hours for the project.
- Prepare and implement a Construction Noise and Vibration Management Plan in accordance with Section 4.2 of this REF.
- Wherever practicable the following measures must be implemented:
  - Position any noisy plant items and equipment as far as practical from residential receivers;
  - Stage the use of plant and equipment to avoid the simultaneous operation of 2 or more noisy plant items in close vicinity and adjacent to residential receivers;
  - Where possible, conduct noisy activities during normal business hours;
  - Schedule noisiest works for early in the evenings or in the middle of the day during weekend possessions. Noisy works involving the use of concrete cutters, concrete pumps and piling rigs are to be completed before 10pm;
  - Notify any residents and other sensitive receivers of any works that are to be conducted outside normal business hours and/or are likely to be noisy at least 5 days prior to those works being carried out. Periods of quiet that will be provided to reduce impacts should also form part of the notification;
  - Limit the use of noisy plant and equipment to 3 consecutive hours if carried out during the night as part of a weekend possession, and provide minimum respite period of 1 hour between each block;
  - Night works are only permitted during weekend possessions, and are therefore limited to no more than 3 consecutive nights;
  - Carry out loading and unloading activities where practical during business hours and away from residential receivers;
  - Position access points to the sites as far from residential receivers as possible;
  - Use broadband reversing alarms only and design worksites for direct access and exits to minimise the need for reversing;
  - No whistles to be used for crane operations, instead radios should be utilised to minimise the impact to the surrounding residents;
  - No yelling, slamming of car doors or portable radios on site;
  - Avoid dropping materials from a height where practical; and
  - Schedule truck movements to avoid residential streets where possible.

**Risk after control H/M/L:**
- M

**Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor:**
- Principal Contractor/Project Manager
<table>
<thead>
<tr>
<th>Impact Category</th>
<th>Cause(s)</th>
<th>Risk</th>
<th>Control Measure(s)</th>
<th>Risk after control</th>
<th>Person Responsible for ensuring the implementation of Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Testing, commissioning and operation of PA System</td>
<td>M</td>
<td>Install, test and commission the PA System in accordance with the RailCorp (2010) Enhanced Public Address System Design and Installation Guideline. An acoustic specialist will be engaged post commissioning of the new system to assess the environmental noise impact of the PA system announcements at the nearest residential receivers. The assessment will involve noise measurements (L-eq,Δt) and short-term background noise monitoring) between 7:00pm and the latest train, plus the earliest train to 6:00am (as shown in the CityRail timetable). The specialist will make recommendations (if necessary) in order to meet the noise goal of less than or equal to background plus 5dBA at the nearest residential receivers.</td>
<td>L</td>
<td>Principal Contractor/Project Manager</td>
</tr>
<tr>
<td></td>
<td>Removal and pruning of trees and other vegetation</td>
<td>L</td>
<td>Removal of two (2) native trees located in the lower car-park area, as indicated on the architectural drawings attached to this REF, is to be carried out by an Arborist. To offset the removal of the trees, develop and implement a landscape plan in consultation with Lake Macquarie City Council, using locally indigenous plant species as per the RailCorp Revegetation Technical Specification EMS-09-TP-0066 (section 4.1). Restrict the trimming and/or removal of any other vegetation to the minimum necessary. Engage an Arborist if necessary to advise on suitable measures to protect trees to be retained from damage by construction activities.</td>
<td>L</td>
<td>Principal Contractor/Project Manager</td>
</tr>
<tr>
<td></td>
<td>Excavation of material causing damage to tree roots</td>
<td>L</td>
<td>Where possible avoid cutting or damaging tree roots during excavation works.</td>
<td>L</td>
<td>Principal Contractor/Project Manager</td>
</tr>
</tbody>
</table>

Flora and Fauna:
- Native vegetation
- Trimming/removing established trees >3m
- Habitat
- Threatened Species
- Sensitive areas: Wetlands, Bush regeneration areas etc
- Noxious Weeds
- Pesticides Use
<table>
<thead>
<tr>
<th>Impact Category</th>
<th>Cause(s)</th>
<th>Risk H/M/L</th>
<th>Control Measure(s)</th>
<th>Risk after control H/M/L</th>
<th>Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste and Resource Use</td>
<td>Waste generated from demolition and construction works</td>
<td>M</td>
<td>Follow the resource management hierarchy principles embodied in the <em>Waste Avoidance and Resource Recovery Act 2001</em>, namely:</td>
<td>L</td>
<td>Principal Contractor/ Project Manager</td>
</tr>
</tbody>
</table>
|                                 |                                                                          |            | 1. avoid unnecessary resource consumption;  
2. recover resources (including reuse, reprocessing, recycling and energy recovery); and  
3. dispose (as a last resort).  
Dispose of concrete waste from concrete wash-down areas off-site to a waste facility that can lawfully receive that type of waste.  
Classify all waste in accordance with the DECCW Waste Classification Guidelines as in force from time to time, and transport the waste to a waste facility that can lawfully receive it.  
Maintain a waste register in accordance with RailCorp’s *Environmental Management Specification for Contractors*. The register must also include copies of waste docket/receipts from the waste facility where the waste transported (date and time of delivery, name and address of the facility, its ABN, contact person). |
| Poor quality fill material imported to the site. | M                         | The only fill material that may be imported to the site is virgin excavated natural material (within the meaning of the *Protection of the Environment Operations (POEO) Act 1997* and/or any other waste-derived material the subject of a resource recovery exemption under clause 51A of the *POEO (Waste) Regulation 2006* that is permitted to be used as fill material.  
Any VENM received at the site must be accompanied by waste classification documentation.  
Any waste-derived material the subject of a resource recovery exemption received at the site must be accompanied by documentation as to the material’s compliance with the exemption conditions. | L                        | Principal Contractor/ Project Manager                                                  |
| Waste material tracked onto public roads | M                        | Ensure that any spoil or waste tracked onto roads is immediately swept up and disposed of lawfully. Water is not to be used to wash any material or waste into stormwater drains. | L                        | Principal Contractor/ Project Manager                                                  |
### Cardiff Railway Station Accessibility Upgrade – Stages 2 & 3

**Review of Environmental Factors**

<table>
<thead>
<tr>
<th>Impact Category</th>
<th>Cause(s)</th>
<th>Risk</th>
<th>Control Measure(s)</th>
<th>Person Responsible for ensuring the implementation of Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social</td>
<td>Litter deposited from meals/materials</td>
<td>L</td>
<td>Provide an adequate number of bins at the project site for workers, and place all litter in these bins. Ensure that work areas of the project site are kept clean and free of litter, including cigarette butts, at all times. Remove all waste from the project site on completion of the works, and ensure that it transported to a waste facility that can lawfully receive that type of waste.</td>
<td>Principal Contractor/Project Manager</td>
</tr>
<tr>
<td>Social</td>
<td>Disruption and disturbance to local residents</td>
<td>M</td>
<td>Notify residents and other sensitive receivers of any works that are to be conducted outside normal business hours and/or are likely to be noisy at least 5 days prior to those works being carried out. Normal business hours are between 7am and 6pm Monday to Friday and 8am and 1pm Saturday.</td>
<td>Principal Contractor/Project Manager</td>
</tr>
<tr>
<td>Heritage:</td>
<td>No heritage items or areas exist at the site</td>
<td>-</td>
<td>N/A</td>
<td>-</td>
</tr>
<tr>
<td>Heritage:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aesthetic:</td>
<td>Use of temporary lighting during construction phase of project</td>
<td>M</td>
<td>To ensure minimisation of any disturbance to the local community, any activity requiring lighting must be arranged to ensure light is directed towards the work area and minimal nuisance light allowed into the surrounding neighbouring properties.</td>
<td>-</td>
</tr>
<tr>
<td>Aesthetic:</td>
<td>Light spill from new or relocated light poles for operational phase of project</td>
<td>L</td>
<td>Where possible any additional light spill must be kept to a minimum by ensuring any new or relocated light poles use light fittings with directional reflectors.</td>
<td>Principal Contractor/Project Manager</td>
</tr>
</tbody>
</table>

**Principal Contractor/Project Manager**
### Cardiff Railway Station Accessibility Upgrade – Stages 2 & 3

**Review of Environmental Factors**

<table>
<thead>
<tr>
<th>Impact Category</th>
<th>Cause(s)</th>
<th>Risk H/M/L</th>
<th>Control Measure(s)</th>
<th>Risk after control H/M/L</th>
<th>Person Responsible for ensuring the implementation of Controls E.g. Site Supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport</td>
<td>Disruption of public access</td>
<td>M</td>
<td>Construction vehicles, materials and equipment must be positioned to minimise impacts to public access. If disruption to access is caused, ensure alternative safe and accessible thoroughfare is provided.</td>
<td>L</td>
<td>Principal Contractor/Project Manager</td>
</tr>
<tr>
<td>□ Traffic and access</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Transport</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Land use impacts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vehicles transporting equipment and materials to and from the site may impact on traffic, property access and parking availability</td>
<td>L</td>
<td>Position construction vehicles, materials and equipment to minimise impacts to public access and parking. Ensure a Traffic and Pedestrian Management Plan is completed and approved by Lake Macquarie City Council for staged construction works to minimise and manage the disruption caused by the project</td>
<td>L</td>
<td>Principal Contractor/Project Manager</td>
</tr>
</tbody>
</table>
7 Project Justification

This REF has been prepared to assess the potential environmental impact of the Cardiff Railway Station Accessibility Upgrade.

The primary objectives of the project are as follows:

1. provide accessibility upgrade to Cardiff Railway Station; and

2. adopt best management and administrative practices and to comply with the Principles of Ecologically Sustainable Development in attaining the above objectives.

The Principles of Ecologically Sustainable Development applied to the Project

<table>
<thead>
<tr>
<th>ESD Principle</th>
<th>Application to the Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precautionary principle</td>
<td>The results of this REF indicate that the project does not pose a risk of serious or irreversible environmental damage. Adverse impacts associate with the project would be minor. Measures to reduce adverse impacts as far as practicable have also been identified within this REF.</td>
</tr>
<tr>
<td>Intergenerational equity</td>
<td>This project is unlikely to adversely impact on the environment to the extent that future generations would be deprived of natural resources that presently exist. The project is expected to contribute towards regional strategic benefits for future generations, including improved public transport, assuming the project encourages modal shift towards public transport. Upgrade to the station will make it more appealing transport option to a broader range of people in the community, including families and people with disabilities.</td>
</tr>
<tr>
<td>Conservation of biological diversity and ecological integrity</td>
<td>The project area is located in a highly developed urban area and would not result in any loss of biodiversity or ecological integrity.</td>
</tr>
<tr>
<td>Improved valuation and pricing of environmental resources</td>
<td>RailCorp recognises the value of environmental resources and aims to minimise the impacts of its activities by ensuring that appropriate mitigation measures are implemented for all aspects of the project.</td>
</tr>
</tbody>
</table>
8 REF Determination and Conditions

ASSESSOR DECLARATION

Name: Mat Neeson  
Title: Environmental Facilitator, RailCorp  
Location: 36-46 George Street, Burwood NSW 2134  
Phone: (02) 8575 0155  
Fax: (02) 8575 0312  
Mobile: 0459 819 197

This REF provides a true and fair review of the activity in relation to its likely effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the project, and provides sufficient information to determine whether there is likely to be a significant impact on the environment as a result of the Project.

I have considered all environmental impacts and safeguards to the best of my knowledge, and have sought advice where required.

Signature:  
Date: 28/04/11

DETERMINER DECLARATION & APPROVAL

Name: Richard Mumford  
Title: Program Manager Stations and Buildings, RailCorp  
Location: 36-46 George Street, Burwood NSW 2134  
Phone: (02) 9536 2599  
Mobile: 0417 494 371

I have reviewed the document and consider that the project will not have a significant impact and can proceed subject to the controls outlined in this REF.

Signature:  
Date: 27/04/11

The following actions must be undertaken as a condition of this approval.

1. The project must be undertaken in accordance with the description of the activity and environmental control measures listed in this Review of Environmental Factors (REF).

2. Prior to the commencement of any works on-site, the RailCorp Project Manager must complete any outstanding consultation as described in Section 3 of this REF.

3. A Construction Environment Management Plan (CEMP) identifying the potential risks of the activity and how these will be managed must be prepared to the satisfaction of the RailCorp Projects Division Environmental Unit.

4. As a minimum the risks and mitigation/controls measures provided in Section 4 and Section 6 of the REF must be included the CEMP.

5. The CEMP must include the following sub-plans:
   b. A Sediment and Erosion Control Plan, which complies with Managing Urban Stormwater: Soils and Construction (Landcom 2004) and incorporates a site diagram showing the positioning of controls.
   c. A Construction Noise and Vibration Management Plan as described in Section 4.1 of this REF.
   d. A Waste Management Plan that includes:
      i. details of, and the waste management action proposed for, each type of waste;
      ii. procedures that ensure the waste is transported to a lawful place; and
      iii. a description of the roles and responsibilities of everyone who manages the waste, including the site supervisor and sub-contractors.
6. Construction hours for this project are between 7am and 6pm Monday to Friday, and 8am and 1pm Saturday. Residents and other sensitive receivers must receive at least 5 days prior notification of any works that are:
   a. to be conducted outside these hours, namely during weekend possessions; and/or
   b. any works that are likely to be noisy.

   Any works scheduled to be carried out outside of the above construction hours must be approved as an addendum to this REF.

7. A copy of this REF and the CEMP are to be retained on-site and produced upon request.

8. Ensure relevant control measures are in place before work commences and that they are regularly monitored.

9. Brief personnel during site inductions on the location of sensitive areas and control measures identified.

10. Stop work and immediately notify the relevant Railcorp Projects Division Program Manager and Environmental Unit if you encounter anything which was not identified adequately or was previously unknown.

11. Prepare a preliminary waste classification and contamination assessment to accurately define the nature and extent of contamination at the site, for the purpose of disposal and potential on-site reuse of excavated material. Where contaminated soils are identified, specific strategies and control measures must be formulated via an EMP in order to manage any risks posed by the identified contamination to site workers, the public and the environment during the site works.

12. An acoustic specialist will be engaged post commissioning of the new system to assess the environmental noise impact of the PA system announcements at the nearest residential receivers. The assessment will involve noise measurements ($L_{Aeq15min}$ and short-term background noise monitoring) between 7:00pm and the latest train, plus the earliest train to 6:00am (as shown in the CityRail timetable). The specialist will make recommendations (if necessary) in order to meet the noise goal of less than or equal to background plus 5dB(A) at the nearest residential receivers.

13. This REF expires after five (5) years from the date of Determination unless works have physically commenced within that period.
Appendix A: Mine Subsidence District Map

LAKE MACQUARIE and LAKE MACQUARIE No.1 EXTENSION MINE SUBSIDENCE DISTRICT
LAKE MACQUARIE: PROCLAIMED 18th MAY 1962 NOTIFIED 15th MAY 1962
LAKE MACQUARIE No.1 EXTENSION: PROCLAIMED 19th JUNE 1969 NOTIFIED 25th JULY, 1969
UNDER SECTION 15(1) MINE SUBSIDENCE COMPENSATION ACT 1961
PARISHES OF NEWHAM, KAHALAH AND TERALBA
COUNTY OF NORTHUMBERLAND

Disclaimer:
This map has been compiled by the Mine Subsidence Board from official records held by the Department of Primary Industries - Mineral Resources, surface area supplied by the Department of Lands and by information supplied by the mine owners. Therefore no warranty is expressed or can be implied in any other person as to the accuracy of the map or that it is free from error or omission. Accordingly the State of New South Wales, the Mine Subsidence Board, their servants and agents expressly disclaim any liability whatsoever for the consequences arising from any act done or omission made in reliance by others on the information contained in the map. Further information is available from the Mine Subsidence Board.

The original Record Tapes are held by the Department of Primary Industries - Mineral Resources.
Appendix B: EPBC Act Search
Protected Matters Search Tool

You are here: Environment Home > EPBC Act > Search

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

You may wish to print this report for reference before moving to other pages or websites.

The Australian Natural Resources Atlas at http://www.environment.gov.au/atlas may provide further environmental information relevant to your selected area. Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

Search Type: Area
Buffer: 0.2 km
Coordinates: -32.9412058,151.6627726, -32.9412436,151.6620204, -32.9420630,151.6620750, -32.9418991,151.6626801, -32.9419538,151.6633861

Report Contents:
- Summary
- Details
  - Matters of NES
  - Other matters protected by the EPBC Act
  - Extra Information
- Caveat
- Acknowledgments

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html.

<table>
<thead>
<tr>
<th>World Heritage Properties</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Heritage Places</td>
<td>None</td>
</tr>
<tr>
<td>Wetlands of International Significance (Ramsar Sites)</td>
<td>1</td>
</tr>
<tr>
<td>Commonwealth Marine Areas</td>
<td>None</td>
</tr>
<tr>
<td>Threatened Ecological Communities</td>
<td>None</td>
</tr>
<tr>
<td>Threatened Species</td>
<td>16</td>
</tr>
<tr>
<td>Migratory Species</td>
<td>14</td>
</tr>
</tbody>
</table>

**Other Matters Protected by the EPBC Act**

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html.

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits/index.html.

<table>
<thead>
<tr>
<th>Commonwealth Lands</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commonwealth Heritage Places</td>
<td>None</td>
</tr>
<tr>
<td>Places on the RNE</td>
<td>None</td>
</tr>
<tr>
<td>Listed Marine Species</td>
<td>12</td>
</tr>
<tr>
<td>Whales and Other Cetaceans</td>
<td>None</td>
</tr>
<tr>
<td>Critical Habitats</td>
<td>None</td>
</tr>
<tr>
<td>Commonwealth Reserves</td>
<td>None</td>
</tr>
</tbody>
</table>
Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves: None
Other Commonwealth Reserves: None
Regional Forest Agreements: 1

Details

Matters of National Environmental Significance

Wetlands of International Significance [Dataset Information]
(Ramsar Sites)

**HUNTER ESTUARY WETLANDS**
Within 10 km of Ramsar site

**Threatened Species** [Dataset Information]

<table>
<thead>
<tr>
<th>Status</th>
<th>Type of Presence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endangered</td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Endangered</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Vulnerable</td>
<td>Species or species habitat may occur within area</td>
</tr>
</tbody>
</table>

**Birds**

*Anthochaera phrygia*
Regent Honeyeater

*Lathamus discolor*
Swift Parrot

*Rostratula australis*
Australian Painted Snipe

**Frogs**

*Litoria aurea*
Green and Golden Bell Frog

*Litoria littlejohni*
Littlejohn's Tree Frog, Heath Frog

**Mammals**

*Chalinolobus dyweryi*
Large-eared Pied Bat, Large Pied Bat

*Dasyurus maculatus maculatus (SE mainland population)*
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)

*Potorous tridactylus tridactylus*
Long-nosed Potoroo (SE mainland)

*Pseudomys novaehollandiae*
New Holland Mouse

*Pteropus poliocephalus*
Grey-headed Flying-fox

**Reptiles**

*Hoplocephalus bungaroides*
Vulnerable | Species or species habitat likely to occur within area |

### Broad-headed Snake

**Plants**
- **Cryptostylis hunteriana**  Leafless Tongue-orchid
- **Eucalyptus camfieldii**  Camfield's Stringybark
- **Melaleuca biconvexa**  Biconvex Paperbark
- **Pterostylis gibbosa**  Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood
- **Tetratheca juncea**  Black-eyed Susan

Migratory Species [Dataset Information]

### Migratory Terrestrial Species

**Birds**
- **Haliaeetus leucogaster**  White-bellied Sea-Eagle
- **Hirundapus caudacutus**  White-throated Needletail
- **Merops ornatus**  Rainbow Bee-eater
- **Monarcha melanopsis**  Black-faced Monarch
- **Myiagra cyanoleuca**  Satin Flycatcher
- **Rhipidura rufifrons**  Rufous Fantail
- **Xanthomyza phrygia**  Regent Honeyeater

### Migratory Wetland Species

**Birds**
- **Ardea alba**  Great Egret, White Egret
- **Ardea ibis**  Cattle Egret
- **Gallinago hardwickii**  Latham's Snipe, Japanese Snipe
- **Rostratula benghalensis s. lat.**  Painted Snipe

### Migratory Marine Birds
- **Apus pacificus**  Fork-tailed Swift
- **Ardea alba**  Great Egret, White Egret
- **Ardea ibis**  

*Species or species habitat may occur within area*
### Cattle Egret

**Other Matters Protected by the EPBC Act**

Listed Marine Species [Dataset Information]

<table>
<thead>
<tr>
<th>Birds</th>
<th>Status</th>
<th>Type of Presence</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Apus pacificus</em>&lt;br&gt;Fork-tailed Swift</td>
<td>Listed - overfly marine area</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td><em>Ardea alba</em>&lt;br&gt;Great Egret, White Egret</td>
<td>Listed - overfly marine area</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td><em>Ardea ibis</em>&lt;br&gt;Cattle Egret</td>
<td>Listed - overfly marine area</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td><em>Gallinago hardwickii</em>&lt;br&gt;Latham’s Snipe, Japanese Snipe</td>
<td>Listed - overfly marine area</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td><em>Haliaeetus leucogaster</em>&lt;br&gt;White-bellied Sea-Eagle</td>
<td>Listed</td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><em>Hirundapus caudacutus</em>&lt;br&gt;White-throated Needletail</td>
<td>Listed - overfly marine area</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td><em>Lathamus discolor</em>&lt;br&gt;Swift Parrot</td>
<td>Listed - overfly marine area</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td><em>Merops ornatus</em>&lt;br&gt;Rainbow Bee-eater</td>
<td>Listed - overfly marine area</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td><em>Monarcha melanopsis</em>&lt;br&gt;Black-faced Monarch</td>
<td>Listed - overfly marine area</td>
<td>Breeding may occur within area</td>
</tr>
<tr>
<td><em>Myiagra cyanoleuca</em>&lt;br&gt;Satin Flycatcher</td>
<td>Listed - overfly marine area</td>
<td>Breeding likely to occur within area</td>
</tr>
<tr>
<td><em>Rhipidura rufifrons</em>&lt;br&gt;Rufous Fantail</td>
<td>Listed - overfly marine area</td>
<td>Breeding may occur within area</td>
</tr>
<tr>
<td><em>Rostratula benghalensis s. lat.</em>&lt;br&gt;Painted Snipe</td>
<td>Listed - overfly marine area</td>
<td>Species or species habitat may occur within area</td>
</tr>
</tbody>
</table>

### Extra Information

Regional Forest Agreements [Dataset Information]
Note that all RFA areas including those still under consideration have been included.
North East NSW RFA, New South Wales

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under "type of presence". For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the migratory and marine provisions of the Act have been mapped.

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as *extinct* or *considered as vagrants*
- some species and ecological communities that have only recently been listed
  - some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very *widespread, vagrant, or only occur in small numbers*.

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgments

This database has been compiled from a range of data sources. The Department acknowledges the following custodians who have contributed valuable data and advice:

- New South Wales National Parks and Wildlife Service
- Department of Sustainability and Environment, Victoria
- Department of Primary Industries, Water and Environment, Tasmania
- Department of Environment and Heritage, South Australia Planning SA
- Parks and Wildlife Commission of the Northern Territory
- Environmental Protection Agency, Queensland
- Birds Australia
- Australian Bird and Bat Banding Scheme
- Australian National Wildlife Collection
- Natural history museums of Australia
- Queensland Herbarium
- National Herbarium of NSW
- Royal Botanic Gardens and National Herbarium of Victoria
- Tasmanian Herbarium
- State Herbarium of South Australia
- Northern Territory Herbarium
- Western Australian Herbarium
- Australian National Herbarium, Atherton and Canberra
- University of New England
- Other groups and individuals

ANUCiIM Version 1.8. Centre for Resource and Environmental Studies, Australian National University was used extensively for the production of draft maps of species distribution. Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Last updated: Thursday, 20-Nov-2008 14:17:56 EST
Appendix C: Aboriginal Sites Search
Railcorp - Burwood
PO Box 515
Burwood New South Wales 1805
Attention: Lesley Corkill

Date: 10 March 2011


A search of the DECCW AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

- 0 Aboriginal sites are recorded in or near the above location.
- 0 Aboriginal places have been declared in or near the above location.

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.

- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.

- You can get further information about Aboriginal places by looking at the gazetted notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette [http://www.nsw.gov.au/gazette] website. Gazettal notices published prior to 2001 can be obtained from DECCW's Aboriginal Heritage Information Unit upon request.

Important information about your AHIMS search

- AHIMS records information about Aboriginal sites that have been provided to DECCW and Aboriginal places that have been declared by the Minister;

- Information recorded on AHIMS may vary in its accuracy and may not be up to date. Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings;

- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.

- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.

- This search can form part of your due diligence and remains valid for 12 months.
Appendix D: Geotechnical report
Report

Geotechnical Investigation
Proposed Station Upgrade – New Canopies
Cardiff Railway Station
Main Road, Cardiff, NSW
28th October 2009
JG09294D-r1

Railcorp
C/- Caldis Cook Group
Level 2, 45 Chippen Street
CHIPPENDALE NSW 2008

Attention: Mr Ken Ng

Dear Sir

Re: Geotechnical Report
Proposed Station Upgrade – New Canopies
Cardiff Railway Station, Main Road, Cardiff

We are pleased to submit our geotechnical report for the proposed Station Upgrade project for Cardiff Railway Station at Main Road, Cardiff, NSW.

This report contains information on sub-surface conditions and our comments and recommendations on geotechnical issues for the proposed development.

Should you have any queries, please contact the undersigned.

Yours faithfully
GeoEnviro Consultancy Pty Ltd

Solern Liew CPEng (NPER)
Director

D:\09DB294\JG09294D-L1.DOC
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>2. SITE DESCRIPTION AND PROJECT APPRECIATION</td>
<td>1</td>
</tr>
<tr>
<td>3. INVESTIGATION METHODOLOGY</td>
<td>2</td>
</tr>
<tr>
<td>3.1 FIELDWORK</td>
<td>2</td>
</tr>
<tr>
<td>3.2 LABORATORY TESTING</td>
<td>3</td>
</tr>
<tr>
<td>4. RESULTS OF THE INVESTIGATION</td>
<td>4</td>
</tr>
<tr>
<td>4.1 SUBSURFACE CONDITIONS</td>
<td>4</td>
</tr>
<tr>
<td>4.2 LABORATORY TEST RESULTS</td>
<td>5</td>
</tr>
<tr>
<td>5. COMMENTS AND RECOMMENDATIONS</td>
<td>6</td>
</tr>
<tr>
<td>5.1 PLATFORM RESURFACING</td>
<td>6</td>
</tr>
<tr>
<td>5.2 NEW CANOPY</td>
<td>7</td>
</tr>
<tr>
<td>6. LIMITATIONS</td>
<td>8</td>
</tr>
</tbody>
</table>

LIST OF DRAWINGS
Drawing No 1 Borehole Location Plan

LIST OF APPENDICES
Appendix A Borehole Reports
Appendix B DCP Test Report
Appendix B Laboratory Test Reports
Appendix C Explanatory Notes and Graphic Symbols
1. INTRODUCTION

This report presents the results of a geotechnical investigation for the proposed station upgrade project for Cardiff Railway Station at Main Road, Cardiff, as shown on Drawing No 1. The investigation was commissioned by Mr Hisham Noori of Caldis Cook Group, acting on behalf of Railcorp. The scope of works were carried out in general accordance with our fee proposal Ref PG09936C dated 29th January 2009.

We understand that the project will include construction of new canopy structures on the station platform area. The new canopies will be about 40m long and cover an area of about 300m². The project will also include some resurfacing of the station platform pavements.

The purpose of this investigation was to assess the subsurface ground conditions and based on the information obtained, to provide the following;

- Assessment on site classification to AS2870.
- Recommendations on platform subgrade preparation and resurfacing.
- Recommendation on suitable footing types for the proposed canopies including allowable bearing capacities and foundation depths.

2. SITE DESCRIPTION AND PROJECT APPRECIATION

Cardiff Railway Station is located between Main Road and Mary Street at Cardiff. The station consists of an island platform with railway tracks on both sides of the platform and an overhead pedestrian footbridge on the northern side. The station office consists of a single storey building of brick and fibro construction with metal roof. There is a car park located on the western side of the station which was benched at two levels with a height difference of about 3.0m. A railway yard abuts to the upper car park to the south.

The site is situated on undulating to rolling terrain. Surrounding ground surface slopes down to the south-west at an average angle of about 10 degrees.
The railway station is situated about 6m below Main Road to the north east and about the same level as the upper carpark to the south west. The lower carpark further to the south west of the station is situated at Mary Street level. Based on the drawing provided, the island platform is at about Reduced Level (RL) 30.1m Australian Height Datum (AHD).

The 1:250,000 Geological map of Newcastle indicates the site to be underlain by Newcastle Measures consisting of shale, sandstone, conglomerate, tuff, chert and coal seams.

We understand that the project will include construction of new canopy structures on the station platform area and these canopies will be about 40m long starting from the overhead footbridge to the station building. The project will also include some pavement resurfacing on the platform.

3. INVESTIGATION METHODOLOGY

3.1 Fieldwork

Fieldwork for the investigation was carried out on the 6th October 2009 and involved drilling of three boreholes (BH 1 to BH 3). Boreholes No 1 was drilled in the railway yard area using a truck-mounted P160 drill rig equipped for site investigation purpose. This borehole was drilled to a depth of about 10.6m below existing ground surface. To assess the strength of the subsurface soil profile, Standard Penetration Tests (SPT) were carried out in the borehole. Hand penetrometer tests were carried out on the SPT split-tube clayey samples to augment the SPT test results.

Boreholes Nos 2 and 3 were drilled on the existing railway platform using a Dingo drill rig mounted on a rubber tracked machine. These boreholes were drilled using spiral augers to depths of about 2.7m and 2.8m respectively below existing ground surface. Immediate adjacent to these boreholes, Dynamic Cone Penetrometer tests (DCP 1 and DCP 2) were carried in order to aid assessment of the relative densities of subsurface profile.
Prior to boreholes drilling, underground services checks were carried out using available drawings provided by Dial-before-you-dig and Railsearch. An underground services locator equipped with a remote sensing device was engaged as an extra precautionary measure to reduce risk of damage to underground services caused by the borehole drilling.

Details of the subsurface profiles and field tests are summarised on the Borehole Reports in Appendix A. The DCP test results are summarised on the DCP Test Report in Appendix B. Explanatory notes defining the terms and symbols used on the preparation of the Borehole Report are attached in Appendix D.

The site investigation was supervised on a full-time basis by our geotechnical engineer and in the presence of a PO4 safety officer. The works were carried out on general accordance with Safe Work Method Statement (Ref JG09294D-L1 dated 09th June 2009).

3.2 Laboratory Testing

Two disturbed soil samples (BH 2 [0.8-1.0m] and BH 3 [1.8-2.0]) were taken from the site to our NATA accredited laboratory for Atterberg Limit tests to aid assessment of soil characteristics and reactivity to moisture variation.

The laboratory test results are summarised on Laboratory Test Reports in Appendix C.
4. RESULTS OF THE INVESTIGATION

4.1 Subsurface Conditions

Reference may be made to the Borehole Reports in Appendix A for details of the subsurface conditions encountered in each test location. The following is a generalised description of the subsurface profiles encountered;

Railway Yard – BH 1

- Rail Ballast was encountered on surface with thickness of about 200mm.
- Underlying the rail ballast, fill was encountered consisting predominantly of medium plasticity Gravelly Silty Clay with variable quantities of gravel and some rail ballast to a depth of about 2.0m below existing ground surface. At lower depth, Clayey/Gravel fill was encountered. The fill was generally found to be moist to wet. The SPT test results indicate the fill to be loose.
- Natural soil was encountered beneath the fill at a depth of about 2.4m below existing ground surface. The natural clay consists of medium to high plasticity Silty Clay with some conglomerate, gravel and shale. At a depth of about 6.8m below existing ground surface, medium plasticity Gravelly Silty Clay was encountered. Based on the SPT test results, the natural clay soil was generally assessed to be very stiff to hard. Moisture content of the natural clayey soil was found to be approximately equal to the plastic limit.
- The borehole was found to be dry during and shortly after completion of the site investigation.

Station Platform – BH 2 and 3

- A thin layer of Asphalt Concrete was encountered on the platform surface with thickness ranging of about 25mm to 30mm.
- Underlying the Asphalt Concrete, fill was encountered predominantly consisting of high plasticity Silty Clay mixture with variable quantities of gravel and rail ballast. Based on the DCP test results, the density of the fill was assessed to be poorly compacted. The fill was found to be moist.
- Natural medium to high plasticity Silty Clay was encountered at depths ranging of about 1.4m to 1.6m below existing platform level. Based on the DCP test results, the natural clay was assessed to be firm to very stiff at the upper 700mm and the natural clay becomes hard at lower depths. Moisture content of the natural clay was found to be approximately equal to the plastic limit.

- The boreholes were found to be dry during and shortly after completion of the site investigation.

4.2 Laboratory Test Results

Based on the laboratory test results, the fill and natural clay soil was assessed to have a highly reactivity to moisture variation. The following is a summary of the Atterberg Limit test results for the samples taken from (BH 2 [0.8-1.0m] and BH 3 [1.8-2.0m]);

<table>
<thead>
<tr>
<th>BH</th>
<th>Liquid Limit (%)</th>
<th>Plastic Index (%)</th>
<th>Plasticity Index (%)</th>
<th>Linear Shrinkage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH 2 (0.8-1.0m)</td>
<td>46</td>
<td>19</td>
<td>27</td>
<td>11.5</td>
</tr>
<tr>
<td>BH 3 (1.8-2.0m)</td>
<td>48</td>
<td>19</td>
<td>29</td>
<td>12.0</td>
</tr>
</tbody>
</table>
5. COMMENTS AND RECOMMENDATIONS

5.1 Platform Resurfacing

The site investigation revealed the station platform to be underlain by a layer of asphalt concrete (i.e. 25mm to 30mm) overlying loosely compacted fill overlying firm to hard natural clay.

We anticipate that the platform resurfacing will require stripping of the existing asphalt concrete and excavation to a depth to suit the design thickness of the proposed new pavement. As the platform fill was assessed to be loose, we recommend the in situ fill be densified prior to construction of new pavement and this may include the following;

- Excavation of the top 0.5m of the fill and stockpiled for reuse as fill at a later stage.
- Rolling of the base of the excavation with a small vibration roller.
- Any soft areas identified during rolling should be further excavated and replaced with select granular fill such as ripped sandstone.
- The excavated clayey fill material may be reuse as fill beneath pavements subject to moisture conditioning. Alternatively, imported good quality fill such as ripped sandstone having a maximum particle size of 40mm may be used.
- The fill material should be compacted in layer not exceeding 250mm loose thickness compacted to a minimum 95% Standard Maximum Dry Density (SMDD) at close to Optimum Moisture Content.

Care should be taken to ensure rolling and compaction of the fill will not destabilise the platform retaining walls.
5.2 New Canopies

We understand that the proposed station upgrade project will include construction of new canopy structures on the platform area. The station platform is elevated about 1.2m above the track level and is retained by brick retaining wall.

The site investigation revealed the station platform to be underlain by a 25mm to 30mm thick layer of Asphalt Concrete overlying poorly compacted fill overlying natural clay. Bedrock was not encountered in the platform boreholes and judging from the borehole drilled on the railway yard, bedrock is expected to be deep, greater than 10m.

The DCP test results indicate the upper 0.7m of the natural clay to be firm to stiff and very stiff to hard clay was encountered at about 2.0m below existing platform level. Groundwater was not encountered in the boreholes during and upon completion of the site investigation.

For the proposed canopies, we are of the opinion that suitable footing should consist of pier taken through the fill and founded on natural very stiff to hard clay expected to be present at about 2.0m below platform level (ie below the existing track level).

For piers taken to a minimum depth of about 2.5m below existing platform surface (i.e. RL 28.0m AHD) and at least 0.5m into natural hard clay, an allowable end bearing of 150kPa may be adopted. Deeper piers taken to a minimum depth of 1.5m into natural very stiff to hard clay may be proportioned to an end allowable bearing capacity of 350kPa.

A shaft adhesion of 20kPa may be adopted for the section of piers within the natural clayey soil stratum. Uplift capacity of the piers should be half of the shaft adhesion. Shaft adhesion of the section of piers within the fill should be ignored.

As the site is underlain by a relatively thick layer (i.e. >10m) of clay assessed to be highly reactive, we recommend that the footings of the proposed structures be adequately designed to accommodate shrink-swell movements proportioned to a Class ‘H’ (Highly Reactive) site in accordance to AS2870 “Residential Slabs and Footings”.

GeoEnviro Consultancy
6. LIMITATIONS

The interpretation and recommendations submitted in this report are based in part upon data obtained from a limited number of boreholes. There is no investigation which is thorough enough to determine all site conditions and anomalies, no matter how comprehensive the investigation program is as site data is derived from extrapolation of limited test locations. The nature and extent of variations between test locations may not become evident until construction.

Groundwater conditions are only briefly examined in this investigation. The groundwater conditions may vary seasonally or as a consequence of construction activities on or adjacent to the site.

In view of the above, the subsurface soil and rock conditions between the test locations may be found to be different or interpreted to be different from those expected. If such differences appear to exist, we recommend that this office be contacted without delay.

The statements presented in this document are intended to advise you of what should be your realistic expectations of this report and to present you with recommendations on how to minimise the risk associated with groundworks for this project. The document is not intended to reduce the level of responsibility accepted by GeoEnviro Consultancy Pty Ltd, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in to doing.

Your attention is drawn to the attached “Explanatory Notes” in Appendix D and this document should be read in conjunction with our report.
APPENDIX A
Borehole Reports

GeoEnviro Consultancy
<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Classification</th>
<th>Color</th>
<th>Consistency/Density Index</th>
<th>Degreee</th>
<th>% Water</th>
<th>N</th>
<th>Soil Type</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Fill: Clayey/Silty Clay: medium plasticity</td>
<td>Yellow brown</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.20</td>
<td>Fill: Clayey/Silty Clay: medium plasticity</td>
<td>Dark grey brown</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.40</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.60</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.80</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.00</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.20</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.40</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.60</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.80</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.00</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.20</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.40</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.60</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.80</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.00</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.20</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.40</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.60</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.80</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.00</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.20</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.40</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.60</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.80</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.00</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.40</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.60</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.80</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.00</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.20</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.40</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.60</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.80</td>
<td>Fill: Clayey/Silty clay: medium plasticity</td>
<td>Grey</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table Notes:**

- **Consistency/Density Index:**
  - 20: Low
  - 30: Medium
  - 40: High

- **% Water:**
  - 20: Low
  - 30: Medium
  - 40: High

- **Soil Type:**
  - Clayey/Silty clay: medium plasticity

- **Material Description:**
  - Yellow brown
  - Dark grey brown
  - Grey
# Borehole 2

## Client
Caldis Cook Group Pty Ltd

## Project
Proposed Station Upgrade - New Canopy

## Location
Cardiff Railway Station

## Job no.
JG09294

## Date
26/10/2009

## Logged by
JC

## Checked By
SL

## Drill Model and Mounting
P160

## Hole Diameter
100 mm

## Slope
90 degrees

## Bearing
-

## R.L. Surface
-30.1 m

## Datum
AHD

## Material Description

**Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component**

### Asphalt Concrete
- Thickness: 25 mm
- The fill appears loosely compacted

### Fill: Silty Clay/Gravel mixture
- Brown with some rail ballast

### Fill: Gravelly Silty Clay
- Medium to high plasticity, yellow brown with some gravel

### Fill: Silty Clay
- High plasticity, yellow brown with some fine gravel

### Silty Clay
- High plasticity, yellow brown with a trace of gravel
- As above, but grey

### End of BH 2 at 2.7 m

### End of DCP at 3.1 m
**Moisture Content, Consistency/Density Index, Dynamic Cone Penetrometer**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Consistency/Density Index</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>2-3</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>3-4</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>4-5</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>5-6</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>6-7</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>7-8</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>8-9</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>9-10</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>10-11</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>11-12</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>12-13</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>13-14</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>14-15</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>15-16</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>16-17</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>17-18</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>18-19</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>19-20</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>20-21</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>21-22</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>22-23</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>23-24</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>24-25</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>25-26</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>26-27</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>27-28</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>28-29</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
<tr>
<td>29-30</td>
<td>Silty Clay/Cobble/Grey</td>
<td>No groundwater</td>
</tr>
</tbody>
</table>

**Classification Symbol**

- **Unified Soil Classification**
  - TC - Bit
  - NO GROUNDWATER ENCOUNTERED

**Depth**

- Depth at 3m: 0m
- Depth at 2m: 0m

**Notations**

- Samples, Tests, etc
- Depth (m)
- Notes, Specifications
- Water
- Support
- Method
- Hole Diameter: 100mm
- Depth: 30m
- Bearing: 0 degrees
- Slope: 50 degrees

**Location**

- Cadell Railway Station - Proposed Station Upgrade - New Canopy
- Job: 0090294D
- Client: Cadell Civil Engineering Pty Ltd

**Date**

- 26/10/2009

**Groundwater Encounter**

- No Groundwater Encountered
APPENDIX B
DCP Test Report
Client/Address: Caldis Cook Group (Chippendale)  
Project: Proposed Station Upgrade - New Canopy  
Location: Cardiff Railway Station  
Job No.: JG09294D  
Report No.: R01A  
Date: 26-10-09

Test Procedure: AS 1289 1.1, 1.2.1, 6.3.2

<table>
<thead>
<tr>
<th>Test No. 1</th>
<th>Test No. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Location: Refer to Drawing No 1</td>
<td>Test Location: Refer to Drawing No 1</td>
</tr>
<tr>
<td>RL: -</td>
<td>RL: -</td>
</tr>
<tr>
<td>Soil Classification: Refer to BH 2</td>
<td>Soil Classification: Refer to BH 3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Blows</th>
<th>Depth (m)</th>
<th>Blows</th>
<th>Depth (m)</th>
<th>Blows</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.1</td>
<td>-</td>
<td>3.0-3.1</td>
<td>16</td>
<td>0.0-0.1</td>
<td>-</td>
</tr>
<tr>
<td>0.1-0.2</td>
<td>-</td>
<td>3.1-3.2</td>
<td>Terminated</td>
<td>0.1-0.2</td>
<td>-</td>
</tr>
<tr>
<td>0.2-0.3</td>
<td>-</td>
<td>3.2-3.3</td>
<td></td>
<td>0.2-0.3</td>
<td>-</td>
</tr>
<tr>
<td>0.3-0.4</td>
<td>-</td>
<td>3.3-3.4</td>
<td></td>
<td>0.3-0.4</td>
<td>-</td>
</tr>
<tr>
<td>0.4-0.5</td>
<td>-</td>
<td>3.4-3.5</td>
<td></td>
<td>0.4-0.5</td>
<td>-</td>
</tr>
<tr>
<td>0.5-0.6</td>
<td>2</td>
<td>3.5-3.6</td>
<td></td>
<td>0.5-0.6</td>
<td>-</td>
</tr>
<tr>
<td>0.6-0.7</td>
<td>2</td>
<td>3.6-3.7</td>
<td></td>
<td>0.6-0.7</td>
<td>-</td>
</tr>
<tr>
<td>0.7-0.8</td>
<td>6</td>
<td>3.8-3.9</td>
<td></td>
<td>0.7-0.8</td>
<td>-</td>
</tr>
<tr>
<td>0.8-0.9</td>
<td>5</td>
<td>3.9-4.0</td>
<td></td>
<td>0.8-0.9</td>
<td>1</td>
</tr>
<tr>
<td>0.9-1.0</td>
<td>2</td>
<td>4.0-4.1</td>
<td></td>
<td>0.9-1.0</td>
<td>1</td>
</tr>
<tr>
<td>1.0-1.1</td>
<td>2</td>
<td>4.1-4.2</td>
<td></td>
<td>1.0-1.1</td>
<td>2</td>
</tr>
<tr>
<td>1.1-1.2</td>
<td>1</td>
<td>4.2-4.3</td>
<td></td>
<td>1.1-1.2</td>
<td>1</td>
</tr>
<tr>
<td>1.2-1.3</td>
<td>5</td>
<td>4.3-4.4</td>
<td></td>
<td>1.2-1.3</td>
<td>2</td>
</tr>
<tr>
<td>1.3-1.4</td>
<td>4</td>
<td>4.4-4.5</td>
<td></td>
<td>1.3-1.4</td>
<td>2</td>
</tr>
<tr>
<td>1.4-1.5</td>
<td>2</td>
<td>4.5-4.6</td>
<td></td>
<td>1.4-1.5</td>
<td>1</td>
</tr>
<tr>
<td>1.5-1.6</td>
<td>5</td>
<td>4.6-4.7</td>
<td></td>
<td>1.5-1.6</td>
<td>3</td>
</tr>
<tr>
<td>1.6-1.7</td>
<td>5</td>
<td>4.7-4.8</td>
<td></td>
<td>1.6-1.7</td>
<td>3</td>
</tr>
<tr>
<td>1.7-1.8</td>
<td>6</td>
<td>4.8-4.9</td>
<td></td>
<td>1.7-1.8</td>
<td>3</td>
</tr>
<tr>
<td>1.8-1.9</td>
<td>8</td>
<td>4.9-5.0</td>
<td></td>
<td>1.8-1.9</td>
<td>3</td>
</tr>
<tr>
<td>1.9-2.0</td>
<td>8</td>
<td>5.0-5.1</td>
<td></td>
<td>1.9-2.0</td>
<td>3</td>
</tr>
<tr>
<td>2.0-2.1</td>
<td>10</td>
<td>5.1-5.2</td>
<td></td>
<td>2.0-2.1</td>
<td>6</td>
</tr>
<tr>
<td>2.1-2.2</td>
<td>11</td>
<td>5.2-5.3</td>
<td></td>
<td>2.1-2.2</td>
<td>11</td>
</tr>
<tr>
<td>2.2-2.3</td>
<td>12</td>
<td>5.3-5.4</td>
<td></td>
<td>2.2-2.3</td>
<td>12</td>
</tr>
<tr>
<td>2.3-2.4</td>
<td>12</td>
<td>5.4-5.5</td>
<td></td>
<td>2.3-2.4</td>
<td>14</td>
</tr>
<tr>
<td>2.4-2.5</td>
<td>10</td>
<td>5.5-5.6</td>
<td></td>
<td>2.4-2.5</td>
<td>16</td>
</tr>
<tr>
<td>2.5-2.6</td>
<td>10</td>
<td>5.6-5.7</td>
<td></td>
<td>2.5-2.6</td>
<td>19</td>
</tr>
<tr>
<td>2.6-2.7</td>
<td>11</td>
<td>5.7-5.8</td>
<td></td>
<td>2.6-2.7</td>
<td>25</td>
</tr>
<tr>
<td>2.7-2.8</td>
<td>13</td>
<td>5.8-5.9</td>
<td></td>
<td>2.7-2.8</td>
<td>27</td>
</tr>
<tr>
<td>2.8-2.9</td>
<td>14</td>
<td>Terminated</td>
<td>2.8-2.9</td>
<td>Terminated</td>
<td>5.9-5.9</td>
</tr>
<tr>
<td>2.9-3.0</td>
<td>16</td>
<td>5.9-6.0</td>
<td></td>
<td>2.9-3.0</td>
<td>5.9-6.0</td>
</tr>
</tbody>
</table>

Remarks:  
Weight: 9kg  
Drop: 510mm  
Rod Diameter: 16mm
APPENDIX C
Laboratory Test Report

GeoEnviro Consultancy
# Client / Address
Caldis Cook Group Pty Ltd (Chippendale)

# Project
Proposed Station Upgrade - New Canopy

# Location
Cardiff Railway Station

# Job No.
JG09294D

# Date
28-10-09

# Report No.
R02A

---

**Test Procedure:**
AS 1289 2.1.1, 3.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

<table>
<thead>
<tr>
<th>Sample Identification</th>
<th>BH 2 (0.8-1.0m)</th>
<th>BH 3 (1.8-2.0m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Register No</td>
<td>SR 5596</td>
<td>SR 5597</td>
</tr>
<tr>
<td>Sample Date</td>
<td>06-10-09</td>
<td>06-10-09</td>
</tr>
<tr>
<td>Test Date</td>
<td>12-10-09</td>
<td>12-10-09</td>
</tr>
</tbody>
</table>

**Test Results**

<table>
<thead>
<tr>
<th>Test</th>
<th>BH 2</th>
<th>BH 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid Limit (%)</td>
<td>46</td>
<td>48</td>
</tr>
<tr>
<td>Plastic Limit (%)</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Plasticity Index (%)</td>
<td>27</td>
<td>29</td>
</tr>
<tr>
<td>Linear Shrinkage (%)</td>
<td>11.5</td>
<td>12.0</td>
</tr>
<tr>
<td>Natural Moisture Content %</td>
<td>20.6</td>
<td>16.9</td>
</tr>
</tbody>
</table>

**Material Description**

- (CH) Silty Clay: high plasticity, yellow brown
- (CI-CH) Silty Clay: medium to high plasticity, grey mottled yellow

---

This document is issued in accordance with NATA's accreditation requirements

Accredited for compliance with ISO/IEC 17025
NATA Accredited Laboratory Number: 14208

Approved Signatory: [Signature]
Principal: [Signature]
Date: 28/10/2009
APPENDIX D
Explanatory Notes and Graphic Symbols

GeoEnviro Consultancy
EXPLANATORY NOTES

Introduction

These notes have been provided to amplify the geotechnical report with regard to investigation procedures, classification methods and certain matters relating to the Discussion and Comments sections. Not all notes are necessarily relevant to all reports.

Geotechnical reports are based on information gained from finite sub-surface probing, excavation, boring, sampling or other means of investigation, supplemented by experience and knowledge of local geology. For this reason they must be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods

The methods the description and classification of soils and rocks used in this report are based on Australian standard 1726, the SSA Site investigation Code, in general descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions. Identification and classification of soil and rock involves to a large extent, judgement within the acceptable level commonly adopted by current geotechnical practices.

 Soil types are described according to the predominant particle size, qualified by the grading or other particles present (eg sandy clay) on the following bases:

<table>
<thead>
<tr>
<th>Soil Classification</th>
<th>Particle Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay</td>
<td>Less than 0.002mm</td>
</tr>
<tr>
<td>Silt</td>
<td>0.002 to 0.06mm</td>
</tr>
<tr>
<td>Sand</td>
<td>0.06 to 2.00mm</td>
</tr>
<tr>
<td>Gravel</td>
<td>2.00mm to 60.00mm</td>
</tr>
</tbody>
</table>

Cohesive soils are classified on the basis of strength, either by laboratory testing or engineering examination. The strength terms are defined as follows:

<table>
<thead>
<tr>
<th>Classification</th>
<th>Undrained Shear Strength kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Soft</td>
<td>Less than 12</td>
</tr>
<tr>
<td>Soft</td>
<td>12 - 25</td>
</tr>
<tr>
<td>Firm</td>
<td>25 - 50</td>
</tr>
<tr>
<td>Stiff</td>
<td>50 - 100</td>
</tr>
<tr>
<td>Very Stiff</td>
<td>100 - 200</td>
</tr>
<tr>
<td>Hard</td>
<td>Greater than 200</td>
</tr>
</tbody>
</table>

Disturbed samples are taken during drilling provided information on plasticity, grain size, colour, type, moisture content, inclusions and depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin walled sample tube (normally known as U42) into the soil and withdrawing a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesionless soils. Details of the type and method of sampling are given in the report.

Field Investigation Methods

The following is a brief summary of investigation methods currently carried out by this company and comments on their use and application.

Hand Auger Drilling

The borehole is advanced by manually operated equipment. The diameter of the borehole ranges from 50mm to 100mm. Penetration depth of hand augered boreholes may be limited by premature refusal on a variety of materials, such as hard clay, gravels or ironstone.

Test Pits

These are excavated with a tractor-mounted backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3.0m for a backhoe and up to 6.0m for an excavator. A potential advantage is the disturbance caused by the excavation.

Care must be taken if construction is to be carried out near, or within the test pit locations, to either adequately compact the backfill during construction, or to design the structure or accommodate the poorly compacted backfill.

Large Diameter Auger (eg Pingo)

The hole is advanced by a rotating plate or short spiral auger generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 65m) and are disturbed, but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers and is usually supplemented by occasional undisturbed tube sampling.

Continuous Spiral Flight Augers

The hole is advanced by using 90mm - 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the augers flights, but they are very disturbed and may be highly mixed with soil of other stratum.

Information from the drilling (as distinct from specific sampling by SPT or undisturbed samples) is of relatively low reliability due to remoulding, mixing or softening of samples by ground water, resulting in uncertainties of the original sample depth.
Continuous Spiral Flight Augers (continued)
The spiral augers are usually advanced by using a V-bit through the soil profile refusal, followed by Tungsten Carbide (TC) bit, to penetrate into bedrock. The quality and continuity of the bedrock may be assessed by examination of the recovered rock fragments and through observation of the drilling penetration resistance.

Non-core Rotary Drilling (Wash Boring)
The hole is advanced by a rotary bit, with water being pumped down the drill rod and returned up the annulus, carrying the cuttings, together with some information from the "feet" and rate of penetration.

Rotary Mud Stabilised Drilling
This is similar to rotary drilling, but uses drilling mud as a circulating fluid, which may consist of a range of products, from bentonite to polymers such as Reverit or Biogel. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg SPT and UU samples).

Continuous Core Drilling
A continuous core sample is obtained using a diamond tipped core barrel. Providing full core recovery is achieved (which is not always possible in very weak rock and granular soils) this technique provides a very reliable (but relatively expensive) method of investigation. In rocks an NMLC triple tube core barrel which gives a core of about 50mm diameter, it is usually used with water flush.

Portable Proline Drilling
This is manually operated equipment and is only used in sites which require bedrock core sampling and there is restricted site access to truck mounted drill rigs. The boreholes are usually advanced initially using a tricone roller bit and water circulation to penetrate the upper soil profile. In some instances a hand auger may be used to penetrate the soil profile. Subsequent drilling into bedrock involves the use of NMLC triple tube equipment, using water as a lubricant.

Standard Penetration Tests
Standard penetration tests are used mainly in non-cohesive soils, but occasionally also in cohesive soils, as a means of determining density or strength and of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289 “Methods of testing Soils for Engineering Purpose” - Test F31.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63Kg hammer with a free fall of 769mm. It is normal for the tube to be driven in three successive 150mm increments and the ‘N’ value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rocks, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In a case where full penetration is obtained with successive blows counts for each 150mm of, say 4, 6, and 7 blows.
  
  \[ N = 13 \]

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm.
  
  \[ N = 13 \]

The results of the tests can be related empirically to the engineering properties of the soil. Occasionally the test methods is used to obtain samples in 50mm diameter thin walled samples tubes in clays. In these circumstances, the best results are shown on the bore logs in brackets.

Dynamic Cone Penetration Test
A modification to the SPT test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The cone can be continuously driven into the borehole and is normally used in areas with thick layers of soft clays or loose sand. The results of this test are shown as 'N' on the bore logs, together with the number of blows per 150mm penetration.

Cone Penetrometer Testing and Interpretation
Cone penetrometer testing (sometimes referred to as Dutch Cone-CPT) described in this report, has been carried out using an electrical friction cone penetrometer and the test is described in Australian Standard 1289 test F5.1.

In the test, a 35mm diameter rod with cone tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig, which is fitted with a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130mm long sleeve, immediately behind the cone. Transducer in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output on continuous chart recorders. The plotted results in this report have been traced from the original records. The information provided on the charts comprises:

- Cone resistance - the actual end bearing force divided by the cross sectional area of the cone, expressed in MPa.
- Sleeve friction - the frictional force on the sleeve divided by the surface area, expressed in kPa.
- Friction ratio - the ratio of sleeve friction to cone resistance, expressed in percentage.

There are two scales available for measurement of cone resistance. The lower "A" scale (0-50MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main "B" scale (0-50MPa) is less sensitive and is shown as a full line.

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative frictions in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and very soft clays, rising to 4% to 10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:

\[ q_c (MPa) = (0.4 to 0.6) N \] (blows per 300mm)

In clays the relationship between undrained shear strength and cone resistance is commonly in the range:

\[ q_c = (12 to 18) C_u \]

Interpretation of CPT values can also be made to allow estimate of modulus or compressibility values to allow calculation of foundation settlements. Inferred stratification, as shown on the attached report, is assessed from the cone and friction traces, from experience and information from nearby boreholes etc.
Cone Penetrometer Testing and Interpretation continued

This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties and where precise information or soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometer (AS1289)

Portable dynamic cone penetrometer tests are carried out by driving a rod in to the ground with a falling weight hammer and measuring the blows per successive 100mm increments of penetration.

There are two similar tests, Cone Penetrometer (commonly known as Scala Penetrometer) and the Perth Sand Cone Penetrometer. Scala Penetrometer is commonly adopted by this company and consists of a 16mm rod with a 20mm diameter cone end, driven with a 9kg hammer, dropping 510mm (AS 1289 Test F3.2).

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedures are given on the individual report forms.

Engineering Logs

The engineering logs presented herein are an engineering and/or geological interpretation of the sub-surface conditions and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, however, this is not always practical or possible to justify economically.

As it is, the boreholes represent only a small sample of the total sub-surface profile. Interpretation of the information and its application to design and construction should take into account the spacing of boreholes, frequency of sampling and the possibility of other "straight line" variations between the boreholes.

Ground water

Where ground water levels are measured in boreholes, there are several potential problems:

- In low permeability soils, ground water although present, may enter the hole slowly, or perhaps not at all, during the investigation period.
- A localized perched water table may lead to a erroneous indication of the true water table.
- Water table levels will vary from time to time, due to the seasons or recent weather changes. They may not be the same at the time of construction as indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole if any water observations are to be made.

More reliable measurements can be made by installing stand pipes, which are read at intervals over several days, or weeks for low permeability soils. Piezometers sealed in a particular stratum may be interference from a perched water table or surface water.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal is changed, say to a twenty storey building. If this occurs, the company will be pleased to review the report and sufficient of the investigation work.

Every care is taken with the report as it relates to interpretation of sub-surface conditions, discussions of geotechnical aspects and recommendations or suggestions for design and construction. However, the company cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on bore spacing and sampling frequency.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of contractors responding to commercial pressures.

If these occur, the company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the company request immediate notification. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information tender Documents", published by the Institute of Engineers Australia. Where information obtained for this investigation is provided for tender purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or make additional copies of the report available for contract purpose, at a nominal charge.

The Company will always be pleased to provide engineering inspection services for geotechnical aspect of work to which this report is related. This could range from a site visit to confirm that the conditions exposed are as expected, to full time engineering presence on site.

Review of Design

Where major civil or structural developments are proposed, or where only a limited investigation has been completed, or where the geotechnical conditions are complex, it is prudent to have the design reviewed by a Senior Geotechnical Engineer.
## Graphic Symbols For Soil and Rock

<table>
<thead>
<tr>
<th>SOIL</th>
<th>ROCK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill</td>
<td>Shale</td>
</tr>
<tr>
<td>Topsoil</td>
<td>Sandstone</td>
</tr>
<tr>
<td>Gravel (GW, GP)</td>
<td>Siltstone, Mudstone, Claystone</td>
</tr>
<tr>
<td>Sand (SP, SW)</td>
<td>Granite, Gabbro</td>
</tr>
<tr>
<td>Silt (ML, MH)</td>
<td>Dolerite, Diorite</td>
</tr>
<tr>
<td>Clay (CL, CH)</td>
<td>Basalt, Andesite</td>
</tr>
<tr>
<td>Clayey Gravel (GC)</td>
<td>Other Materials</td>
</tr>
<tr>
<td>Silty Sand (SM)</td>
<td>Concrete</td>
</tr>
<tr>
<td>Clayey Sand (SC)</td>
<td>Bitumen, Asphaltic Concrete, Coal</td>
</tr>
<tr>
<td>Sandy Silt (ML)</td>
<td>Ironstone Gravel</td>
</tr>
<tr>
<td>Gravelly Clay (CL, CH)</td>
<td>Organic Material</td>
</tr>
<tr>
<td>Silty Clay (CL, CH)</td>
<td></td>
</tr>
<tr>
<td>Sandy Clay (CL, CH)</td>
<td></td>
</tr>
<tr>
<td>Peat or Organic Soil</td>
<td></td>
</tr>
</tbody>
</table>
## Appendix E: Hazardous Materials Register for Cardiff Railway Station (at 9 March 2011)

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Station</th>
<th>Platform</th>
<th>Building</th>
<th>Room</th>
<th>Surface</th>
<th>Material Application</th>
<th>Quantity</th>
<th>Units</th>
<th>Sample Type</th>
<th>Sample ID No.</th>
<th>Photo No.</th>
<th>Analytical Result</th>
<th>Material Condition as Surveyed</th>
<th>Risk Status</th>
<th>Control Recommendations / Comments</th>
<th>Review interval (Months after Date)</th>
<th>Review date</th>
</tr>
</thead>
<tbody>
<tr>
<td>13/07/2006</td>
<td>1</td>
<td>Cardiff</td>
<td>1</td>
<td>Main Building</td>
<td>Kitchen</td>
<td>N/A</td>
<td>Hot water unit</td>
<td>1</td>
<td>count</td>
<td>Fabric</td>
<td>N/A</td>
<td>1</td>
<td>Positive</td>
<td>Good</td>
<td>Low</td>
<td>Maintain material in current condition. Remove prior to refurbishment/demolition. Inspected on 7/06/07 by BMM North, Condition unchanged. Inspected 17/06/10, condition unchanged - DMM North.</td>
<td>36</td>
<td>17-Jun-13</td>
</tr>
<tr>
<td>13/07/2006</td>
<td>2</td>
<td>Cardiff</td>
<td>1</td>
<td>Main Building</td>
<td>Ceiling</td>
<td>Ceiling Space</td>
<td>SMF insulation</td>
<td>200 sq. m</td>
<td>Fabric</td>
<td>N/A</td>
<td>2</td>
<td>N/A</td>
<td>Good</td>
<td>Low</td>
<td>Maintain material in current condition. Remove prior to refurbishment/demolition. Inspected on 7/06/07 by BMM North, Condition unchanged. Inspected 17/06/10, condition unchanged - DMM North.</td>
<td>36</td>
<td>17-Jun-13</td>
<td></td>
</tr>
<tr>
<td>13/07/2006</td>
<td>3</td>
<td>Cardiff</td>
<td>1</td>
<td>Main Building</td>
<td>Ceiling</td>
<td>Ceiling Space</td>
<td>Hot water unit</td>
<td>1 sq. m</td>
<td>Fabric</td>
<td>N/A</td>
<td>3</td>
<td>N/A</td>
<td>Good</td>
<td>Low</td>
<td>Maintain material in current condition. Remove prior to refurbishment/demolition. Inspected on 7/06/07 by BMM North, Condition unchanged. Inspected 17/06/10, condition unchanged - DMM North.</td>
<td>36</td>
<td>17-Jun-13</td>
<td></td>
</tr>
</tbody>
</table>
## Cardiff Railway Station Accessibility Upgrade - Stages 2 & 3

### Review of Environmental Factors

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Type</th>
<th>Condition</th>
<th>Status</th>
<th>Action Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>13/07/2006</td>
<td>Cardiff 1</td>
<td>Main Building</td>
<td>Sarking</td>
<td>N/A 200 sq.m</td>
<td>N/A 4 N/A Good N/A Low</td>
</tr>
<tr>
<td>13/07/2006</td>
<td>Cardiff 1</td>
<td>Main Building</td>
<td>External Panels</td>
<td>N/A N/A N/A N/A N/A</td>
<td>N/A N/A N/A N/A N/A N/A</td>
</tr>
<tr>
<td>13/07/2006</td>
<td>Cardiff 1</td>
<td>Main Building</td>
<td>Station Manager's Office</td>
<td>N/A N/A N/A N/A N/A</td>
<td>N/A N/A N/A N/A N/A N/A</td>
</tr>
<tr>
<td>13/07/2006</td>
<td>Cardiff 1</td>
<td>Main Building</td>
<td>Booking Office</td>
<td>N/A N/A N/A N/A N/A</td>
<td>N/A N/A N/A N/A N/A N/A</td>
</tr>
<tr>
<td>13/07/2006</td>
<td>Cardiff 1</td>
<td>Commuter Shelter</td>
<td>Shelter</td>
<td>N/A N/A N/A N/A N/A</td>
<td>N/A N/A N/A N/A N/A N/A</td>
</tr>
<tr>
<td>13/07/2006</td>
<td>Cardiff 1</td>
<td>External areas and fenceline</td>
<td>Exterior</td>
<td>N/A N/A N/A N/A N/A</td>
<td>N/A N/A N/A N/A N/A N/A</td>
</tr>
</tbody>
</table>

Author: Lesley Corkill – Projects Division, Environment Unit
Determiner: Richard Mumford – Projects Division, Stations and Buildings
Appendix G: Architectural drawings
EXHIBIT E - CONTRACT SPECIFIC REQUIREMENTS
Exhibit E – Contract Specific Requirements
Transport Access Program
Cardiff Station Upgrade

Document Number: 1780182_2

© TfNSW 2011
# Table of Contents

## 1 Definitions and Terms

1. Definitions and Terms

## 2 Site

1. Description of the Site
2. Setting-Out and Survey
   1. General
   2. RailCorp Detailed Site Survey
3. Site Compound
4. Facilities for use by the Principal
5. Site Access and Controls
6. Existing Public Thoroughfares and Rights of Way
7. Existing Property Condition
8. Site Parking
9. Unloading Zones
10. Existing Services
11. Site Storage
12. Rectification of Roads and Footpaths
13. Cleaning and Protection of Work
14. Final Cleaning
15. Properties Adjacent to the Site
16. Site Meetings
17. Track Possessions

## 3 Materials and Workmanship

1. Means, Methods, Techniques, Sequences and Procedures
   1. Information
   2. Alterations
2. Proprietary Items
   1. Definition
   2. Implication
   3. Claims
   4. Information
   5. Alterations

## Appendix A Site Plans
1 Definitions and Terms

Unless stated otherwise, terms within this Contract Specific Requirements have the same meaning as those defined within the General Conditions.

In addition, the following definitions apply:

"Area" means the areas within the Worksites.

"Control" of an Area or Worksite means undertaking all the activities required to manage all access to and across the Area or Worksite, and maintaining the temporary infrastructure required for the Area or Worksite provided by the Contractor or RailCorp. Such activities will include managing and maintaining the security of the Area or Worksite, conducting familiarisation and safety inductions to, and for all those accessing, the Area or Worksite (but not inductions specific to Other Contractors' activities), operating and maintaining the wheel wash and other facilities involved, managing parking areas and liaising with Authorities in relation to the temporary infrastructure for which the Contractor in Control is responsible.

"Establish" an Area or a Worksite means providing all the temporary infrastructure required by the Contractor for its use of the part of the Site involved, including obtaining all Authority Approvals, survey for and construction of all perimeter fences, clearing vegetation, and providing all temporary Services, construction roads, signage, traffic management, car wash bays, drainage, perimeter security management, environmental management measures, pedestrian access, road changes off the Site to provide access, hard stand areas, wheel wash facilities and other facilities required for the Worksite, with all the Contractor's establishment such as offices and amenities (including those for the Principal where required). Other Contractors are responsible for providing their own establishment, including offices and amenities, and to adjust and augment (and maintain such augmentations to) any of the temporary infrastructure to suit their activities.

"Reinstate" an Area or Worksite means restoring the Area or Worksite to a condition not less than that existing immediately prior to the Contractor obtaining access to the Area or Worksite (except for flora growth and improved surfaces that grow), in compliance with conditions of the Planning Approval and any additional conditions required by relevant Authorities, but excluding any change to temporary infrastructure required for use of the Area or Worksite after the reinstatement.

"Worksites" means the worksites described in clause 2.1 to this Contract Specific Requirements.

2 Site

2.1 Description of the Site

The Site consists of two Worksites:

Worksite A the rail corridor within DP 92170 Lots 1 and 2 extending 50 metres beyond the end of the new platform extensions, and

Worksite B the area indicated for stage 2 works within the council car park in DP 8186 Lots 19 and 20;

as shown on the drawings in Appendix A.
2.2 Setting-Out and Survey

2.2.1 General
The Contractor must:

(a) check and verify all dimensions and levels on the Site and the location of existing Services on and within the Site;
(b) set out and survey in accordance with the MGA coordinate system;
(c) verify positions of grids and levels from survey marks;
(d) verify and confirm its acceptance of the cadastral survey and all property boundaries provided by the Principal’s Representative;
(e) set out the Works using permanent survey marks for the sole purpose of the Works. The permanent survey marks must be coordinated with the cadastral survey;
(f) preserve and maintain in their true position all survey marks;
(g) give the Principal’s Representative at least two (2) Business Days notice of the Contractor’s intention to perform any part of the setting out or levelling, so that suitable arrangements can be made for review of such work by the Principal’s Representative; and
(h) provide adequate recovery pegs in suitable locations within or adjacent to the Site.

2.2.2 RailCorp Detailed Site Survey
When conducting RailCorp detailed site surveys, the Contractor must comply with the RailCorp requirements described in the following documents:

(a) RailCorp Detailed Site Survey Accurate Field Drawing Procedure (EP0491);
(b) RailCorp Detailed Site Survey Data Capture Procedure (EP0492);
(c) RailCorp Detailed Site Survey Infrastructure Services Data Policy (EP0495);
(d) RailCorp Detailed Site Survey Plan Symbols & Interpretation Guidelines (EP0511);
(e) RailCorp Detailed Site Survey Scope Procedure (EP0493);
(f) RailCorp Detailed Site Survey Specification for Collection of Services Data (EP0496); and
(g) RailCorp Detailed Site Survey Work as Executed Procedure (EP0494).

The Contractor must ensure that the personnel performing the RailCorp detailed site surveys are competent and familiar with rail survey requirements.

2.3 Site Compound
The Contractor’s site compound must be located within the Area of Worksite A known as the upper accessway.

The Contractor must:

(a) submit a 100% design for the site compound and fence to the Principal’s Representative for approval two weeks prior to the planned commencement of the site compound and fence or otherwise as agreed with the Principal’s Representative;
(b) notify the Principal's Representative that it proposes to use the area at least one week prior to the planned commencement of construction of the site compound and fence or otherwise as agreed with the Principal's Representative; and

(c) prior to Completion, restore the Site to its original or improved condition and remove all temporary site access roads.

2.4 Facilities for use by the Principal

Unless otherwise agreed by the Principal's Representative, the Contractor must:

(d) provide a 6m x 3m lockable accommodation (as a minimum) with power, including a meeting table (3m x 1.2 m approximately) with 6 chairs, for the joint use of the Principal and the Contractor's site foreman, and a desk and chair and a secure lockable filing cabinet for the exclusive use of the Principal's Representative or other authorised persons; and

(e) allow the Principal's Representative and authorised persons the reasonable use of the Contractor's telephone, fax, photo-copy machine, tea making facilities, and toilet facilities.

The Contractor is responsible for the cleaning of these facilities.

2.5 Site Access and Controls

The Contractor must:

(a) Establish, Control and Reinstall Areas within Worksite A as necessary to construct the Works, allow train operations, and ensure safe use of the station by the public and RailCorp staff during operational periods; and

(b) Establish, Control and Reinstall Areas within Worksite B as necessary to construct the Works

The Contractor must ensure that access to all Areas are restricted to authorised personnel and registered visitors.

The Contractor must submit details of the Areas to the Principal's Representative prior to their establishment and comply with any reasonable conditions required to ensure safe and uninterrupted operations of the railway and council carpark.

Site access is generally restricted to the existing access points off Main Road and Mary Street for the Rail Corridor and the council carpark respectively. The Contractor must maintain a vehicular access route for RailCorp through the Site to the existing rail track at all times. RailCorp operations and emergency vehicles will use this access on a periodic and emergency basis. A 24 hour contact telephone number will be required by RailCorp to ensure access to the site and their property. If RailCorp access is to be temporarily unavailable, prior approval will be required from the Principal's Representative.

Access to the existing council car park and station must be maintained at all times. The Contractor must comply with the Licensee obligations contained in the Deed of Licence with the City of Lake Macquarie, given in Exhibit H.

The Contractor must maintain in good condition the existing temporary stairs (installed and removed by Other Contractor) between the council carpark and the upper access way for the duration of the Works.
Site access controls must include:

(a) a secure perimeter to any part of the Site or Area where hazards exist;
(b) minimisation of access points;
(c) control of all access points with gates kept closed during working hours and locked when the Site or Area is unoccupied;
(d) a notice at the main gate of the site compound stating the name and the 24 hour contact number of the person who has custody of the keys to access the site compound; and
(e) clear and prominently positioned directional, information and safety signage in regard to visitors, site safety, emergency egress and assembly points, the wearing of personal protective equipment, emergency contact numbers and Site conduct in general.

2.6 Existing Public Thoroughfares and Rights of Way

The Contractor must provide unimpeded and uninterrupted access twenty four hours a day, seven days a week:

(a) for existing formalised pedestrian access to any adjoining railway station;
(b) for adjoining and nearby property owners, occupiers and users to areas adjacent to and outside the Site or Areas;
(c) to RailCorp and other contractors requiring access to the Rail Corridor through any access gate;
(d) for emergency services; and
(e) RailCorp maintenance vehicles and personnel.

2.7 Existing Property Condition

The Contractor, when preparing Condition Surveys required under clause 3.12 of the General Conditions, must comply with the following requirements.

Prior to commencing any work which may cause damage, the Contractor must make an inspection and produce a comprehensive written and photographic record of the condition of all property (including assets and services below ground level) on and adjacent to the Site or Areas and in the sphere of influence of the Contractor’s Activities, including all premises, buildings, structures, utilities, and railway system assets (including all RailCorp property) (‘Condition Survey’). The Condition Survey must describe and identify the property, its location and its existing condition, prior to the commencement of the Contractor’s Activities and document the activities most likely to cause damage and the monitoring frequency proposed by the Contractor.

All areas that show evidence of existing damage or failure must be photographed and carefully recorded, including the location and extent of the damage and the date when the photograph was taken.

The results of the Condition Survey must be embodied in a written report and submitted to the Principal’s Representative prior to commencing the Contractor’s Activities.

The condition of the property covered by the Condition Survey must be regularly monitored during the carrying out of the Contractor’s Activities and the Condition Survey augmented to address any change to the conditions observed.
The Contractor must notify the Principal's Representative immediately of any damage to property caused by the Contractor's Activities whether the property was part of the Condition Survey or not and submit to the Principal's Representative details on the rectification measures the Contractor proposes to undertake.

Within one month of Completion, the Contractor must:

(a) survey, review and record the current condition of each property included in the previous Condition Survey and confirm:
   i. the condition of the property relative to that recorded previously; and
   ii. that any damage caused by the Contractor's Activities has been repaired;

(b) obtain the Principal's Representative's agreement that the Contractor's record represents the true condition of their property; and

(c) provide a copy of the record to the Principal's Representative within 14 days of the completion of the survey of the property.

2.8 Site Parking

The Contractor must make its own arrangements for parking facilities.

The Contractor is responsible for the provision of parking for construction vehicles and to ensure there is minimal impact to on-street parking during the Contractor's Activities.

2.9 Unloading Zones

The Contractor must make its own arrangements regarding loading zones and pay all necessary Authority fees etc.

2.10 Existing Services

The information available on the location of existing Services including utilities and/or structures is approximate only and in some cases may be inaccurate or incomplete. Without limiting clause 3.6 of the General Conditions, the Principal accepts no responsibility for and does not guarantee or make any representation as to the accuracy, adequacy, suitability or completeness of the information.

The Contractor must make such further enquiries and investigations, including carrying out any Services searches, as are required to ensure existing Services including utilities and/or structures remain undamaged.

The existence of underground Services may not shown on the drawings listed in the Works Brief, or may be in location or elevations different from those shown on the drawings listed in the Works Brief. The Contractor must ascertain the exact location of each underground Services prior to doing any work that may damage any such Service.

Any damage to the existing Services including utilities and/or structures must be repaired at the Contractor's cost either by the Contractor to the satisfaction of the Authority concerned, or if the relevant Authority so elects, repairs will be effected by the relevant Authority.

The cost of making further enquiries and investigation to ensure the existing Services including utilities and/or structures remain undamaged and the protection and maintenance of existing the existing Services including utilities and/or structures is included in the Original Contract Price.
Where the Contractor's method of working results in additional adjustments to any existing Services being deemed necessary by any Authority having statutory rights in relation to the Service, the Contractor must arrange for and bear all costs in relation to those additional adjustments, notwithstanding that the Principal's Representative may have approved the method of working.

The Contractor is to test, validate and undertake its own assessment of existing Services terminations prior to the commencement of the works in accordance with the WHS Legislation.

The Contractor must deal with any related existing Services encountered, obstructed, or damaged in the course of performing the Contractor's Activities, as follows:

(a) if the Service is to be continued: repair, divert, relocate as required; and
(b) if the Service is to be abandoned: cut and seal or disconnect, and make safe and/or remove - in accordance with the requirements of the Principal's Representative and the relevant Authorities.

The Contractor must liaise with the appropriate Authorities and resolve all issues with respect to existing Services in accordance with the Contract and the requirements of any relevant Authorities.

2.11 Site Storage

The Contractor is responsible for the care of the Contractor's Activities including providing safe and proper storage of all Construction Plant and on-Site materials used for or in carrying out the Contractor's Activities.

The Contractor is responsible for the provision of any security enclosures that may be required around or within storage areas. All proper precautions must be taken by the Contractor to keep all poisons and other injurious substances in places secured against access by unauthorised persons.

All Construction Plant and materials on the Site must be stored in accordance with statutory requirements and in such a manner as to prevent mechanical and climatic damage. Storage areas must be kept in a neat and tidy manner to minimise hazards to persons, materials and equipment.

2.12 Rectification of Roads and Footpaths

The Contractor must rectify any and all damage to all roads and footpaths affected by the Contractor's Activities in a timely manner.

2.13 Cleaning and Protection of Work

Whilst undertaking the Contractor's Activities the Contractor must clean and protect the Works, the Temporary Works and the Site. The Site must be in a clean and tidy state at all times (including free from graffiti).

The Contractor must entirely at its own cost remove daily from the Site all materials removed during the course of construction, unless the Principal's Representative indicates that some of these are to be retained by the Principal.

The Contractor must entirely at its own cost, remove from the Site at regular intervals but not less than weekly, refuse (including food scraps) resulting from the Contractor's Activities including any
work performed during the Defects Rectification Period. The Contractor must handle refuse in a manner so as to confine the materials completely and prevent dust and odour emissions.

No fires or burning off are permitted on the Site

The Contractor must properly dispose of solid, liquid and gaseous contaminants in accordance with the Law.

The Contractor must protect newly installed Works to ensure no damage or deterioration occurs. The Contractor must also clean and perform maintenance on newly installed Works as frequently as necessary in accordance with the manufacturers’ and other relevant cleaning, protection and maintenance requirements until Completion.

The Contractor must remove protection when directed by the Principal’s Representative. The Contractor must clean and make good, re-work or re-build any Works soiled, marred or damaged.

2.14 Final Cleaning

The Contractor must provide final cleaning of the Works when directed by the Principal's Representative, or in the absence of such direction immediately prior to Completion. This must consist of cleaning each surface of unit of work to a clean condition expected from a first class building cleaning and maintenance program.

The Contractor must comply with the manufacturer’s instructions for cleaning operations.

The necessary cleaning work includes, but is not limited to, the following:

(a) removal of labels that are not required as permanent labels;
(b) cleaning of exposed exterior and interior hard surfaced finishes to be free from dirt, fingermarks, films and any foreign substances and marks;
(c) except as otherwise indicated by the Works Brief or as directed by the Principal's Representative, avoid disturbance of natural weathering of exterior surfaces;
(d) restore reflective surfaces to original and new reflective condition;
(e) wiping the surface of mechanical and electrical equipment clean, including lift equipment and similar equipment and remove excess lubrication and other substances;
(f) removal of debris and surface dust from limited access spaces, paying particular attention to concealed spaces such as plumbing ducts, shafts, pits, cupboards and false ceiling spaces;
(g) vacuum cleaning of floors, including concrete floors, in areas intended to be occupied;
(h) thorough sweeping, cleaning and where required vacuuming, of all floors to ensure a clean and dust free surface;
(i) cleaning light fixtures and lamps so as to function with full efficiency (re-lamp non functioning lamps); and
(j) cleaning signage.

The Contractor must employ experienced workers or professional cleaners for final cleaning operations.
2.15 Properties Adjacent to the Site

The Contractor must prevent nuisance to the owners, tenants or occupiers of properties adjacent to or within the Site, and to the public generally, and must take all steps necessary to maintain clear unobstructed access to buildings still under occupation and neighbouring buildings.

The Contractor must execute the Contractor’s Activities in a manner so as to avoid pollution or Contamination of the Site and its surroundings (including not causing any inconvenience to adjoining properties).

2.16 Site Meetings

The Contractor, appropriate Subcontractors and as required by the Principal’s Representative must attend weekly site progress and co-ordination meetings. The meetings will be chaired and minuted by the Principal’s Representative or its representative. The location of the progress meetings will be within the Contractor’s site offices, unless instructed otherwise by the Principal’s Representative.

The site progress meetings and coordination meetings referred to in the paragraph above will be held weekly as a minimum requirement unless otherwise approved by the Principal’s Representative and the Contractor must allow for any additional meetings and discussions which are necessary to fully inform the Principal’s Representative of the progress of the Contractor’s Activities.

The Contractor must, at the first site meeting, submit the names and telephone numbers of all responsible persons who may need to be contacted after hours during the course of the Contractor’s Activities.

2.17 Track Possessions

Track Possessions are made available to the contractor by the Principal (at no cost for the Contractor) for the Contractor to carry out Contractor’s Activities. The Track Possessions listed are subject to change.

The configuration 9 Track Possessions generally commence at 0200 hours Saturday and cease 0200 hours Monday.

<table>
<thead>
<tr>
<th>Configuration No.</th>
<th>Possession Weekend No.</th>
<th>Duration</th>
<th>Dates</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>50</td>
<td>3 days</td>
<td>9-11 June 2012</td>
<td>Full possession with power out and no freight trains</td>
</tr>
<tr>
<td>9</td>
<td>11</td>
<td>12 days</td>
<td>10-21 September 2012</td>
<td>Peak am/pm services running with power on and freight trains</td>
</tr>
<tr>
<td>9</td>
<td>15</td>
<td>2 days</td>
<td>13-14 October 2012</td>
<td>Freight trains operating during possession</td>
</tr>
<tr>
<td>9</td>
<td>24</td>
<td>2 days</td>
<td>15-16 December 2012</td>
<td>Full possession with power out and no freight trains</td>
</tr>
</tbody>
</table>
The construction program must be coordinated with these possessions. Additional possessions may be available but these would be subject to agreement from RailCorp and the Contractor would be responsible for all associated costs.

3 Materials and Workmanship

3.1 Means, Methods, Techniques, Sequences and Procedures

3.1.1 Information
When proposing an alternative work method, technique, sequence of activities or procedures for approval by the Principal's Representative, the Contractor must provide at its cost all available technical information, and any other relevant information requested by the Principal's Representative. If requested by the Principal's Representative, the Contractor must at its cost obtain and submit reports on relevant tests by an independent testing authority with respect to such work method, technique, sequence of activities or procedures.

3.1.2 Alterations
The information provided to the Principal's Representative by the Contractor pursuant to clause 3.1.1 of this Contract Specific Requirements must include whether the use of the alternative will require alteration to any other part of the Contractor's Activities. If the alternative is approved by the Principal's Representative and adopted, the Contractor must carry out any such alteration at its cost.

3.2 Proprietary Items

3.2.1 Definition
A proprietary item is any item identified by graphic representation in the drawings or specifications listed in the Works Brief, or by naming one or more of the following: manufacturer, supplier, installer, trade name, brand name, catalogue or reference number, and the like.

3.2.2 Implication
The identification of a proprietary item must not necessarily imply exclusive preference for the item so identified, but must be deemed to indicate the required properties of the item. Where the proprietary item is not obtainable, the Contractor may propose an alternative provided it is equal to or better than the original item. The Principal's Representative must not unreasonably withhold approval or reject any proposed alternative provided that any obligations under a sales contract are not compromised.

3.2.3 Claims
The Contractor will not be entitled to make any claim arising out of or in connection with any rejection or adoption of an alternative, unless otherwise agreed.
3.2.4 Information

When proposing an alternative for approval by the Principal's Representative, the Contractor must provide at its cost all available technical information, and any other relevant information requested by the Principal's Representative. If requested by the Principal's Representative, the Contractor must obtain and submit reports on relevant tests by an independent testing authority at its cost.

3.2.5 Alterations

The information provided to the Principal's Representative by the Contractor pursuant to clause 3.2.4 of this Contract Specific Requirements must include whether the use of the alternative will require alteration to any other part of the Contractor's Activities. If the alternative is approved by the Principal's Representative and adopted, the Contractor must carry out any such alteration at its cost.
Appendix A – Site Plans
STAGE 1 WORKS:
TEMPORARY STAIR

STAGE 1: 5 CAR SPACES TO BE OCCUPIED BY TEMPORARY STAIRS UNTIL STAGE 2 WORKS ARE COMPLETED, APPROX AREA - 73.5sqm

STAGE 2: ABOUT 19 CAR PARK SPACES WILL BE OCCUPIED FOR THE WORKS FOR STAGE 2, APPROX AREA - 425 sqm

MAIN ROAD
MARY STREET
RAILCORP ACCESS WAY
CARDIFF STATION
RAILCORP ACCESS WAY
COUNCIL CAR PARK

CARDIFF ACCESSIBILITY UPGRADE
REQUIRED COUNCIL CAR PARK SPACES FOR EASY ACCESS UPGRADE WORKS
01/03/2012
## List of Reports

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Author / Source</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1.1</td>
<td>Environmental Management Plan. Cardiff Railway Station Upgrade.</td>
<td>GHD</td>
<td>July 2011</td>
</tr>
<tr>
<td>A1.2</td>
<td>Geotechnical Assessment for Proposed Easy Access at Cardiff Railway Station, Main Road, Cardiff, NSW (ref 21820ZRrpt)</td>
<td>Jeffery and Katauskas Pty Ltd</td>
<td>10 Mar 2008</td>
</tr>
<tr>
<td>A1.3</td>
<td>Geotechnical Investigation. Proposed Station Upgrade – New Canopies. Cardiff Railway Station. Main Road, Cardiff, NSW (JG09294D-r1)</td>
<td>GeoEnviro Consultancy Pty Ltd</td>
<td>Oct 2009</td>
</tr>
<tr>
<td>A1.4</td>
<td>Geotechnical Investigation for Platform Extension at Cardiff</td>
<td>RailCorp</td>
<td>1 Mar 2011</td>
</tr>
<tr>
<td>A1.5</td>
<td>Hazardous Materials Register</td>
<td>RailCorp</td>
<td>24 Jun 2010</td>
</tr>
</tbody>
</table>
RailCorp New South Wales
Environmental Management Plan
Cardiff Railway Station Upgrade
July 2011
## Contents

List of Abbreviations ................................................. 5

1. Introduction .................................................. 1

2. Objectives ..................................................... 1

3. Regulatory Requirements ....................................... 2

4. Site Location and Description .................................. 3
   4.1 Site Location ............................................... 3
   4.2 Site Description ........................................... 3

5. Summary of Potential Contamination Issues ..................... 4

6. Potential Health, Safety and Environmental Risks ................. 6

7. Application of EMP, Roles and Responsibilities .................. 7

8. Environmental Management of Intrusive Works .................. 8
   8.1 Introduction ............................................... 8
   8.2 Soil and Water Management ................................ 8
   8.3 Dust and Odour Management ................................ 8
   8.4 Waste Management ........................................ 8
   8.5 Emergency Preparedness and Response ..................... 8

9. Health and Safety Management .................................... 10
   9.1 Regulatory Requirements .................................. 10
   9.2 Site Access Control ....................................... 10
   9.3 Hazard Controls .......................................... 10
   9.4 Management of Subcontractors ............................ 11

10. Revision of EMP ............................................. 13

11. References .................................................. 14

12. Limitations .................................................. 15
Table Index

Table 3-1  Site Location Summary  3
Table 4-1  Summary Results  5
Table 6-1  Roles and Responsibilities  7

Appendices

A  Figures
B  Regulatory Requirements
# List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACM</td>
<td>Asbestos Containing Material</td>
</tr>
<tr>
<td>B[a]P</td>
<td>Benzo[a]pyrene</td>
</tr>
<tr>
<td>BTEX</td>
<td>Benzene, toluene, ethyl benzene and total xylenes</td>
</tr>
<tr>
<td>DEC</td>
<td>NSW Department of Environment and Conservation (now the Office of Environment and Heritage)</td>
</tr>
<tr>
<td>DECC</td>
<td>NSW Department of Environment and Climate Change (incorporating the EPA)</td>
</tr>
<tr>
<td>DMP</td>
<td>Dewatering Management Plan</td>
</tr>
<tr>
<td>DP</td>
<td>Deposited Plan</td>
</tr>
<tr>
<td>EIL</td>
<td>Environmental Investigation Level</td>
</tr>
<tr>
<td>EPA</td>
<td>NSW Environment Protection Authority (now part of the DECC)</td>
</tr>
<tr>
<td>HBM</td>
<td>Hazardous Building Material</td>
</tr>
<tr>
<td>HIL</td>
<td>Health Investigation Level</td>
</tr>
<tr>
<td>mg/Kg</td>
<td>Milligrams per Kilogram</td>
</tr>
<tr>
<td>NEPM</td>
<td>National Environmental Protection Measure</td>
</tr>
<tr>
<td>NOHSC</td>
<td>National Occupational Health and Safety Commission</td>
</tr>
<tr>
<td>OCP</td>
<td>Organochlorine pesticides</td>
</tr>
<tr>
<td>OEH</td>
<td>Office of Environment and Heritage</td>
</tr>
<tr>
<td>OH&amp;S or OHS</td>
<td>Occupational Health and Safety</td>
</tr>
<tr>
<td>PAHs</td>
<td>Polycyclic Aromatic hydrocarbons</td>
</tr>
<tr>
<td>PCBs</td>
<td>Polychlorinated Biphenyl's</td>
</tr>
<tr>
<td>PID</td>
<td>Photo Ionisation Detector</td>
</tr>
<tr>
<td>POEO Act</td>
<td>Protection of the Environment Operations Act</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
</tr>
<tr>
<td>QA</td>
<td>Quality Assurance</td>
</tr>
<tr>
<td>QC</td>
<td>Quality Control</td>
</tr>
<tr>
<td>TPH</td>
<td>Total petroleum hydrocarbons</td>
</tr>
<tr>
<td>UCL</td>
<td>Upper Confidence Limit</td>
</tr>
</tbody>
</table>
1. Introduction

1.1 Project Overview

GHD Pty Ltd (GHD) was engaged by Rail Corporation New South Wales (Rail Corp) to prepare an Environmental Management Plan (EMP) to manage potential site contamination issues during the Cardiff Railway Station Upgrade, located at Cardiff, NSW (the Site).

As part of the development, there is a need to excavate soil from various areas for re-grading and to facilitate the installation of infrastructure. An environmental investigation was previously conducted to provide in-situ waste classification in the event that off-site disposal of material is required during the development works as part of the accessibility upgrade. The results of the targeted soil assessment demonstrated that the material within the proposed excavation areas is suitable, from a contamination perspective, for use under a commercial/industrial land use and as such, material would be suitable for re-use on site.

This EMP has been prepared for the purpose of protecting workers and the environment from potential contamination at the Site. The EMP is not designed for the purpose of protecting the workers and the environment from site activities (site safety / work plans will need to be prepared to address this, as discussed in Section 1.2).

1.2 Objectives of EMP

This EMP details provisions for the management of environmental, health and safety risks that may arise from potential soil contamination. The key objectives of this EMP are as follows:

- Identify potential contamination issues at the Site requiring management.
- Describe management procedures to mitigate risks of harm posed by potential contamination to site workers, contractors and the environment (including the surrounding community).
- Provide a framework for managing potentially contaminated media in accordance with legislative requirements.
- Outline roles and responsibilities for implementation and control of the EMP.

If unanticipated changes in site or working conditions occur which are not addressed by the EMP, Rail Corp is responsible for ensuring their management. Future operations or extensive disturbance of the Site may involve activities that have not been anticipated by this EMP and hence additional procedures would need to be prepared addressing the specific activities to be undertaken outside the provisions of this EMP.

As this EMP is specifically to provide guidance with respect to potential site contamination issues, it is intended that Rail Corp incorporate this EMP into their site management procedures for the broader OH&S and environmental issues associated with operational works at the Site.
2. Regulatory Requirements

Works on the Site are required to be in accordance with various environmental legislation and government guideline documents. The primary Acts, Regulations and Guidelines are listed in Appendix B. Please note, however, that the list is not intended to be a comprehensive listing of Acts and Regulations and their specific requirements. Property owners and contractors are required to satisfy themselves that all applicable permits and licences have been obtained and their conditions satisfied.

All references to Acts, Regulations and Guidelines are current as of the time of preparation of this EMP. These should be checked and updated as required, and the intent of the EMP is to require reference to Acts, Regulations and Guidelines current at the time of use.
3. Site Location and Description

3.1 Site Location

The Site is located at Cardiff Railway Station, off Main Road, Cardiff, NSW, 2285. Further site details are summarised in Table 3-1. The area covered by this EMP is shown on Figure 1, Appendix A.

Table 3-1 Site Location Summary

| Street Address | Main Road
| Cardiff, NSW, 2285 |
| Approximate Grid Co-Ordinates | 6354393N 374996E |
| Title Identifiers | Lot 1 DP1120089 and Lot 1 DP921702 |
| Local Government Area | City of Lake Macquarie |
| Current Land Use | Operational Train Station |
| Local Land Use Zoning | Under the Local Environmental Plan 2004, Zoning Map 7 the Site is zoned 5 Infrastructure Zone. |

3.2 Site Description

Based on information provided by Rail Corp, GHD understands that eight areas of the site have been identified for the proposed upgrade works. These include:

- **Zone 1**: Located between the Council car park and upper access-way to enable installation of new access-way and three stop lift;
- **Zone 2**: Installation of two stop lift from footbridge to Island platform;
- **Zone 3**: Island platform extension – 74 m at the city end and 10 m at the country end;
- **Zone 4**: Council car park – re-grading of five car-parking spaces adjacent to new access-way and lift;
- **Zone 5**: Upper access way re-grading;
- **Zone 6**: Access pathway re-grading;
- **Zone 7**: Re-grading of track levels -170 m of track; and
- **Zone 8**: Installation of rainwater tank on island platform.

The site layout, identifying each of the eight zones, is shown on Figure 1.
4. Summary of Potential Contamination Issues

Given the site's location within and adjacent to the rail corridor, and the potential historical uses of the site, there is a potential for this soil from these areas to be contaminated. Due to the site's limited space and the limited opportunities for recycling and reuse as part of the development, the excavated soil is proposed to be disposed of off-site to landfill.

A summary of the subsurface conditions encountered in the boreholes at each zone is provided below:

- **Zone 1**: Ballast and road based gravelly fill to a maximum of 0.3 m, underlain by silty sandy clay grading to clay/sandy clay.
- **Zone 2**: Topsoil, underlain by clay with sands and minor gravels to the end of the borehole.
- **Zone 3**: Ballast fill to 0.1 m, underlain by gravelly clay grading to clay at approximately 0.3 m.
- **Zone 4**: Light brown, gravelly clay with sands to 0.3 m.
- **Zone 5**: Ballast and road based gravel fill, underlain by sandy, gravelly clay with some silty sands to a maximum depth of 0.5 m.
- **Zone 6**: Cement ground cover to 0.1 m. Underlain by a mixture of clay with sand and gravels.
- **Zone 7**: Saturated ground cover in parts with topsoil. Gravelly clays from 0.05 m to 0.4 m, with gravel composition increasing with depth; and
- **Zone 8**: Silty sand with trace gravels to 1.0 m, with increasing gravel content to 2.7 m. Underlain by gravelly silty sands.

No visual or olfactory signs of contamination were noted at any of the sampling locations.

The results were compared to the Health Based Investigation Levels listed in the NSW EPA (2006) "Guidelines for the NSW Site Auditor Scheme" (HIL F) and the NSW DECC (2009) Waste Classification Guidelines, Part 1: Classifying Waste. A summary of results of the material against investigation levels is presented in Table 4-1. The results are summarised as follows:

- Within all 8 zones, the majority of samples reported concentrations less than the laboratory practical quantitation limit. Detections of metals all fell below the adopted health investigation level for commercial/industrial use.
- The concentrations of contaminants were compared to the criteria outlined in Tables 1 and 2 of the NSW DECC (2009) Waste Classification Guidelines, Part 1: Classifying Waste. Based on the results of laboratory analyses, the waste classification of the material present at the site would be *general solid waste* within all 8 zones.
<table>
<thead>
<tr>
<th>Zone</th>
<th>Summary Results</th>
<th>Waste Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Concentrations of all CoPC were reported below the practical quantitation limit of the laboratory or HIL(F). No asbestos detected</td>
<td>Concentrations reported below CT1. Material would be suitable for re-use on site or off-site disposal as <strong>General Solid Waste</strong></td>
</tr>
<tr>
<td>2</td>
<td>Concentrations of all CoPC were reported below the practical quantitation limit of the laboratory or HIL(F). No asbestos detected</td>
<td>With the exception of lead in surface sample Z2/1, all concentrations were reported below CT1. Leachable concentration of lead was low and the material would be suitable for re-use on site or off-site disposal as <strong>General Solid Waste</strong>.</td>
</tr>
<tr>
<td>3</td>
<td>Concentrations of all CoPC were reported below the practical quantitation limit of the laboratory or HIL(F). No asbestos detected</td>
<td>Concentrations reported below CT1. Material would be suitable for re-use on site or off-site disposal as <strong>General Solid Waste</strong></td>
</tr>
<tr>
<td>4</td>
<td>Concentrations of all CoPC were reported below the practical quantitation limit of the laboratory or HIL(F). No asbestos detected</td>
<td>Concentrations reported below CT1. Material would be suitable for re-use on site or off-site disposal as <strong>General Solid Waste</strong></td>
</tr>
<tr>
<td>5</td>
<td>Concentrations of all CoPC were reported below the practical quantitation limit of the laboratory or HIL(F). No asbestos detected</td>
<td>With the exception of lead in two samples (Z5/1/0.5 and Z5/3/0.25), all concentrations were reported below CT1. Leachable concentration of lead was low and the material would be suitable for re-use on site or off-site disposal as <strong>General Solid Waste</strong>.</td>
</tr>
<tr>
<td>6</td>
<td>Concentrations of all CoPC were reported below the practical quantitation limit of the laboratory or HIL(F). No asbestos detected</td>
<td>With the exception of lead and benzo(a)pyrene, all concentrations were reported below CT1. Leachable concentration of lead and benzo(a)pyrene were low and the material would be suitable for re-use on site or off-site disposal as <strong>General Solid Waste</strong>.</td>
</tr>
<tr>
<td>7</td>
<td>Concentrations of all CoPC were reported below the practical quantitation limit of the laboratory or HIL(F). No asbestos detected. GHD understands that ballast is to be re-used on site. No samples of ballast were collected for analysis.</td>
<td>With the exception of lead in two samples (Z7/2/0.4 and Z7/7/0.4), all concentrations were reported below CT1. Leachable concentration of lead was low. Material underlying the ballast would be suitable for re-use on site or off-site disposal as <strong>General Solid Waste</strong>.</td>
</tr>
<tr>
<td>8</td>
<td>Concentrations of all CoPC were reported below the practical quantitation limit of the laboratory or HIL(F). No asbestos detected</td>
<td>Concentrations reported below CT1. Material would be suitable for re-use on site or off-site disposal as <strong>General Solid Waste</strong></td>
</tr>
</tbody>
</table>

Groundwater was not encountered during the environmental investigation and as such the contamination status and depth to groundwater is not known.
5. Potential Health, Safety and Environmental Risks

The environmental investigation did not identify soil contamination at the Site with the potential to pose a risk to health, safety and/or the environment. However, this EMP provides guidance aimed to minimise the potential for exposure to potential contamination not identified in the environmental investigation, thus minimising the potential for risk to health and safety, or the environment.

The risks posed by potential hazards not identified at the Site are summarised below:

- Exposure to contaminated soil by way of ingestion (e.g. from hand to mouth transfer).
- Exposure to contaminated soil by way of inhalation (e.g. of dust).
- Exposure to contaminated soil by way of dermal adsorption (prolonged skin contact), as well as contaminants being taken home on soil clothing which could result in chronic health effects.
- Migration of contaminated soil or groundwater into the environment (e.g. by stormwater runoff) may result in pollution of offsite areas and water ways.

As noted in Section 1, this EMP does not cover other risks outside the site area as shown in Figure 1, Appendix A, or risks other than those related to contamination.
6. Application of EMP, Roles and Responsibilities

The following table outlines the main parties who have involvement in the EMP, and their respective roles and responsibilities. This table is not intended to list all responsibilities under relevant legislation (eg including but not limited to the OH&S Act and regulations), but is presented as a brief clarification of the parties’ respective responsibilities in implementing this EMP.

Table 6-1 Roles and Responsibilities

<table>
<thead>
<tr>
<th>Title</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Owner – Rail Corp</td>
<td>Responsible for promoting good environmental and OH&amp;S management. Responsible for:</td>
</tr>
<tr>
<td>Site Manager / Operator – Rail Corp</td>
<td>Taking all practical measures to ensure the workplace under their supervision is operating according to the agreed principles of the EMP, and without risks to health or the environment.</td>
</tr>
<tr>
<td></td>
<td>Ensuring all personnel under their control entering the Site are inducted to an appropriate level in environmental and emergency procedures.</td>
</tr>
<tr>
<td></td>
<td>Implementing, controlling and maintaining the EMP.</td>
</tr>
<tr>
<td></td>
<td>Responding to any OH&amp;S or environmental incident.</td>
</tr>
<tr>
<td></td>
<td>Providing subcontractors with the requirements of this EMP prior to commencement of work.</td>
</tr>
<tr>
<td></td>
<td>Ensuring that all changes to the EMP are communicated to all personnel working on site, including subcontractors.</td>
</tr>
<tr>
<td></td>
<td>Where encountered, reporting of previously unidentified areas of contamination or differences in subsurface conditions to those noted in Section 4 to Rail Corp.</td>
</tr>
<tr>
<td>Subcontractors</td>
<td>All subcontractors are required to comply with the EMP and to comply with directions from Rail Corp in this respect. Where encountered, reporting of previously unidentified areas of contamination or differences in subsurface conditions to those noted in Section 4 to Rail Corp.</td>
</tr>
<tr>
<td>Employees and Visitors to Site</td>
<td>Responsible for attending appropriate induction and training sessions following procedures and making Rail Corp aware of any actual or potential breaches of procedures. Where encountered, reporting of previously unidentified areas of contamination or differences in subsurface conditions to those noted in Section 4 to Rail Corp.</td>
</tr>
</tbody>
</table>
7. Environmental Management of Intrusive Works

7.1 Introduction
Site works should be conducted in a manner designed to minimise environmental impacts. This section describes the processes that should be considered prior to undertaking any intrusive works across the Site.

7.2 Soil and Water Management
The following management measures will apply:

- Any excavated material brought to the surface and placed in stockpiles will be placed on dedicated parts of the Site as approved by the Site Manager.
- All stockpiles will be covered if left for more than 24 hours.
- Perimeter silt fencing or appropriate stormwater diversion bunds around the work area will be installed to ensure that potentially contaminated materials do not migrate laterally from the excavation or stockpile area(s).
- Stockpiles are to be located away from concentrated stormwater flow paths including drainage lines, gutters, stormwater pits and inlets as appropriate.
- If excavated material appears or is suspected of being contaminated the material shall be kept segregated to allow for assessment.
- Where encountered, reporting of previously unidentified areas of contamination or differences in subsurface conditions to those noted in Section 4 to Rail Corp.

7.3 Dust and Odour Management
Works will be undertaken in a manner that minimises dust and odour emissions. The following measures will be undertaken:

- Careful handling of the excavated material in a manner that minimises dust emissions.
- Minimal spraying of soil with water.
- Use of tarpaulins to cover loads (incoming and outgoing).

7.4 Waste Management
All wastes generated at the Site will be classified, managed and disposed in accordance with the Environmental Guidelines: Assessment, Classification and Management of Liquid & Non Liquid Wastes (DECC 2009).

7.5 Emergency Preparedness and Response
The following procedure will be followed in the event of an emergency:

- Assess the risks associated with the release of the material from the site and ensure that appropriate procedures are included in the response to address such hazards.
- Identify the reason behind the release of the material and isolate/contain, including suspension of any activities which will result in additional material being generated/released.
- Recover the fill material which was released as far as practicable (for example, sweep spilt material from the area).
- Place the recovered material in an appropriate secure location.
- Complete the incident response form.
- Identify any additional controls/procedures to minimise the chance for similar releases to occur in the future.
8. Health and Safety Management

8.1 Regulatory Requirements
Safe work method statements (SWMS) must be prepared prior to undertaking intrusive investigations across the Site. As a minimum, SWMS's must:

- Provide a description of the work to be undertaken.
- Identify the safety risks.
- Describe the control measures to be implemented as part of the works.
- Describe the equipment to be used in the work.
- Describe relevant codes / standards applicable to the work.
- Provide details on the training and qualifications of persons undertaken the work.

8.2 Site Access Control
All workers entering the Site are required to meet the applicable personal protective equipment (PPE) requirements. Access to the Site is permitted by the site manager only after persons entering the Site have been advised of the potential contamination hazards as described in Section 5.

Any authorised person accessing the Site shall do so in accordance with the environmental, health and safety requirements as indicated in this plan.

8.3 Hazard Controls

8.3.1 Overview
All personnel working on the Site are to avoid contact with soil as it may be potentially contaminated and follow strict personal hygiene.

8.3.2 Personal Protective Equipment (PPE)
All workers shall wear the following personal protective equipment if in direct contact with potentially contaminated soil:

- Steel capped boots.
- High visibility vest.
- Long sleeve shirt.
- Long pants.
- Chemical and water resistant gloves.
- Dust masks if exposure to dust is likely.
8.3.3 Personal Hygiene

All workers on the Site shall observe the following personal hygiene rules:

- Heavily soiled clothing shall be removed before leaving the Site and cleaned or laundered separately. Consider the use of disposable overalls if heavy soiling is likely.
- Good hygiene facilities and practices will minimise additional employee exposure to potential contaminants via ingestion or inhalation, and prevent potential contamination of workers' vehicles and homes.
- Hand-washing facilities shall be used to wash hands and face hands prior to eating, drinking or smoking.
- Eating facilities shall be clean and accessible areas for employees and subcontractors. The work area should not be used as eating areas.

8.3.4 Training and Certification

The Site Manager shall ensure that awareness training is undertaken prior to any works being undertaken at the Site which disturb or result in contact with potentially contaminated soil.

The Site Manager must keep a record of the training undertaken.

8.4 Management of Subcontractors

Subcontractors working on-site will be required to adopt the provisions of this plan and will be advised of potential safety and environmental issues on site during site-specific induction training. This induction will include the occupational health and safety responsibilities, requirements and controls for all subcontractors working on site. All subcontractor activities will be monitored by the Site Manager to ensure compliance with the requirements of this plan.

Contractors and subcontractors whose work will be performed on-site, or who otherwise could be exposed to health and safety hazards, will be advised of known hazards through distribution of site information contained in this plan.

They shall be solely responsible for the health and safety of their employees and shall comply with all applicable laws and regulations.

8.4.1 Incident Management and Emergency Response

The Site Manager is to ensure proper coordination of incident and emergency response systems.

A written Incident Report Form must be completed for any incident or near-miss which may have resulted in an injury. Incident Report Forms are to be completed by the Site Manager within 24 hours of becoming aware of the incident.

8.4.2 Incident Response

Once a safety issue or incident is brought to the attention of the Site Manager, the Site Manager will:

1. Order all work to cease immediately.
2. Attempt to contain the situation and administer first aid (if appropriate).
3. Seek any medical help as required.
4. Notify any necessary agencies.

The site safety representative will report environmental or OH&S incidents in an Incident Form which is to be completed detailing corrective and preventative actions taken.

Any non-conformance issues shall be corrected to the satisfaction of the Site Manager prior to work continuing.
9. Revision of EMP

This EMP is a "working" document, and will be modified or updated as required by Rail Corp to reflect changing environmental conditions and / or incidents. This will ensure that the EMP remains effective in mitigating the potential environmental impacts on the Site.

As outlined in Section 1, environmental investigations to assess contamination in soils at the Site did not identify contamination. However, if different subsurface conditions, staining, odours or suspected contamination is observed during works, Rail Corp should cease work in that area and assess the potential for contamination. In this instance, it may be necessary to revise the EMP to reflect the results from further investigation works. It may also from time to time be necessary to revise the EMP to reflect changes to legislation, changes on site and / or improvements in technologies or knowledge.

Revision of the EMP should be undertaken by suitable qualified or experienced persons or organisations on behalf of Rail Corp.

All revisions of the document should be tracked through an appropriate document control system. The copies of the revised EMP should be distributed to the current stakeholders in the site for ongoing implementation.
10. References


GHD 2011: Cardiff Railway Station Accessibility Upgrade In-situ Waste Classification, 13 July 2011.

NSW DEC 2006: "Guidelines for the NSW Site Auditor Scheme (2nd edition)", NSW DEC, April 2006.


11. Limitations

This Environmental Management Plan ("Report"):

1. has been prepared by GHD Pty Ltd ("GHD") for Rail Corporation New South Wales ("Rail Corp");
2. may only be used and relied on by Rail Corp;
3. must not be copied to, used by, or relied on by any person other than Rail Corp without the prior written consent of GHD and subject always to the next paragraph; and
4. may only be used for the purpose as stated in Section 1 of the Report (and must not be used for any other purpose).

GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than Rail Corp arising from or in connection with this Report.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the Report are excluded unless they are expressly stated to apply in this Report.

The services undertaken by GHD in connection with preparing this Report:

- were limited to those specifically detailed in section 1 of this Report and GHD proposal dated 20 May 2011 document number 164543; and
- were undertaken in accordance with current profession practice and by reference to relevant environmental regulatory authority and industry standards, guidelines and assessment criteria in existence as at the date of this Report.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking the services mentioned above and preparing the Report ("Assumptions"), as specified throughout this Report.

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.

Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation of this Report and are relevant until such times as the site conditions or relevant legislations changes, at which time, GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with those opinions, conclusions and any recommendations.

GHD has prepared this Report on the basis of information provided by Rail Corp which GHD has not independently verified or checked ("Unverified information") beyond the agreed scope of work.

GHD expressly disclaims responsibility in connection with the Unverified Information, including (but not limited to) errors in, or omissions from, the Report, which were caused or contributed to by errors in, or omissions from, the Unverified Information.
The opinions, conclusions and any recommendations in this Report are based on information obtained from, and testing undertaken at or in connection with, specific sampling points and may not fully represent the conditions that may be encountered across the site at other than these locations. Site conditions at other parts of the site may be different from the site conditions found at the specific sampling points.

Investigations undertaken in respect of this Report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this Report.

GHD has considered and/or tested for only those chemicals specifically referred to in this Report and makes no statement or representation as to the existence (or otherwise) of any other chemicals.

Site conditions (including any the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD expressly disclaims responsibility:

- arising from, or in connection with, any change to the site conditions; and
- to update this Report if the site conditions change.

Except as otherwise expressly stated in this Report GHD makes no warranty or representation as to the presence or otherwise of asbestos and/or asbestos containing materials ("ACM") on the site. If fill material has been imported on to the site at any time, or if any buildings constructed prior to 1970 have been demolished on the site or material from such buildings disposed of on the site, the site may contain asbestos or ACM.

Subsurface conditions can vary across a particular site and cannot be exhaustively defined by the investigations carried out prior to this Report. As a result, it is unlikely that the results and estimations expressed or used to compile this Report will represent conditions at any location other than the specific points of sampling. A site that appears to be unaffected by contamination at the time of the Report may later, due to natural causes or human intervention, become contaminated.

Except as otherwise expressly stated in this Report, GHD makes no warranty, statement or representation of any kind concerning the suitability of the site for any purpose or the permissibility of any use, development or re-development of the site.

These Disclaimers should be read in conjunction with the entire Report and no excerpts are taken to be representative of the findings of this Report.
Appendix A

Figures
Appendix B

Regulatory Requirements
All references to Acts, Regulations and Guidelines are current as of the time of preparation of this EMP. These should be checked and updated as required, and the intent of the EMP is to require reference to Acts, Regulations and Guidelines current at the time of use.

The POEO Act aims to protect, restore and enhance the quality of the environment. Under the Act, it is an offence to pollute the environment. The Act has consolidated several pieces of previous environmental legislation. The Act administers a number of related regulations, and also controls the transport and disposal of wastes.

**Contaminated Land Management Act 1997 (CLM Act)**
The CLM Act controls the assessment of contamination and requirement of remediation of soils and groundwater. The act also allows for accreditation of Site Auditors.

**Water Act 1912 and Water Management Act 2000**
These Acts include requirements for licensing and approval for groundwater extraction.

The WARR Act replaced the *Waste Minimisation and Management Act 1995* and controls waste generation and waste reduction.

**Environmentally Hazardous Chemicals Act 1985 (EHC Act)**
The EHC Act contains guidance for waste classification and disposal of some waste types. It also provides for the licensing of related activities.

**Protection of the Environment Amendment (Scheduled Activities and Waste) Regulation 2008**
This regulation contains general environmental obligations for waste activities, waste facilities and waste transporters, and special provisions relating to matters such as contaminant immobilisation approvals and the management of particular wastes (including asbestos waste).

**State Environmental Planning Policy (SEPP) 55 'Remediation of Land'**
SEPP 55 relates to the decision making process in undertaking remediation of land and making planning decisions in regard to contaminated and potentially contaminated land. SEPP 55 includes requirements for notification of remediation works.

**NSW DECC Waste Classification Guidelines 2009**
Provides practical guidance in the relevant requirements of the POEO Act and the Waste Regulations.

**ANZECC/ARMCANZ Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000**
Sets water quality guidelines for discharges into fresh and marine water resources.
Lake Macquarie City Council – Policy for Managing Contaminated or Potentially Contaminated Land in Lake Macquarie, Version 02, 2010
Provides a framework to assist Council, residents and proponents of current and proposed development to respond positively and proactively to contaminated land based hazards and risks, both past and present.

Lake Macquarie City Council – Lake Macquarie City Development Control Plan No. 1, Principals of Development, Revision 06, 2011.
Sets guidelines for the management of contaminated land and remediation works. Sets guidelines for determining level of statutory approvals required for remediation works.

National Environment Protection (Assessment of Site Contamination) Measure 1999
Sets guidelines for the assessment of land contamination. Includes recommended soil and groundwater assessment criteria for a variety of land uses.

Occupational Health and Safety Act, 2000
The overarching Act for NSW setting law relating to employee health and safety and employer responsibilities.

Occupational Health and Safety Regulation, 2001
Sets Regulations and details the duties for employers to achieve required employee health and safety performance.

This national code of practice has been developed to assist persons with control of premises and/or plant to control the risks of asbestos-containing materials (ACM) in workplaces. It sets out the steps to be taken to eliminate or otherwise minimise the risks of exposure to airborne asbestos fibres, including the identification of ACM, risk assessments and the implementation of control measures. The objective of these measures is to prevent workplace exposure to airborne asbestos fibres and thereby reduce the incidence of asbestos-related diseases such as mesothelioma, asbestosis and lung cancer.

Outlines the basic principles for the safe removal of asbestos-based materials and is aimed at minimising or eliminating the concentration of airborne asbestos fibres.

Provides specific directions for the safe handling and removal of asbestos-based materials.

Polychlorinated biphenyl (PCB) chemical control order 1997
Provides specific requirements for the management control, storage, transport and disposal of PCB containing materials and waste.
Environmental Management Plan
Cardiff Railway Station Upgrade
REPORT
TO
CALDIS COOK GROUP
ON
GEOTECHNICAL ASSESSMENT
FOR
PROPOSED EASY ACCESS
AT
CARDIFF RAILWAY STATION, MAIN ROAD, CARDIFF, NSW

10 March 2008
Ref: 21820ZRrpt

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
Postal Address: PO Box 976, North Ryde BC NSW 1670
Tel: 02 9888 5000 • Fax: 02 9888 5003 • Email: engineers@kgroup.net.au • ABN 17 003 550 801
# TABLE OF CONTENTS

1 INTRODUCTION 1
2 ASSESSMENT PROCEDURE 2
3 RESULTS OF ASSESSMENT 4
  3.1 Summary of Observations 4
  3.2 Expected Subsurface Conditions 11
4 STABILITY OF RETAINING WALLS, CUT SLOPES AND RISK ASSESSMENT 13
  4.1 Existing Retaining Walls 13
  4.2 Risk Assessment 14
    4.2.1 Car Park Retaining Walls 15
    4.2.2 Railway Cut Slopes 17
  4.3 Additional Comments 19
5 COMMENTS AND RECOMMENDATIONS 19
  5.1 Stabilisation Measures 19
    5.1.1 Stormwater Drainage 20
    5.1.2 Wall Strengthening and/or Re-Construction 20
    5.1.3 Support/Regrading of Sloping Retained Surface 23
    5.1.4 Stabilisation of Railway Cut Slopes 23
    5.1.5 Monitoring 24
  5.2 Preliminary Geotechnical Advice 25
    5.2.1 Overview 25
    5.2.2 Option 1 25
    5.2.3 Option 2 28
    5.2.4 Option 3 29
  5.3 Further Geotechnical Work 31
6 GENERAL COMMENTS 31

FIGURE 1: GEOTECHNICAL SITE PLAN
FIGURE 2: GEOTECHNICAL MAPPING SYMBOLS
PLATES 1 TO 5: PHOTOGRAPHIC PLATES
APPENDIX A: LANDSLIDE RISK MANAGEMENT TERMINOLOGY
REPORT EXPLANATION NOTES

Last printed 10/03/2008 3:37:00 PM
1 INTRODUCTION

This report presents the results of our geotechnical assessment of the existing railway cuttings and existing retaining wall within the station platform area and car park area at Cardiff Station, Main Road, Cardiff, NSW. The assessment was commissioned by Mr Stephen Caldis (Caldis Cook Group) in a letter dated 11 December 2007 in accordance with our proposal (Ref: P14663ZA) dated 18 September 2007.

We understand that it is proposed to construct an 'Easy Access' to the existing station together with an upgrade of the existing car parking areas. Based on provided undated architectural drawings (DWG. No. SK-01 Sheets 1 to 3, DWG. No. SK-02 Sheets 1 & 2 and DWG. No. SK-03 Sheets 1 & 2) prepared by Caldis Cook Group, we understand that three options are being considered:

**Option 1**
A new lift to be provided at the northern end of the station platform; extension of the northern end of the platform (8.2m additional length) will be required. A new canopy over the southern end of the platform will be constructed. The footpath adjacent to the eastern end of the footbridge will be regraded.

**Option 2**
A new lift to be provided at the northern end of the station platform; extension of the northern end of the platform (46m additional length) will be required. There may also be an additional lift located at the western end of the footbridge. A new canopy over the southern end of the platform and the footbridge will be constructed.

**Option 3**
A new lift to be provided at the northern end of the station platform; extension of the northern end of the platform (8.2m additional length) will be required. The footbridge would also be extended to the west and a new lift provided at the
western end of the footbridge extension. A new canopy over the platform and the footbridge will be constructed.

Based on discussions with Mr Stephen Caldis (Caldis Cook Group) and Mr Greg Simpson (Hughes Trueman) we also understand that Railcorp have raised concerns regarding the stability of an existing retaining wall lining the eastern side of the lower station car park; recent collapse of a section of the retaining wall has occurred. We understand that Railcorp are considering stabilisation of this wall. However, only the architectural drawings for Option 1 make mention of this likely aspect of the works.

Based on discussions with Mr Neil Morris (Caldis Cook Group) we understand that consideration is being given to re-configuration of the existing car parks. However, details have yet to be finalised with Railcorp and as such no comments are provided in this report.

The purpose of the assessment was to assess the existing stability of the car park retaining wall and cut slopes within the station platform area, assess the need and scope of stabilisation measures to improve stability of the retaining wall and provide preliminary comments and recommendations regarding geotechnical issues relating to the proposed ‘Easy Access’ options.

2 ASSESSMENT PROCEDURE

The subject site comprised the eastern and western sides of the Cardiff Railway Station platform cutting, which extends to the south from the Main Road overbridge, together with the car park areas to the west of the station.

An Associate carried out the assessment on 10 January 2008. The assessment was completed from the Main Road overbridge, existing pedestrian overbridge and car
park areas and included a detailed inspection of the topographic, surface drainage and geological conditions of the site and its immediate environs.

Any identified potentially unstable features were compared to those of other similar lots in neighbouring locations to provide a comparative basis for assessing the risk of instability affecting the site. The attached Appendix A defines the terminology adopted for the risk assessment together with a flow chart illustrating the Risk Management Process based on the guidelines given in AGS 2007 (Reference 1).

A summary of our observations and assessment of likely subsurface conditions is presented in Section 3 below. Our comments regarding risk levels with regard to the existing retaining walls and railway cut slopes are provided in Section 4. Our specific recommendations regarding proposed retaining wall stabilisation measures and the geotechnical aspects of the proposed ‘Easy Access’ options are discussed in Sections 5.1 and 5.2, respectively.

The attached Figure 1 presents a geotechnical sketch plan of the site showing the principal geotechnical features present at the site. Figure 1 is based on the provided survey plans (Drawing No’s 3534-01-B to 3534-06-B, dated 25 September 2007) prepared by Meadows Consulting Pty Ltd, supplemented with hand held tape and measuring wheel measurements, inclinometer and compass techniques. Should any of the features be critical to the proposed development, we recommend they be located more accurately using instrument survey techniques. Figure 2 presents an explanation of geotechnical mapping symbols. Plates 1 to 5 provide a photographic record of the site and are presented in the attached photographic portfolio.
3 RESULTS OF ASSESSMENT

3.1 Summary of Observations

We recommend that the summary of observations which follows be read in conjunction with the attached Figure 1, and the attached photographic portfolio (Plates 1 to 5). For descriptive purposes the railway line has been assumed to be orientated north-south.

The site is located on a hillside that generally slopes down to the west at between approximately 10º and 15º. For ease of description the site has been sub-divided into two sections; the railway station cutting and the car park areas.

Railway Station Cutting

Where a track kilometrage has been referenced below, it has been referenced as follows: track kilometrage 154.910km has been presented as 154.910km. The track kilometrage has been estimated from the OHWS locations indicated on the provided survey plans.

- The railway cutting within the subject site was about 170m long, extending to the south from the Main Road overbridge (154.83km) to 155.00km. The base of the cutting was a maximum of about 20m wide and contained a station platform structure (about 135m long) and two tracks supported on a railway ballast subgrade. At approximately 154.86km, a concrete footbridge extended over the northern end of the station platform from Main Road west to the upper car park.

With regard to the station platform, we note the following additional features:

- The bitumen surfaced platform was supported by brick walls (about 1m high). Due to OH&S access restrictions, close observation of the condition of the walls was not possible. The platform bitumen
The concrete panel office and steel frame awnings located along the platform appeared to be in reasonably good condition.

- Over the length of the subject site, the downside cut face sloped down to the west at about 45° with a maximum vertical height of about 10m. Generally, the cut face was thickly vegetated although towards the northern end of the cut face (in particular below the Main Road overbridge) weathered conglomerate bedrock was revealed. Over the downside cut face, we note the following specific features:
  - Close to the crest of the cut slope in the vicinity of 154.90km, an old fenceline comprising what appeared to be old steel rail lines was misaligned and leaning over to the west.
  - The vegetated cut slope face south of the footbridge appeared to be uneven and contained intermittent sub-vertical faces (about 1m maximum height). Further, the slope face appeared to be slightly concave.
  - Below the footbridge what appeared to be a wash-out feature was located at the toe of the cut slope. The wash-out was about 3m long, 1.5m wide, a maximum of about 0.5m deep and revealed weathered conglomerate bedrock.
  - Below the Main Road overbridge, the cut slope face revealed weathered conglomerate bedrock which contained a near surface slump feature approximately 4m long, 3m wide and about 0.5m deep. Immediately to the north of this eroded portion of the cut face a concrete surface had been provided over the lower portion of the cut slope.
At the northern end of the subject site, the upside cut face sloped down to the east at about 45°. However, south of the footbridge, the cut face sloped down to the east at a maximum of about 15°. The cut face attained a maximum vertical height of about 3m at the northern end of the site and reduced to 0m by about 154.91km. Over the upside cut face, we note the following specific features:

- Below the Main Road overbridge, the cut slope face revealed weathered conglomerate bedrock which contained a number of erosion rills which extended back under the base of the concrete edge to the asphaltic concrete (AC) paved pathway leading under the overbridge.
- From approximately 154.825km a concrete crib wall about 15m long and 2.5m maximum height lined the toe of the cut slope and supported the above mentioned AC pathway. Based on observations from the footbridge, the crib wall appeared to be in reasonably good condition although occasional cracked and displaced cribs were noted towards the crest and base of the wall.
- South of the crib wall, the concave cut slope was thickly vegetated. The upper sub-vertical portion of the cut slope (about 05m high) revealed weathered conglomerate bedrock.

**Car Park Areas**

The chainages provided below are indicated on the attached Figure 1 and are based on site measurements and do not relate to the track kilometrage referenced above. The car parks comprised an upper area accessed from Main Road and which lined the western margin of the upside track and a lower area accessed from Mary Street.

**Upper Car Park**

The entry into the upper car park sloped down to the south at a maximum of about 15°. West from the car park entry a concrete paved footpath extended downslope and
lined a vegetated surface that sloped down to the south at a maximum of about 35° to the crest of a crib wall below. The crib wall is described in more detail below. The concrete footpath was in poor condition with vertical displacements across construction joints of the order of 50mm; the fence lining the crest of the slope was also visibly leaning over to the south.

Below the eastern side of the entry an existing cut face sloped down to the east at about 45°. The cut face revealed weathered conglomerate which contained a number of erosion rills. The AC surface lining the western side of the upper car park entry comprised a raised edge (about 0.1m high). Below the edge of the AC surface, a grassed surface sloped down to the south at a maximum of about 35°. However, close to the edge of the AC surface, the upper portion of the slope was sparsely vegetated and the natural soil surface was eroded revealing the edge and underside of the AC surface. The grass surfaced slope extended down to the crest of the sandstone block wall and concrete crib wall which lined the eastern and north-eastern edge of the lower car park; the walls are described in more detail below. The grassed slope was a maximum of about 1.5m vertical height (about chainage 60m).

The remainder of the upper AC paved car park was generally flat and contained occasional hairline to 5mm wide cracks. A flat grass surfaced area extended beyond the southern end of the paved car park. The site surface to the east of the flat portion of car park was vegetated, at a similar surface level and extended to the ballast surface of the railway line.

The western side of the flat portion of the upper paved car park was lined by a concave vegetated slope that extended down to the crest of the sandstone block retaining wall lining the eastern side of the lower car park (chainage 0m to 60m). Between about chainage 25m and 30m, the upper approximately 0.2m of the slope
was sub-vertical with signs of erosion of the soil surface. The sandstone block wall is described in more detail below.

For a distance of about 50m to the south of chainage 0m, the paved car park surface extended to the fenceline. The western side of this remaining portion of paved car park and the flat grass surfaced portion of the site to the south comprised a stepped vegetated slope of maximum 2m vertical height with an overall slope down to the west of a maximum of about 30°. Neighbouring gently sloping grass surfaced rear yards of residences extended west from the toe of the slope. We note that the slope was thickly vegetated and observations were therefore limited.

The fenceline lining the western side of the upper car park was leaning over to the west.

**Lower Car Park**

The AC paved car park surface sloped down to the west at a maximum of about 10° with vegetated verge and planter bed areas lined by concrete kerbs. Based on a cursory inspection the paved car park surface was in a reasonable condition with some cracking and signs of localised surface repair evident. Hairline to 10mm cracking was recorded within the concrete kerbing.

Site surfaces were generally similar over the western (Mary Street) frontage of the car park and the southern side of the car park; a neighbouring yard area lined the southern site boundary. However, the eastern and northern sides of the car park were lined by a sandstone block wall and concrete crib wall. The walls extended over a length of approximately 85m (chainage 0m to 85m) and are described in more detail below:

Between chainage 0m and 60m the sub-vertical wall was of stacked sandstone block construction and was of maximum 2.5m vertical height. In some areas the wall face
sloped down to the west at between 60° and 70°. The blocks within the wall ranged between about 0.1m and 0.4m long, between 0.1m and 0.15m high and the wall was about 0.2m thick at the crest. The vegetated verge area at the toe of the wall was approximately 2m wide. In addition, we note the following specific features:

- Chainage 10m to 12m: the upper 0.5m of the wall had collapsed revealing sandy fill with gravel and cobble sized sandstone inclusions.

- Chainage 15m: a small tree was growing out of the wall face.

- Chainage 20m to 22m: the wall had collapsed over this section and at least 1m to the north and south the adjacent wall face was bulging. Voids of up to about 0.2m width were present behind the wall face and there was some evidence of sandstone rubble which may represent backfill or the remains of a previously collapsed wall. Behind the crest of the wall, the slope surface revealed natural clayey gravel.

- Chainage 22m to 25m: occasional cracks of up to 5mm width were recorded within the wall blocks.

- Chainage 28m to 31m: this section corresponded with the most recent area of reported wall collapse and which extended up the southern side of the concrete paved access steps. The section of wall at the toe of the steps had been re-stacked. However, the upper portion of the wall collapse had not been repaired and a sub-vertical face of maximum 2m vertical height revealed extremely weathered conglomerate bedrock. Some temporary timbers with steel ‘star pickets’ had been used to support the western edge of the AC paved car park surface at the top of the steps.
- Chainage 32m to 60m: the verge area contained occasional traces of rotting low height log walls. Occasional sandstone blocks believed to be derived from the wall face were present within the verge area. In addition, an intermittently buried 150mm diameter PVC pipe ran parallel to the toe of the wall. The side of the pipe also contained holes (about 50mm diameter). We assume the pipe discharges stormwater run-off although the pipeline was unable to be traced beyond the wall toe area.

Beyond chainage 60m, the retaining wall was of variable construction as described below:

- Chainage 60m to 62m: the interface between the stacked sandstone wall and the concrete crib wall comprised a stacked concrete block wall of about 2.5m to 3m vertical height. Within the concrete blocks occasional cracking up to 15mm width was recorded. The sloping backfill surface above the wall sloped down to the west at between about 25° and 30° and was about 2m vertical height. Trees were growing within the sloping surface above the blocks and through the concrete block wall.

- Between chainage 62m and 85m the sub-vertical wall generally comprised a concrete crib wall (maximum 3.6m vertical height) with concrete gravel and cobble sized rubble backfill. The top surface of what appeared to be a concrete footing was intermittently revealed at the verge surface and occasional concrete fragments assumed to be from the wall backfill were also present along the verge surface. Occasional concrete cribs were out of vertical alignment by a maximum of about 10mm.

From chainage 85m to 90m, the vegetated slope to the west of the crib wall sloped down to the south at a maximum of about 30° and extended beyond the concrete steps leading down from Main Road. Although observations were restricted by the

Last printed 10/03/2008 3:37:00 PM
vegetation, there appeared to be a short length of sub-vertical rubble of maximum 2m vertical height.

3.2 Expected Subsurface Conditions

Reference to the 1:250,000 geological map of Newcastle indicates that the site is underlain by Newcastle Coal Measures comprising a variable bedrock sequence that includes conglomerate, sandstone, tuff, shale and coal.

We note that we have been provided with a copy of a structural drawing (Drawing No. PTC 1170 - 2A, dated 22 March 1983) prepared by MacDonald Wagner & Priddle Pty Ltd. The drawing provides details of the footbridge structure which now spans over the station platform area and also includes the locations of three boreholes (BH2, BH5 and BH6) which were drilled in the vicinity of the proposed footbridge location. Summary borehole logs are also provided on the drawing. We also note that we have completed a recent investigation approximately 1km to the south-east of the station.

Based on a review of the provided borehole logs, the results of our recent nearby investigation and our site observations we provide below our assessment of expected subsurface conditions across the site.

**Fill**

Sand and ash fill (maximum about 0.5m thick was encountered in the boreholes beneath the platform surface (BH2) and the upper car park paved surface (BH6). Within BH2, we have interpreted the clay layer beneath the sand and ash to comprise fill which extended to 1.1m depth. This would then indicate that the walls supporting the station platform also support fill which forms the station platform subgrade.
Within the upper car park area, BH6 then encountered clayey fill down to a depth of 1.9m. We note that some localised fill is likely to be encountered along the length of the western side of the upper car park. Based on our observations, the fill may well form at least the upper portion of sections of the sloping backfill surface above the stacked sandstone wall, particularly at the southern end.

**Residual Soils**

The three footbridge boreholes encountered residual soils comprising sandy or clayey gravel or clay with gravel inclusions and was interpreted as ‘decomposed conglomerate’ on the borehole logs. We concur with this assessment, although current soil description terminology would class the material as residual soil. The gravels have been assessed to be dense and the clay as hard. In BH2 and BH6, the residual soils were 0.6m and 2.1m thick, respectively over the station platform and upper car park area. BH5 indicated that the residual soils were at least 5.95m thick. BH5 and BH6 were terminated within the soil profile. The indicated thickness of the residual soil profile over the eastern side of the railway cutting (BH5) generally corresponds with our site observations; what appeared to be extremely weathered (XW) conglomerate and/or residual soils derived from conglomerate bedrock appeared to form the cut batter faces where vegetation was not present.

Our nearby investigation encountered residual soils of similar composition. However, we note the following:

- The cohesive (clayey) soils were assessed to be of medium to high plasticity and of variable strength; very soft to soft and very stiff. Laboratory testing indicated the clays to have a moderate potential for shrink-swell reactivity with changes in moisture content. A laboratory Standard compaction and four day soaked CBR test returned a CBR value of 2% for the clayey residual soil.

- The granular soils were assessed to be very loose.
Bedrock
In BH2 (station platform) conglomerate bedrock assessed to be extremely weathered and weak was encountered at 1.7m depth below the platform surface.

We note that our site observations within the site identified conglomerate bedrock which, where access was permissible was assessed to be extremely weathered and of extremely low strength. Near surface slumping of the conglomerate cut faces within the railway cutting are interpreted to indicate that the conglomerate revealed within the cut faces is generally XW and of extremely low strength. We also note that what was interpreted to be fine grained sandstone bands were also observed over sections of the eastern cut face.

Our boreholes drilled at the nearby site encountered an interbedded sequence of sandstone (0.3m to 1.5m thick) and conglomerate (0.2m to 2.5m thick). The bedrock was typically assessed to be slightly to distinctly weathered and of variable strength; low to high.

Groundwater
BH2 (station platform) was the only borehole to encounter groundwater. Seepage was noted at 1.3m depth, within the gravelly residual soils. No other groundwater observations were recorded.

4 STABILITY OF RETAINING WALLS, CUT SLOPES AND RISK ASSESSMENT

4.1 Existing Retaining Walls
The existing stacked sandstone retaining wall lining the eastern side of the lower car park is of limited thickness and appears to be a facing to a sub-vertical cut face through extremely weathered conglomerate bedrock. We note that the retained surface above the wall is moderately steep and based on the observed condition and
form of the wall we do not consider that it has been designed to support the additional surcharge of the sloping retained surface. Furthermore, there appears to be no evidence of formal drainage behind the wall or through the wall. However, we note that the stacked nature of the wall would allow some through-flow of water.

We understand from Railcorp representatives that the recent area of wall collapse (adjacent to the steps) occurred within the last 12 months. This and previous areas of collapse have occurred at night and the wall debris has extended into the car park area. Railcorp representatives also reported that stormwater run-off from the upper car park flows directly downslope and over the wall.

Based on our observations, the concrete crib wall appears to be performing satisfactorily. The crib wall has been assumed to be supporting a profile comprising possibly some localised fill, residual soils and extremely weathered conglomerate bedrock. The granular rubble backfill to the crib wall may be regarded as free draining however no other indications of behind wall drainage were observed. In this regard we assume that the wall has been engineer designed although we have not been provided with any design information. In addition, we assume that the wall has been designed to support the surcharge effects of the sloping retained surface above the wall.

We have no information regarding the retaining wall comprising a short length of stacked concrete blocks located at the interface between the crib wall and stacked sandstone wall. In addition, we have no information regarding the overgrown rubble to the west of the crib wall.

4.2 Risk Assessment
We note the contents of the “Geotechnical Problems Affecting Rail Operations – Risk Assessment and Hazard Management Guidelines”, dated October 2005 prepared by
Railcorp, which deals with the probability and consequences of potential geotechnical hazards affecting the rail track. However, as the area of potential wall instability will not affect the rail track, we have undertaken a preliminary geotechnical assessment of the risk of instability affecting the car park areas and persons within the car parks based on the methodology proposed by AGS 2007 (Reference 1) and our site observations. For comments relating to cut slope stability the rail track could be affected and therefore the Railcorp guidelines have been adopted.

4.2.1 Car Park Retaining Walls

The potential landslide hazards for the sloping area of the site between the upper and lower car parks are:

1. Collapse of the stacked sandstone wall.
2. Collapse of the stacked concrete block retaining wall and overgrown rubble wall.
3. Collapse of the concrete crib wall.
4. Erosion and near surface slumping of the sloping backfill surfaces above the retaining walls.

The following Table A summarises our preliminary assessment of risk to property for the above potential landslide hazards.
TABLE A

Preliminary Assessment of Risk to Property – Existing Conditions

<table>
<thead>
<tr>
<th>Potential Geotechnical Hazards</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td><strong>Likelihood</strong></td>
<td>Almost Certain</td>
<td>Possible</td>
<td>Unlikely</td>
<td>Almost Certain</td>
</tr>
<tr>
<td><strong>Consequences</strong></td>
<td>Medium – wall, parked vehicle, Insignificant – car parks</td>
<td>Medium – wall, parked vehicle, upper car park entry, Insignificant – lower car park</td>
<td>Medium – wall, parked vehicle, upper car park entry and footpath, Insignificant – lower car park</td>
<td>Minor – wall, parked vehicle, upper car park entry and footpath, Insignificant – lower car park</td>
</tr>
<tr>
<td><strong>Risk</strong></td>
<td>Very High – wall, parked vehicle, Moderate – car parks</td>
<td>Moderate – wall, parked vehicle and upper car park entry, Very Low – lower car park</td>
<td>Low – wall, parked vehicle, upper car park entry and footpath, Very Low – lower car park</td>
<td>High – wall, parked vehicle, upper car park entry and footpath, Very Low – lower car park</td>
</tr>
</tbody>
</table>

In relation to the criteria given in the attached Reference 1, High and Very High risk levels may be regarded as ‘unacceptable’, Moderate risk levels may be regarded as ‘tolerable’ and low risk levels may be regarded as ‘acceptable’.

We have also used the indicative annual probability associated with the assessed likelihood of Hazard 2 occurring to calculate the risk to life for users of the car park above and below the sloping area between the two car parks and people on the footpath above (including people entering the station and heading towards the footbridge). We have assumed:
• An average annual occupancy of ½ hour per day.
• A 4m length of wall or sloping backfill surface collapses.
• A 50% probability of evacuating the area if the collapse occurred.
• A 50% vulnerability to life for an individual if the collapse occurred.

These assumptions probably err towards the side of caution.

On this basis, under existing conditions, our calculated risk to life is as follows:

• For a person standing above or below the stacked sandstone wall would be about $3.5 \times 10^5$.
• For a person standing above or below the stacked concrete block wall or overgrown rubble wall would be about $5.2 \times 10^6$.
• For a person standing above or below the crib wall would be about $8.3 \times 10^6$.
• For a person standing above or below the sloping retained surface would be about $2.5 \times 10^5$.

The above levels of risk to life would be regarded as 'acceptable' in relation to the criteria given in the attached Reference 1.

With the recommendations in Section 5 fully implemented, risk to property would be reduced to 'acceptable' levels and the risk to life would remain at 'acceptable', but improved, levels. These recommendations form an integral part of the Landslide Risk Management (LRM) process.

4.2.2 Railway Cut Slopes

Table B (see below) has been completed using the Geotechnical Risk Assessment and Hazard Management Guidelines, dated October 2005 prepared by Railcorp and
summarises our qualitative assessment of each identified potential landslide hazard based on our observations. The potential landslide hazards are as follows:

- Near surface instability of cut slopes.
- Deep seated instability of cut slopes.
- Collapse of existing concrete crib wall.

**TABLE B**

**Railway Cut Slopes - Preliminary Assessment of Risk Under Existing Conditions**

<table>
<thead>
<tr>
<th>Potential Geotechnical Hazard</th>
<th>Probability of Potential Geotechnical Hazard Occurring and Affecting Track</th>
<th>Consequences</th>
<th>Risk Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near surface instability of cut slopes</td>
<td>M</td>
<td>S</td>
<td>3 Priority 1</td>
</tr>
<tr>
<td>Deep seated instability of cut slopes</td>
<td>VL</td>
<td>E</td>
<td>4</td>
</tr>
<tr>
<td>Collapse of existing concrete crib wall</td>
<td>VL</td>
<td>MC</td>
<td>5</td>
</tr>
</tbody>
</table>

Table B indicates that the consequence to life and property (the train and rail infrastructure) typically varies between Extreme and Moderate. Based on our observations, it is clear that on-going degradation and near surface instability affects the cut slopes within the weathered conglomerate bedrock. However, fragments within the slip debris are relatively small (less than cobble or boulder size) and the mass of slump debris is expected to be of low volume. We have no information as to the frequency of slumps within the cut slopes and it would be beneficial to obtain information from Railcorp so as to refine the above preliminary risk assessment.
Further, Table B provides the risk category for each potential geotechnical hazard. This risk category can be used to outline the required inspection regime in accordance with the Railcorp Guidelines. Further advice on the scope of stabilisation measures is provided in Section 5.1.4 below.

4.3 Additional Comments

It is recognised that, due to the many complex factors that can affect a site, the subjective nature of a risk analysis, and the imprecise nature of the science of geotechnical engineering, the risk of instability for a site cannot be completely removed. It is, however, essential that risk be reduced to at least that which could be reasonably anticipated by the community in everyday life and that landowners be made aware of reasonable and practical measures available to reduce risk as far as possible. Hence, risk cannot be completely removed, only reduced, as removing risk is not currently scientifically achievable.

In preparing our recommendations given below we have assumed that no activities on surrounding land which may affect the risk on the subject site would be carried out. We have further assumed that all buried services within and surrounding the site are, and will be regularly maintained to remain, in good condition.

5 COMMENTS AND RECOMMENDATIONS

5.1 Stabilisation Measures

To improve risk levels we recommend the following stabilisation measures be implemented:

1. Improve stormwater run-off drainage within the upper car park area.
2. Re-construction and/or strengthening of the stacked sandstone wall and concrete block wall.
3. Support/regrading of the sloping retained surface above the retaining walls.
4. Provide reinforced shotcrete supported by rock bolts to control the near surface instability of the railway cut slopes.

The geotechnical aspects of each of the above stabilisation measures are outlined below.

5.1.1 Stormwater Drainage
Currently, there appears to be little control of run-off from the upper car park discharging down over the sloping retained surface and the walls below. If not controlled, such run-off will continue to erode the soil profile above and behind the walls.

We recommend that a concrete kerb and/or dish drain be provided along the entire length of the eastern side of the upper car park, upper car park entry and the footpath leading down Main Road from the upper car park entry. The drainage line should discharge in a controlled manner to the stormwater system. Any discharge over the sloping retained surface or walls below must be via PVC pipes. The drainage measures should be designed by a hydraulic engineer.

5.1.2 Wall Strengthening and/or Re-Construction

Stacked Sandstone Wall
As a minimum, the sections of stacked sandstone wall that have collapsed or are showing signs of distress should be replaced. The reader is referred to the following Section 5.2.4 which discusses the geotechnical aspects of proposed 'Easy Access 'Option 3' and its potential impact on this wall.

We understand that there are no heritage issues with regard to the sandstone wall and so similar construction techniques are not necessarily required; although similar
construction may be selected for aesthetic reasons. However, based on our observations, we do not consider that the current wall construction would comply with current design standards; this should be checked by a structural engineer.

In any event, the replaced sections of wall should be designed in accordance with the advice provided below.

To allow re-construction of the stacked sandstone wall, temporary excavation batters would need to be laid back to an angle of about 1 Vertical (V) in 1.5 Horizontal (H). However, such batters would potentially de-stabilise the sloping backfill surface above. This may be mitigated by provision of shotcrete and rock bolts (see Section 5.1.3, below). Otherwise, the temporary batters would need to extended to the car park level above or steeper batters excavated and temporarily supported with raking props; construction in short panel lengths on a ‘hit 1 miss 2’ basis would likely be required to maintain temporary stability.

We note the above works would potentially impact on the lift locations and footbridge extension outlined for ‘Easy Access’ Options 2 and 3. Timing of the retaining wall stabilisation works and ‘Easy Access’ construction will therefore need to take these potential impacts into account.

The following characteristic earth pressure coefficients and subsoil parameters may be adopted for the design of re-constructed walls:

- The wall design may be based on a triangular lateral earth pressure distribution and an ‘active’ earth pressure coefficient, K_a, of 0.85, assuming a sloping retained surface of maximum 30°.
- A bulk unit weight of 20kN/m³ should be adopted for the retained profile.
Any surcharge (including construction traffic, compaction stresses etc) affecting the wall should be allowed in the design using a $K_p$ value of 0.35.

The walls should be designed as drained and provision made for permanent and effective drainage of the ground behind the walls. Subsurface drains should incorporate the non-woven geotextile fabric, such as Bidim A34, to act as a filter against subsoil erosion.

Lateral toe restraint can be calculated using a triangular earth pressure distribution with a 'passive' earth pressure coefficient, $K_p$, of 3 (but with a factor of safety of at least 2 to limit deformations), assuming horizontal ground in front of the wall. The passive pressure due to the upper 0.5m below the adjacent verge surface should be ignored in the analysis to take account of possible buried services and excavation tolerances. Where the wall is socketted into bedrock, an allowable lateral stress of 200kPa may be adopted for toe restraint, assuming the rock surface is near horizontal in front of the wall.

We note that this would only improve the sections repaired and only over these sections would risk levels to property be regarded as 'acceptable'. Over the remaining lengths of stacked sandstone wall the risk levels would remain at 'unacceptable' levels. However, some improvement in the performance of the remaining lengths of the stacked sandstone wall could be provided by re-pointing the wall with mortar and providing weep holes through the base of the wall. These measures, together with control of run-off and some monitoring (as outlined below in section 5.1.5) would improve risk to property levels to at least 'tolerable' levels.

**Stacked Concrete Block Wall and Overgrown Rubble Wall**

Assuming that there are no aesthetic concerns regarding the short length of stacked concrete block wall or overgrown rubble wall, these sections of wall could be strengthened using reinforced shotcrete supported by rock bolts with drainage behind the shotcrete.
Rock bolts would need to be installed in drill holes orientated at a downward angle of at least 15°. The bond length should be calculated beyond a theoretical failure plane projected up from the rear of the base of the existing wall at an angle of 35°. The rock bolts should be bonded into weathered conglomerate bedrock of at least low strength; an allowable bond strength of 100kPa may be assumed in their design.

Detailed design of such stabilisation measures is beyond the scope of this report. However, once the scope and extent of stabilisation measures has been agreed upon, further advice can be provided.

Alternatively, the walls could be replaced with an engineer designed sandstone wall or crib wall. Any of the above measures would improve risk to property to ‘acceptable’ levels. With only run-off from above controlled, the concrete block wall could be regularly monitored and this would improve risk to ‘tolerable’ levels.

5.1.3 Support/Regrading of Sloping Retained Surface
The sloping retained surface should be protected from potential erosion by protection with reinforced shotcrete supported by rock bolts as outlined above. This would improve risk to property to ‘acceptable’ levels. However, we note that provided the stormwater run-off is controlled (Section 5.1.1, above) then additional planting with rapid growing vegetation together with regular monitoring would improve risk to ‘tolerable’ levels.

5.1.4 Stabilisation of Railway Cut Slopes
The existing non-vegetated railway cut slopes close to the Main Road overbridge should be protected using reinforced shotcrete supported by rock bolts with drainage behind the shotcrete. Consideration could be given to extending this treatment over the entire length of the vegetated cut slope on the down side of the track but
extensive vegetation clearance would be required. At this stage, the vegetation appears to be providing stability to the near surface materials and monitoring by Railcorp is believed to be sufficient at this stage.

Detailed design of such stabilisation measures is beyond the scope of this report. However, once the extent of stabilisation measures has been agreed upon, further advice can be provided.

5.1.5 Monitoring

Depending on the scope of stabilisation measures selected (as discussed above) then there may well be a need for periodic monitoring of the retaining walls lining the eastern and northern sides of the lower car park, the sloping retained surfaces and paved surfaces above the walls.

Periodic monitoring may be defined as visual inspections on an annual basis and after periods of heavy or prolonged rainfall. It is imperative that such inspections/monitoring be formally documented and that the required frequency of reporting (and to whom) is clearly defined. We would suggest that Railcorp carry out the inspections/monitoring and report to a nominated consulting engineer so that if there are any causes for concern, further advice can be provided. The need for any additional remediation can then be assessed.

With regard to monitoring the railway cut slopes, the required inspection regime should be completed in accordance with the Railcorp Guidelines for the assessed risk levels provided in Table B, above.
5.2 Preliminary Geotechnical Advice

5.2.1 Overview
We note that a preferred option for the ‘Easy Access’ works has not yet finalised and the geotechnical advice provided below is of a preliminary nature. More specific design advice can be provided once the final option has been selected and will likely need to be confirmed by geotechnical investigation and/or regular geotechnical inspections during construction.

5.2.2 Option 1
New Lift
The excavations for the new lift are expected to be of the order of 2m and will extend through fill, natural soils and probably weathered conglomerate bedrock. Temporary excavation batters of 1V in 1.5H (natural soil) and 1V in 1H (weathered bedrock) are likely to be appropriate. However, such batters have the potential to de-stabilise the northern end of the platform and possibly the footbridge footings. Care will therefore need to be exercised and appropriate propping of existing structures will be required.

The lift pit base is expected to be founded in weathered conglomerate bedrock and may be designed on the basis of an allowable bearing pressure of 800kPa, subject to geotechnical inspection.

The following characteristic earth pressure coefficients and subsoil parameters may be adopted for the design of lift pit walls:
• The wall design may be based on a triangular lateral earth pressure distribution and an ‘at rest’ earth pressure coefficient, $K_r$, of 0.55, assuming a horizontal retained surface.

• A bulk unit weight of 20kN/m³ should be adopted for the retained profile.

• Any surcharge (including construction traffic, nearby footings, sloping backfill, compaction stresses etc) affecting the wall should be allowed in the design using the above earth pressure coefficient.

• The walls should either be designed for a hydrostatic pressure equivalent to the adjacent railway ballast surface or be designed as drained and provision made for permanent and effective drainage of the ground behind the walls; a sump and pump system would likely be required. Subsurface drains should incorporate the non-woven geotextile fabric, such as Bidim A34, to act as a filter against subsoil erosion.

**New Canopy**
If any new supports are required for the new platform canopy, we recommend that they be founded in bedrock. In order that no surcharge is transferred to the station platform walls the footings should also be founded below a theoretical zone of influence defined by a line projected up from the rear of the wall at an angle of 45°. Temporary excavation batters as outlined above for the lift pit are appropriate together with the warnings regarding potential de-stabilisation of nearby structures.

**Platform Extension**
The new station platform walls should be founded in weathered bedrock (using the above allowable bearing pressure) and founded below the invert levels of nearby drainage lines and/or buried service trenches.

If the station platform slab is suspended from the walls, then no backfilling will be required.
If the additional platform area is to be backfilled, the new walls will need to be designed to support the fill in accordance with the guidelines for the lift pit walls, assuming that the new platform slab props the station walls.

Prior to placing engineered fill the existing soil subgrade will need to be proof rolled as outlined below (Footpath Re-Grading section). However, the subgrade is likely to comprise railway ballast which will very likely be contaminated; such potentially contaminated material will need to be removed (see Section 6 for comments regarding classification of waste in accordance with Department of Environment & Conservation (NSW) guidelines).

We recommend that engineered fill comprise clean granular materials (such as recycled concrete or building rubble) with a maximum particle size of 40mm compacted to a minimum Density Index of 70%. Density testing should be regularly carried out on the fill to confirm the above specifications are achieved. We recommend at least Level 2 control of fill compaction as defined in AS3798. Preferably, the geotechnical testing authority should be engaged directly by the client rather than the earthworks subcontractor. Care will need to be exercised during fill compaction so as not to damage or de-stabilise the new platform walls, particularly when compacting under vibration. The vibration levels affecting the platform walls should be qualitatively monitored by site staff. If transmitted vibrations are considered excessive, proof rolling should be completed using the static mode with no vibration.

**Footpath Re-Grading**

Following re-grading of the footpath adjacent to the eastern end of the footbridge, the design subgrade surface should be proof rolled with a light roller (say 2 tonne) or a hand held vibrating plate compactor. The purpose of the proof rolling will be to improve the near surface compaction of the subgrade and detect any soft or
unstable areas which would need to be removed and replaced with engineered fill (as described above).

We note that the works would be carried out close to the crest of the railway cutting and there is the potential for localised instability of the upper portion of the cut slope. Care will need to be exercised during proof rolling. In addition, prior to works commencing, we recommend that the vegetation be cleared from this area of the cut slope and further geotechnical inspection carried out to check for any signs of slope instability. If there are stability concerns, then stabilisation measures such as shotcrete and rock bolts would likely be required.

Any potential surface run-off from the paved surface above the cut slope should be controlled and, all but prevented from discharging onto the cut slope as there is the potential for on-going erosion which may lead to cut slope instability.

5.2.3 Option 2

New Lift

For the new lift to be located at the northern end of the platform, the reader is referred to the comments provided for Option 1.

With regard to the possible location of the lift at the western end of the proposed footbridge extension, the lift pit base would need to be founded in weathered bedrock. Pile footings may need to be provided as weathered bedrock was not encountered over the depth of BH6 (5.8m). Bored piles would be suitable although there is the potential for collapse of the fill materials during pile boring and the use of temporary liners may be required. Bored piles would need to be witnessed by a geotechnical engineer as to confirm that bedrock has been penetrated.
Footbridge Extension

We recommend that the new extension to the footbridge is founded in bedrock and as outlined above for the new lift, bored piles would be required. We assume that the existing footbridge was founded in bedrock and this should be confirmed by Railcorp. If not, then additional settlement analyses will need to be undertaken to assess the affects of potential differential settlements, particularly if the extension is structurally connected to the existing footbridge.

New Canopy

See comments for Option 1.

Platform Extension

See comments for Option 1.

5.2.4 Option 3

New Lift

For the new lift to be located at the northern end of the platform, the reader is referred to the comments provided for Option 1.

With regard to the possible location of the lift at the western end of the proposed footbridge extension, the lift pit base would need to be founded in weathered bedrock. We do not have any geotechnical information below the lower car park surface although we expect bedrock would be at shallow depth (say of the order of 2m). On this basis, the lift pit base could probably be constructed directly onto the bedrock surface, subject to geotechnical inspection. However, if bedrock is not encountered at shallow depth, then pile footings may be required and in this regard the comments provided for Option 2 apply.
With regard to the possible lift location at the western end of the proposed footbridge extension we also note the following:

Temporary excavations would extend below the stacked sandstone wall and there would be the potential for the existing wall to be de-stabilised. We note our previous comments regarding options for repair of the stacked sandstone wall. The selection of wall repair option should be made with due regard for the selected ‘Easy Access’ option. If Option 3 is selected, we would recommend that the sandstone wall be repaired following construction of the lift pit; some interim stabilisation option would need to be considered to control risk levels in the short term.

**Footbridge Extension**

We recommend that the new extension to the footbridge is founded in bedrock and the reader is referred to the above comments regarding likely bedrock levels provided for the proposed new lift. We assume that the existing footbridge was founded in bedrock and this should be confirmed by Railcorp. If not, then additional settlement analyses will need to be undertaken to assess the affects of potential differential settlements, particularly if the extension is structurally connected to the existing footbridge.

**New Canopy**

See comments for Option 1.

**Platform Extension**

See comments for Option 1.
5.3 Further Geotechnical Work

The following summarises the scope of further geotechnical work recommended within this report, for future detailed design development, construction documentation and construction stages. For specific details reference should be made to the relevant sections of this report.

- Specific detailed design advice on the selected wall stabilisation options and ‘Easy Access’ option.
- Subsurface investigations.
- Inspection of the railway cut slope beneath the regraded footpath (if selected).
- Inspection of footing and lift pit bases.
- Witnessing the drilling of bored piles.
- Witnessing construction of wall stabilisation measures.
- Proof rolling of exposed sub-grade.
- Qualitative vibration monitoring proof rolling and engineered fill compaction.
- Density testing of engineered fill.

6 GENERAL COMMENTS

The recommendations presented in this report include specific issues to be addressed during the implementation of the proposed stabilisation measures. In the event that any of the recommendations presented in this report are not implemented, the general recommendations may become inapplicable and Jeffery and Katauskas Pty Ltd accept no responsibility whatsoever for the performance of the stabilisation measures where recommendations are not implemented in full and properly tested, inspected and documented.

It is possible that the subsurface soil, rock or groundwater conditions encountered during construction may be found to be different (or may be interpreted to be different) from those inferred from our surface observations in preparing this report.
Also, we have not had the opportunity to observe surface run-off patterns during heavy rainfall and cannot comment directly on this aspect. If conditions appear to be at variance or cause concern for any reason, then we recommend that you immediately contact this office.

This report provides advice on geotechnical aspects for the proposed civil and structural design. As part of the documentation stage of this project, Contract Documents and Specifications may be prepared based on our report. However, there may be design features we are not aware of or have not commented on for a variety of reasons. The designers should satisfy themselves that all the necessary advice has been obtained. If required, we could be commissioned to review the geotechnical aspects of contract documents to confirm the intent of our recommendations has been correctly implemented.

The offsite disposal of soil will most likely require classification in accordance with the Department of Environment & Conservation (NSW) guidelines as inert, solid, industrial or hazardous waste. We can complete the necessary classification and testing if you wish to commission us. As testing requires about seven days to complete, allowance should be made for such testing in the construction program unless testing is completed prior to construction. If contamination is found to be present then substantial further testing and delays should be expected. We strongly recommend this issue be addressed prior to commencement of excavation on site.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. Copyright in this report is the property of Jeffery and Katauskas Pty Ltd. We have used a degree of care, skill and diligence normally exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees
due for the investigation, the client alone shall have a licence to use this report. The report shall not be reproduced except in full.

Should you have any queries regarding this report, please do not hesitate to contact the undersigned.

Paul Roberts
Associate

For and on behalf of
JEFFERY AND KATAUSKAS PTY LTD.

TOPOGRAPHY

Symbol | Ground Profile | Description
-------|----------------|-----------------
\[\begin{array}{c}
v\bar{v} & \text{convex} \\
v\bar{v} & \text{concave} \\
v\bar{v} & \text{convex} \\
v\bar{v} & \text{concave} \\
\hline
\end{array}\]
well defined or angular break of slope
poorly defined or smooth change of slope
convex and concave too close together to allow the use of separate symbols
ridge crest
Cliff or escarpment or sharp break
40° or more (estimated height in metres)

\[\begin{array}{c}
\rightarrow_{15} & \text{Uniform Slope} \\
\rightarrow_{10} & \text{Concave Slope} \\
\rightarrow_{8} & \text{Convex Slope} \\
\hline
\end{array}\]
Slope direction and angle (Degrees)
Cut or fill slope, arrows pointing down slope

EXAMPLE OF USE OF TOPOGRAPHIC SYMBOLS:

OTHER FEATURES

- Boulder
- Seepage/spring
- Swallow hole for runoff
- Natural water course
- Open drain, unlined
- Open drain, lined
- Fenceline
- Property boundary
- Dry Stone Wall
- Major joint in rock face (opening in millimetres)
- Tension crack (opening in millimetres)
- Masonry or concrete wall
- Ponding water
- Boggy or swampy area

Block Diagram

Geotechnical Plan

GEOTECHNICAL MAPPING SYMBOLS

Jeffery and Katauskas Pty Ltd
Report No. 21820ZR... Figure No. 2
To be read in conjunction with text of report.
Chainage 60m

To be read in conjunction with text of report.

General view of upper carpark

Steps leading down to lower carpark (Chainage 31m)
To be read in conjunction with text of report.

UP SIDE CUT FACE
Looking south from footbridge

Main Road = 154.86 km

Footbridge (≈ 154.86 km)

Near surface slump beneath footbridge

DOWN SIDE CUT FACE

To be read in conjunction with text of report.
To be read in conjunction with text of report.
APPENDIX A

LANDSLIDE RISK MANAGEMENT

DEFINITION OF TERMS

Risk – A measure of the probability and severity of an adverse effect to health, property or the environment.
Risk is often estimated by the product of probability x consequences. However, a more general interpretation of risk involves a comparison of the probability and consequences in a non-product form.

Hazard – A condition with the potential for causing an undesirable consequence (*the landslide*). The description of landslide hazard should include the location, volume (or area), classification and velocity of the potential landslides and any resultant detached material, and the likelihood of their occurrence within a given period of time.

Elements at Risk – Meaning the population, buildings and engineering works, economic activities, public services utilities, infrastructure and environmental features in the area potentially affected by landslides.

Probability – The likelihood of a specific outcome, measured by the ratio of specific outcomes to the total number of possible outcomes. Probability is expressed as a number between 0 and 1, with 0 indicating an impossible outcome, and 1 indicating that an outcome is certain.

Frequency – A measure of likelihood expressed as the number of occurrences of an event in a given time. See also Likelihood and Probability.

Likelihood – used as a qualitative description of probability or frequency.

Temporal Probability – The probability that the element at risk is in the area affected by the landsliding, at the time of the landslide.

Vulnerability – The degree of loss to a given element or set of elements within the area affected by the landslide hazard. It is expressed on a scale of 0 (no loss) to 1 (total loss). For property, the loss will be the value of the damage relative to the value of the property; for persons, it will be the probability that a particular life (the element at risk) will be lost, given the person(s) is affected by the landslide.

Consequence – The outcomes or potential outcomes arising from the occurrence of a landslide expressed qualitatively or quantitatively, in terms of loss, disadvantage or gain, damage, injury or loss of life.

Risk Analysis – The use of available information to estimate the risk to individuals or populations, property, or the environment, from hazards. Risk analyses generally contain the following steps: scope definition, hazard identification, and risk estimation.

This appendix is an extract from LANDSLIDE RISK MANAGEMENT CONCEPTS AND GUIDELINES as presented in Australian Geomechanics, Vol. 36, No.1, 2000 which discusses the matter more fully.
Risk Estimation – The process used to produce a measure of the level of health, property, or environmental risks being analysed. Risk estimation contains the following steps: frequency analysis, consequence analysis, and their integration.

Risk Evaluation – The stage at which values and judgements enter the decision process, explicitly or implicitly, by including consideration of the importance of the estimated risks and the associated social, environmental, and economic consequences, in order to identify a range of alternatives for managing the risks.

Risk Assessment – The process of risk analysis and risk evaluation.

Risk Control or Risk Treatment – The process of decision making for managing risk, and the implementation, or enforcement of risk mitigation measures and the re-evaluation of its effectiveness from time to time, using the results of risk assessment as one input.

Risk Management – The complete process of risk assessment and risk control (or risk treatment).

Individual Risk – The risk of fatality or injury to any identifiable (named) individual who lives within the zone impacted by the landslide; or who follows a particular pattern of life that might subject him or her to the consequences of the landslide.

Societal Risk – The risk of multiple fatalities or injuries in society as a whole: one where society would have to carry the burden of a landslide causing a number of deaths, injuries, financial, environmental, and other losses.

Acceptable Risk – A risk for which, for the purposes of life or work, we are prepared to accept as it is with no regard to its management. Society does not generally consider expenditure in further reducing such risks justifiable.

Tolerable Risk – A risk that society is willing to live with so as to secure certain net benefits in the confidence that it is being properly controlled, kept under review and further reduced as and when possible.

In some situations risk may be tolerated because the individuals at risk cannot afford to reduce risk even though they recognise it is not properly controlled.

Landslide Intensity – A set of spatially distributed parameters related to the destructive power of a landslide. The parameters may be described quantitatively or qualitatively and may include maximum movement velocity, total displacement, differential displacement, depth of the moving mass, peak discharge per unit width, kinetic energy per unit area.

Note: Reference should also be made to Figure A1 which shows the inter-relationship of many of these terms and the relevant portion of Landslide Risk Management.

Reference should also be made to the paper referenced below for Landslide Terminology and more detailed discussion of the above terminology.

This appendix is an extract from LANDSLIDE RISK MANAGEMENT CONCEPTS AND GUIDELINES as presented in Australian Geomechanics, Vol. 36, No.1, 2000 which discusses the matter more fully.
TABLE A1: LANDSLIDE RISK ASSESSMENT
QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

### Qualitative Measures of Likelihood

<table>
<thead>
<tr>
<th>Level</th>
<th>Descriptor</th>
<th>Description</th>
<th>Indicative Annual Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>ALMOST CERTAIN</td>
<td>The event is expected to occur.</td>
<td>$&gt;10^{-3}$</td>
</tr>
<tr>
<td>B</td>
<td>LIKELY</td>
<td>The event will probably occur under adverse conditions.</td>
<td>$10^{-2}$</td>
</tr>
<tr>
<td>C</td>
<td>POSSIBLE</td>
<td>The event could occur under adverse conditions.</td>
<td>$10^{-3}$</td>
</tr>
<tr>
<td>D</td>
<td>UNLIKELY</td>
<td>The event might occur under very adverse circumstances.</td>
<td>$10^{-4}$</td>
</tr>
<tr>
<td>E</td>
<td>RARE</td>
<td>The event is conceivable but only under exceptional circumstances.</td>
<td>$10^{-5}$</td>
</tr>
<tr>
<td>F</td>
<td>NOT CREDIBLE</td>
<td>The event is inconceivable or fanciful.</td>
<td>$&lt;10^{-6}$</td>
</tr>
</tbody>
</table>

**Note:** "X" means that the indicative value may vary by say $\pm \frac{1}{2}$ order of magnitude, or more.

### Qualitative Measures of Consequences to Property

<table>
<thead>
<tr>
<th>Level</th>
<th>Descriptor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CATASTROPHIC</td>
<td>Structure completely destroyed or large scale damage requiring major engineering works for stabilisation.</td>
</tr>
<tr>
<td>2</td>
<td>MAJOR</td>
<td>Extensive damage to most of structure, or extending beyond site boundaries requiring significant stabilisation works.</td>
</tr>
<tr>
<td>3</td>
<td>MEDIUM</td>
<td>Moderate damage to some of structure, or significant part of site requiring large stabilisation works.</td>
</tr>
<tr>
<td>4</td>
<td>MINOR</td>
<td>Limited damage to part of structure, or part of site requiring some reinstatement/stabilisation works.</td>
</tr>
<tr>
<td>5</td>
<td>INSIGNIFICANT</td>
<td>Little damage.</td>
</tr>
</tbody>
</table>

**Note:** The "Description" may be edited to suit a particular case.

### Qualitative Risk Analysis Matrix – Level of Risk to Property

<table>
<thead>
<tr>
<th>LIKELIHOOD</th>
<th>CONSEQUENCES to PROPERTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A – ALMOST CERTAIN</td>
<td>VH</td>
</tr>
<tr>
<td>B – LIKELY</td>
<td>VH</td>
</tr>
<tr>
<td>C – POSSIBLE</td>
<td>H</td>
</tr>
<tr>
<td>D – UNLIKELY</td>
<td>M-L</td>
</tr>
<tr>
<td>E – RARE</td>
<td>M-L</td>
</tr>
<tr>
<td>F – NOT CREDIBLE</td>
<td>VL</td>
</tr>
</tbody>
</table>

### Risk Level Implications

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Example Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>VH</td>
<td>Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to acceptable levels; may be too expensive and not practical.</td>
</tr>
<tr>
<td>H</td>
<td>Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable levels.</td>
</tr>
<tr>
<td>M</td>
<td>Tolerable provided treatment plan is implemented to maintain or reduce risks. May be accepted. May require investigation and planning of treatment options.</td>
</tr>
<tr>
<td>L</td>
<td>Usually accepted. Treatment requirements and responsibility to be defined to maintain or reduce risk.</td>
</tr>
<tr>
<td>VL</td>
<td>Acceptable. Manage by normal slope maintenance procedures.</td>
</tr>
</tbody>
</table>

**Note:**
1. The implications for a particular situation are to be determined by all parties to the risk assessment; these are only given as a general guide.
2. Judicious use of dual descriptors for Likelihood, Consequence and Risk to reflect the uncertainty of the estimate may be appropriate in some cases.

---

These tables are an extract from LANDSLIDE RISK MANAGEMENT CONCEPTS AND GUIDELINES as presented in Australian Geomechanics, Vol. 35, No. 1, 2000 which discusses the matter more fully.
FIGURE A1: FLOWCHART FOR LANDSLIDE RISK MANAGEMENT

This figure is an extract from LANDSLIDE RISK MANAGEMENT CONCEPTS AND GUIDELINES as presented in Australian Geomechanics Vol35, No1, 2000 which discusses the matter more fully.
REPORT EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the geotechnical report in regard to classification methods, field procedures and certain matters relating to the Comments and Recommendations section. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, the SAA Site Investigation Code. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached Unified Soil Classification Table qualified by the grading of other particles present (e.g. sandy clay) as set out below:

<table>
<thead>
<tr>
<th>Soil Classification</th>
<th>Particle Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay</td>
<td>less than 0.002mm</td>
</tr>
<tr>
<td>Silt</td>
<td>0.002 to 0.06mm</td>
</tr>
<tr>
<td>Sand</td>
<td>0.06 to 2mm</td>
</tr>
<tr>
<td>Gravel</td>
<td>2 to 60mm</td>
</tr>
</tbody>
</table>

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

<table>
<thead>
<tr>
<th>Relative Density</th>
<th>SPT ‘N’ Value (blows/300mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very loose</td>
<td>less than 4</td>
</tr>
<tr>
<td>Loose</td>
<td>4 - 10</td>
</tr>
<tr>
<td>Medium dense</td>
<td>10 - 30</td>
</tr>
<tr>
<td>Dense</td>
<td>30 - 50</td>
</tr>
<tr>
<td>Very Dense</td>
<td>greater than 50</td>
</tr>
</tbody>
</table>

Cohesive soils are classified on the basis of strength (consistency) either by use of hand penetrometer, laboratory testing or engineering examination. The strength terms are defined as follows:

<table>
<thead>
<tr>
<th>Classification</th>
<th>Unconfined Compressive Strength kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Soft</td>
<td>less than 25</td>
</tr>
<tr>
<td>Soft</td>
<td>25 - 50</td>
</tr>
<tr>
<td>Firm</td>
<td>50 - 100</td>
</tr>
<tr>
<td>Stiff</td>
<td>100 - 200</td>
</tr>
<tr>
<td>Very Stiff</td>
<td>200 - 400</td>
</tr>
<tr>
<td>Hard</td>
<td>Greater than 400</td>
</tr>
<tr>
<td>Friable</td>
<td>Strength not attainable</td>
</tr>
<tr>
<td></td>
<td>- soil crumbles</td>
</tr>
</tbody>
</table>

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, ‘Shale’ is used to describe thinly bedded to laminated siltstone.

SAMPLING

Sampling is carried out during drilling or from other excavations to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon the degree of disturbance, some information on strength and structure. Bulk samples are similar but of greater volume required for some test procedures.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All except test pits, hand auger drilling and portable dynamic cone penetrometers require the use of a mechanical drilling rig which is commonly mounted on a truck chassis.
Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Premature refusal of the hand augers can occur on a variety of materials such as hard clay, gravel or ironstone, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock fragments. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the soil cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from “feel” and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term ‘mud’ encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg from SPT and U60 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an NMCL triple tube core barrel, which gives a core of about 50mm diameter, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS. The location of losses are determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the top end of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, “Methods of Testing Soils for Engineering Purposes” – Test F3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the ‘N’ value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of, say, 4, 6 and 7 blows, as
  \[ N = 13 \]
  \[ 4, 6, 7 \]
- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as
  \[ N > 30 \]
  \[ 15, 30/40/mm \]

The results of the test can be related empirically to the engineering properties of the soil.

Occasionally, the drop hammer is used to drive 50mm diameter thin walled sample tubes (U50) in clays. In such circumstances, the test results are shown on the borehole logs in brackets.

A modification to the SPT test is where the same drilling system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid core can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCTP) are shown as “Nc” on the borehole logs, together with the number of blows per 150mm penetration.
Static Cone Penetrometer Testing and Interpretation: Cone penetrometer testing (sometimes referred to as a Dutch Cone) described in this report has been carried out using an Electronic Friction Cone Penetrometer (EFCP). The test is described in Australian Standard 1289, Test F5.1.

In the tests, a 35mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the frictional resistance on a separate 134mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are electrically connected by wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output as incremental digital records every 10mm. The results given in this report have been plotted from the digital data.

The information provided on the charts comprise:

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio – the ratio of sleeve friction to cone resistance, expressed as a percentage.

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and occasionally very soft clays, rising to 4% to 10% in stiff clays and peats. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as exact.

Correlations between EFCP and SPT values can be developed for both sands and clays but may be site specific.

Interpretation of EFCP values can be made to empirically derive modulus or compressibility values to allow calculation of foundation settlements.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive. The test method provides a continuous profile of engineering properties but, where precise information on soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometers: Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a rod into the ground with a sliding hammer and counting the blows for successive 100mm increments of penetration.

Two relatively similar tests are used:

- Cone penetrometer (commonly known as the Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS1289, Test F3.2). The test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various Road Authorities.
- Perth sand penetrometer – a 16mm diameter flat ended rod is driven with a 9kg hammer, dropping 600mm (AS1289, Test F3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.

LOGS

The borehole or test pit logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment, but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The attached explanatory notes define the terms and symbols used in preparation of the logs.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than “straight line” variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

Where groundwater levels are measured in boreholes, there are several potential problems:

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole or ‘reverted’ chemically if water observations are to be made.
More reliable measurements can be made by installing standpipes which are read after stabilising at intervals ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

FILL
The presence of fill materials can often be determined only by the inclusion of foreign objects (eg bricks, steel etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably determine the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING
Laboratory testing is normally carried out in accordance with Australian Standard 1289 ‘Methods of Testing Soil for Engineering Purposes‘. Details of the test procedure used are given on the individual report forms.

ENGINEERING REPORTS
Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building) the information and interpretation may not be relevant if the design proposal is changed (eg to a twenty storey building). If this happens, the company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions – the potential for this will be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of persons or contractors responding to commercial pressures.

If these occur, the company will be pleased to assist with investigation or advice to resolve any problems occurring.

SITE ANOMALIES
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed that at some later stage, well after the event.

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES
Attention is drawn to the document ‘Guidelines for the Provision of Geotechnical Information in Tender Documents’, published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Copyright in all documents (such as drawings, borehole or test pit logs, reports and specifications) provided by the Company shall remain the property of Jeffrey and Katauskas Pty Ltd. Subject to the payment of all fees due, the Client alone shall have a licence to use the documents provided for the sole purpose of completing the project to which they relate. License to use the documents may be revoked without notice if the Client is in breach of any objection to make a payment to us.

REVIEW OF DESIGN
Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/ constraints are quite complex, it is prudent to have a joint design review which involves a senior geotechnical engineer.

SITE INSPECTION
The company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

Requirements could range from:

i) a site visit to confirm that conditions exposed are no worse than those interpreted, to

ii) a visit to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pile founding depths, or

iii) full time engineering presence on site.
# Graphic Log Symbols for Soils and Rocks

<table>
<thead>
<tr>
<th>Soil</th>
<th>Rock</th>
<th>Defects and Inclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill</td>
<td>Conglomerate</td>
<td>Clay Seam</td>
</tr>
<tr>
<td>Topsoil</td>
<td>Sandstone</td>
<td>Sheared or Crushed Seam</td>
</tr>
<tr>
<td>Clay (CL, CH)</td>
<td>Shale</td>
<td>Brecciated or Shattered Seam/Zone</td>
</tr>
<tr>
<td>Silt (ML, MH)</td>
<td>Siltstone, Mudstone, Claystone</td>
<td>Ironstone Gravel</td>
</tr>
<tr>
<td>Sand (SP, SW)</td>
<td>Limestone</td>
<td>Organic Material</td>
</tr>
<tr>
<td>Gravel (GP, GW)</td>
<td>Phyllite, Schist</td>
<td></td>
</tr>
<tr>
<td>Sandy Clay (CL, CH)</td>
<td>Tuff</td>
<td></td>
</tr>
<tr>
<td>Silty Clay (CL, CH)</td>
<td>Granite, Gabbro</td>
<td>Bituminous Concrete, Coal</td>
</tr>
<tr>
<td>Clayey Sand (SC)</td>
<td>Dolerite, Diorite</td>
<td>Colluvium</td>
</tr>
<tr>
<td>Silty Sand (SM)</td>
<td>Basalt, Andesite</td>
<td></td>
</tr>
<tr>
<td>Gravelly Clay (CL, CH)</td>
<td>Quartzite</td>
<td></td>
</tr>
<tr>
<td>Clayey Gravel (GC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sandy Silt (ML)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peat and Organic Soils</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other Materials:
- Concrete
- Colluvium
- Other Materials
<table>
<thead>
<tr>
<th>Field Identification Procedures</th>
<th>Group Symbols</th>
<th>Typical Names</th>
<th>Information Required for Describing Soils</th>
<th>Laboratory Classification Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Excluding particles larger than 75 μm and passing fractions on estimated weight)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wide range in grain size and substantial amounts of all intermediate particle sizes</td>
<td>GW</td>
<td>Well graded gravel, gravel-sand mixture, little or no fines</td>
<td>Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and handiness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses. For undisturbed soils add information on stratification, degree of compaction, consolidation, moisture conditions and drainage characteristics.</td>
<td></td>
</tr>
<tr>
<td>Predominantly one size or a range of sizes with some intermediate sizes missing</td>
<td>GP</td>
<td>Poorly graded gravel, gravel-sand mixture, little or no fines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonplastic fines (for identification procedures see ML below)</td>
<td>GM</td>
<td>Silty gravel, poorly graded gravel-sand-silt mixture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastic fines (for identification procedures, see CL below)</td>
<td>GC</td>
<td>Clayey gravel, poorly graded gravel-sand-clay mixture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wide range in grain sizes and substantial amounts of all intermediate particle sizes</td>
<td>SW</td>
<td>Well graded sands, gravelly sands, little or no fines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predominantly one size or a range of sizes with some intermediate sizes missing</td>
<td>SP</td>
<td>Poorly graded sands, gravelly sands, little or no fines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonplastic fines (for identification procedures, see ML below)</td>
<td>SM</td>
<td>Silty sands, poorly graded sand-silt mixture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastic fines (for identification procedures, see CL below)</td>
<td>SC</td>
<td>Clayey sands, poorly graded sand-clay mixture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identification Procedures on Fraction Smaller than 380 μm Sieve Size</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry Strength (resisting characteristics)</td>
<td>Dilatancy (resisting to straining)</td>
<td>Toughness (resistance to plasticity)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None to slight</td>
<td>Quick to slow</td>
<td>None</td>
<td>ML</td>
<td>Inorganic soils and very fine sands, rock flour, silty or clayey fine sands with slight plasticity</td>
</tr>
<tr>
<td>Medium to high</td>
<td>None to very slow</td>
<td>Medium</td>
<td>CL</td>
<td>Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays</td>
</tr>
<tr>
<td>Slight to medium</td>
<td>Slow to very slow</td>
<td>Slight to medium</td>
<td>OL</td>
<td>Organic clays and organic silts: clays of low plasticity</td>
</tr>
<tr>
<td>Slight to medium</td>
<td>Slow to very slow</td>
<td>Slight to medium</td>
<td>ML</td>
<td>Organic clays and organic silts: clays of high plasticity</td>
</tr>
<tr>
<td>High to very high</td>
<td>None to very slow</td>
<td>High to very high</td>
<td>CH</td>
<td>Organic clays of medium to high plasticity, fat clays</td>
</tr>
<tr>
<td>Highly Organic Soils</td>
<td>Reader identified by colour, odour, spongy feel and frequently by fibrous texture</td>
<td>PI</td>
<td>Peat and other highly organic soils</td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
1. Soils possessing characteristics of two groups are designated by combinations of group symbols (e.g. GW-GC, well graded gravel-sand mixture with clay fines).
2. Soils with liquid limits of the order of 35 to 50 may be visually classified as being of medium plasticity.
<table>
<thead>
<tr>
<th>LOG COLUMN</th>
<th>SYMBOL</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater Record</td>
<td>e</td>
<td>Standing water level. Time delay following completion of drilling may be shown.</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>Extent of borehole collapse shortly after drilling.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundwater seepage into borehole or excavation noted during drilling or excavation.</td>
</tr>
<tr>
<td>Samples</td>
<td>ES</td>
<td>Soil sample taken over depth indicated, for environmental analysis.</td>
</tr>
<tr>
<td></td>
<td>U50</td>
<td>Undisturbed 50mm diameter tube sample taken over depth indicated.</td>
</tr>
<tr>
<td></td>
<td>DB</td>
<td>Bulk disturbed sample taken over depth indicated.</td>
</tr>
<tr>
<td></td>
<td>DS</td>
<td>Small disturbed bag sample taken over depth indicated.</td>
</tr>
<tr>
<td></td>
<td>ASB</td>
<td>Soil sample taken over depth indicated, for asbestos screening.</td>
</tr>
<tr>
<td></td>
<td>ASS</td>
<td>Soil sample taken over depth indicated, for acid sulfate soil analysis.</td>
</tr>
<tr>
<td></td>
<td>SAL</td>
<td>Soil sample taken over depth indicated, for salinity analysis.</td>
</tr>
<tr>
<td>Field Tests</td>
<td>N = 17</td>
<td>Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'R' as noted below.</td>
</tr>
<tr>
<td></td>
<td>4, 7, 10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nc =</td>
<td>Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 160mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3R</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VNS = 25</td>
<td>Vane shear reading in kPa of Undrained Shear Strength.</td>
</tr>
<tr>
<td></td>
<td>PID = 100</td>
<td>Photoionisation detector reading in ppm (Soil sample headspace test).</td>
</tr>
<tr>
<td>Moisture Condition</td>
<td>MC&gt;PL</td>
<td>Moisture content estimated to be greater than plastic limit.</td>
</tr>
<tr>
<td>Cohesive Soils</td>
<td>MC&lt;PL</td>
<td>Moisture content estimated to be approximately equal to plastic limit.</td>
</tr>
<tr>
<td>(Cohesionless Soils)</td>
<td>D</td>
<td>DRY - runs freely through fingers.</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>MOIST - does not run freely but no free water visible on soil surface.</td>
</tr>
<tr>
<td></td>
<td>W</td>
<td>WET - free water visible on soil surface.</td>
</tr>
<tr>
<td>Strength (Consistency)</td>
<td>VS</td>
<td>VERY SOFT - Unconfined compressive strength less than 25kPa</td>
</tr>
<tr>
<td>Cohesive Soils</td>
<td>S</td>
<td>SOFT - Unconfined compressive strength 25-50kPa</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>FIRM - Unconfined compressive strength 50-100kPa</td>
</tr>
<tr>
<td></td>
<td>St</td>
<td>STIFF - Unconfined compressive strength 100-200kPa</td>
</tr>
<tr>
<td></td>
<td>ST</td>
<td>VERY STIFF - Unconfined compressive strength 200-400kPa</td>
</tr>
<tr>
<td></td>
<td>H</td>
<td>HARD - Unconfined compressive strength greater than 400kPa</td>
</tr>
<tr>
<td>( )</td>
<td></td>
<td>Bracketed symbol indicates estimated consistency based on tactile examination or other tests.</td>
</tr>
<tr>
<td>Density Index/ Relative Density</td>
<td>VL</td>
<td>Density Index (ki) Range (%)</td>
</tr>
<tr>
<td>Cohesionless Soils</td>
<td>L</td>
<td>Very Loose &lt;15</td>
</tr>
<tr>
<td></td>
<td>MD</td>
<td>Loose 15-35</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>Medium Dense 35-65</td>
</tr>
<tr>
<td></td>
<td>VD</td>
<td>Dense 65-85</td>
</tr>
<tr>
<td>( )</td>
<td></td>
<td>Very Dense &gt;85</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SPT 'N' Value Range (Blows/300mm)</td>
</tr>
<tr>
<td>Hand Penetrometer Readings</td>
<td>300</td>
<td>Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.</td>
</tr>
<tr>
<td></td>
<td>260</td>
<td></td>
</tr>
<tr>
<td>Remarks</td>
<td>'V' bit</td>
<td>Hardened steel 'V' shaped bit.</td>
</tr>
<tr>
<td></td>
<td>'TC' bit</td>
<td>Tungsten carbide wing bit.</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.</td>
</tr>
</tbody>
</table>

Ref: Standard Sheets/Log Symbols
November 2007
**LOG SYMBOLS**

### ROCK MATERIAL WEATHERING CLASSIFICATION

<table>
<thead>
<tr>
<th>TERM</th>
<th>SYMBOL</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual Soil</td>
<td>RS</td>
<td>Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.</td>
</tr>
<tr>
<td>Extremely weathered rock</td>
<td>XW</td>
<td>Rock is weathered to such an extent that it has “soil” properties, ie it either disintegrates or can be remoulded, in water.</td>
</tr>
<tr>
<td>Distinctly weathered rock</td>
<td>DW</td>
<td>Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.</td>
</tr>
<tr>
<td>Slightly weathered rock</td>
<td>SW</td>
<td>Rock is slightly discoloured but shows little or no change of strength from fresh rock.</td>
</tr>
<tr>
<td>Fresh rock</td>
<td>FR</td>
<td>Rock shows no sign of decomposition or staining.</td>
</tr>
</tbody>
</table>

### ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (IS 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Journal of Rock Mechanics, Mining, Science and Geomechanics. Abstract Volume 22, No 2, 1985.

<table>
<thead>
<tr>
<th>TERM</th>
<th>SYMBOL</th>
<th>IS (50) MPa</th>
<th>FIELD GUIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely Low:</td>
<td>EL</td>
<td>0.03</td>
<td>Easily remoulded by hand to a material with soil properties.</td>
</tr>
<tr>
<td>Very Low:</td>
<td>VL</td>
<td>0.1</td>
<td>May be crumbled in the hand. Sandstone is “sugary” and friable.</td>
</tr>
<tr>
<td>Low:</td>
<td>L</td>
<td>0.3</td>
<td>A piece of core 150mm long x 50mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.</td>
</tr>
<tr>
<td>Medium Strength:</td>
<td>M</td>
<td>1</td>
<td>A piece of core 150mm long x 50mm dia. can be broken by hand with difficulty. Readily scored with knife.</td>
</tr>
<tr>
<td>High:</td>
<td>H</td>
<td>3</td>
<td>A piece of core 150mm long x 50mm dia. core cannot be broken by hand, can be slightly scratched or scored with knife; rock rings under hammer.</td>
</tr>
<tr>
<td>Very High:</td>
<td>VH</td>
<td>10</td>
<td>A piece of core 150mm long x 50mm dia. may be broken with hand-held pick after more than one blow. Cannot be scratched with pen knife; rock rings under hammer.</td>
</tr>
<tr>
<td>Extremely High:</td>
<td>EH</td>
<td></td>
<td>A piece of core 150mm long x 50mm dia. is very difficult to break with hand-held hammer. Rings when struck with a hammer.</td>
</tr>
</tbody>
</table>

### ABBREVIATIONS USED IN DEFECT DESCRIPTION

<table>
<thead>
<tr>
<th>ABBREVIATION</th>
<th>DESCRIPTION</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Be</td>
<td>Bedding Plane Parting</td>
<td>Defect orientations measured relative to the normal to the long core axis (ie relative to horizontal for vertical holes)</td>
</tr>
<tr>
<td>CS</td>
<td>Clay Seam</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>Joint</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>Planar</td>
<td></td>
</tr>
<tr>
<td>Un</td>
<td>Undulatang</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Smooth</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>Rough</td>
<td></td>
</tr>
<tr>
<td>IS</td>
<td>Ironstained</td>
<td></td>
</tr>
<tr>
<td>XWS</td>
<td>Extremely Weathered Seam</td>
<td></td>
</tr>
<tr>
<td>Cr</td>
<td>Crushed Seam</td>
<td></td>
</tr>
<tr>
<td>60t</td>
<td>Thickness of defect in millimetres</td>
<td></td>
</tr>
</tbody>
</table>

Ref: Standard Sheets/Log Symbols
November 2007
Report

Geotechnical Investigation
Proposed Station Upgrade – New Canopies
Cardiff Railway Station
Main Road, Cardiff, NSW

Prepared for
Railcorp
C/- Caldis Cook Group
Level 2, 45 Chippen Street
CHIPPENDALE NSW 2008

Ref: JG09294D-r1
October 2009
28th October 2009

JG09294D-r1

Railcorp
C/- Caldis Cook Group
Level 2, 45 Chippen Street
CHIPPENDALE NSW 2008

Attention: Mr Ken Ng

Dear Sir

Re Geotechnical Report
Proposed Station Upgrade – New Canopies
Cardiff Railway Station, Main Road, Cardiff

We are pleased to submit our geotechnical report for the proposed Station Upgrade project for Cardiff Railway Station at Main Road, Cardiff, NSW.

This report contains information on sub-surface conditions and our comments and recommendations on geotechnical issues for the proposed development.

Should you have any queries, please contact the undersigned.

Yours faithfully
GeoEnviro Consultancy Pty Ltd

Solern Liew CPEng (NPER)
Director

ID:090DB294JG09294D-L1.DOC
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>2. SITE DESCRIPTION AND PROJECT APPRECIATION</td>
<td>1</td>
</tr>
<tr>
<td>3. INVESTIGATION METHODOLOGY</td>
<td>2</td>
</tr>
<tr>
<td>3.1 FIELDWORK</td>
<td>2</td>
</tr>
<tr>
<td>3.2 LABORATORY TEST RESULTS</td>
<td>3</td>
</tr>
<tr>
<td>4. RESULTS OF THE INVESTIGATION</td>
<td>4</td>
</tr>
<tr>
<td>4.1 SUBSURFACE CONDITIONS</td>
<td>4</td>
</tr>
<tr>
<td>4.2 LABORATORY TEST RESULTS</td>
<td>5</td>
</tr>
<tr>
<td>5. COMMENTS AND RECOMMENDATIONS</td>
<td>6</td>
</tr>
<tr>
<td>5.1 PLATFORM RESURFACING</td>
<td>6</td>
</tr>
<tr>
<td>5.2 NEW CANOPY</td>
<td>7</td>
</tr>
<tr>
<td>6. LIMITATIONS</td>
<td>8</td>
</tr>
</tbody>
</table>

## LIST OF DRAWINGS

Drawing No 1 Borehole Location Plan

## LIST OF APPENDICES

- Appendix A Borehole Reports
- Appendix B DCP Test Report
- Appendix B Laboratory Test Reports
- Appendix C Explanatory Notes and Graphic Symbols

GeoEnviro Consultancy
1. INTRODUCTION

This report presents the results of a geotechnical investigation for the proposed station upgrade project for Cardiff Railway Station at Main Road, Cardiff, as shown on Drawing No 1. The investigation was commissioned by Mr Hisham Noori of Caldis Cook Group, acting on behalf of Railcorp. The scope of works were carried out in general accordance with our fee proposal Ref PG09936C dated 29th January 2009.

We understand that the project will include construction of new canopy structures on the station platform area. The new canopies will be about 40m long and cover an area of about 300m². The project will also include some resurfacing of the station platform pavements.

The purpose of this investigation was to assess the subsurface ground conditions and based on the information obtained, to provide the following;

- Assessment on site classification to AS2870.

- Recommendations on platform subgrade preparation and resurfacing.

- Recommendation on suitable footing types for the proposed canopies including allowable bearing capacities and foundation depths.

2. SITE DESCRIPTION AND PROJECT APPRECIATION

Cardiff Railway Station is located between Main Road and Mary Street at Cardiff. The station consists of an island platform with railway tracks on both sides of the platform and an overhead pedestrian footbridge on the northern side. The station office consists of a single storey building of brick and fibro construction with metal roof. There is a car park located on the western side of the station which was benched at two levels with a height difference of about 3.0m. A railway yard abuts to the upper car park to the south.

The site is situated on undulating to rolling terrain. Surrounding ground surface slopes down to the south-west at an average angle of about 10 degrees.
The railway station is situated about 6m below Main Road to the north east and about the same level as the upper carpark to the south west. The lower carpark further to the south west of the station is situated at Mary Street level. Based on the drawing provided, the island platform is at about Reduced Level (RL) 30.1m Australian Height Datum (AHD).

The 1:250,000 Geological map of Newcastle indicates the site to be underlain by Newcastle Measures consisting of shale, sandstone, conglomerate, tuff, chert and coal seams.

We understand that the project will include construction of new canopy structures on the station platform area and these canopies will be about 40m long starting from the overhead footbridge to the station building. The project will also include some pavement resurfacing on the platform.

3. INVESTIGATION METHODOLOGY

3.1 Fieldwork

Fieldwork for the investigation was carried out on the 6th October 2009 and involved drilling of three boreholes (BH 1 to BH 3). Boreholes No 1 was drilled in the railway yard area using a truck-mounted P160 drill rig equipped for site investigation purpose. This borehole was drilled to a depth of about 10.6m below existing ground surface. To assess the strength of the subsurface soil profile, Standard Penetration Tests (SPT) were carried out in the borehole. Hand penetrometer tests were carried out on the SPT split-tube clayey samples to augment the SPT test results.

Boreholes Nos 2 and 3 were drilled on the existing railway platform using a Dingo drill rig mounted on a rubber tracked machine. These boreholes were drilled using spiral augers to depths of about 2.7m and 2.8m respectively below existing ground surface. Immediate adjacent to these boreholes, Dynamic Cone Penetrometer tests (DCP 1 and DCP 2) were carried in order to aid assessment of the relative densities of subsurface profile.
Prior to boreholes drilling, underground services checks were carried out using available drawings provided by Dial-before-you-dig and Railsearch. An underground services locator equipped with a remote sensing device was engaged as an extra precautionary measure to reduce risk of damage to underground services caused by the borehole drilling.

Details of the subsurface profiles and field tests are summarised on the Borehole Reports in Appendix A. The DCP test results are summarised on the DCP Test Report in Appendix B. Explanatory notes defining the terms and symbols used on the preparation of the Borehole Report are attached in Appendix D.

The site investigation was supervised on a full-time basis by our geotechnical engineer and in the presence of a PO4 safety officer. The works were carried out on general accordance with Safe Work Method Statement (Ref JG09294D-L1 dated 09th June 2009).

3.2 Laboratory Testing

Two disturbed soil samples (BH 2 [0.8-1.0m] and BH 3 [1.8-2.0]) were taken from the site to our NATA accredited laboratory for Atterberg Limit tests to aid assessment of soil characteristics and reactivity to moisture variation.

The laboratory test results are summarised on Laboratory Test Reports in Appendix C.
4. RESULTS OF THE INVESTIGATION

4.1 Subsurface Conditions

Reference may be made to the Borehole Reports in Appendix A for details of the subsurface conditions encountered in each test location. The following is a generalised description of the subsurface profiles encountered;

Railway Yard – BH 1

- Rail Ballast was encountered on surface with thickness of about 200mm.
- Underlying the rail ballast, fill was encountered consisting predominantly of medium plasticity Gravelly Silty Clay with variable quantities of gravel and some rail ballast to a depth of about 2.0m below existing ground surface. At lower depth, Clayey/Gravel fill was encountered. The fill was generally found to be moist to wet. The SPT test results indicate the fill to be loose.

- Natural soil was encountered beneath the fill at a depth of about 2.4m below existing ground surface. The natural clay consists of medium to high plasticity Silty Clay with some conglomerate, gravel and shale. At a depth of about 6.8m below existing ground surface, medium plasticity Gravelly Silty Clay was encountered. Based on the SPT test results, the natural clay soil was generally assessed to be very stiff to hard. Moisture content of the natural clayey soil was found to be approximately equal to the plastic limit.

- The borehole was found to be dry during and shortly after completion of the site investigation.

Station Platform – BH 2 and 3

- A thin layer of Asphalt Concrete was encountered on the platform surface with thickness ranging of about 25mm to 30mm.

- Underlying the Asphalt Concrete, fill was encountered predominantly consisting of high plasticity Silty Clay mixture with variable quantities of gravel and rail ballast. Based on the DCP test results, the density of the fill was assessed to be poorly compacted. The fill was found to be moist.
- Natural medium to high plasticity Silty Clay was encountered at depths ranging of about 1.4m to 1.6m below existing platform level. Based on the DCP test results, the natural clay was assessed to be firm to very stiff at the upper 700mm and the natural clay becomes hard at lower depths. Moisture content of the natural clay was found to be approximately equal to the plastic limit.

- The boreholes were found to be dry during and shortly after completion of the site investigation.

4.2 Laboratory Test Results

Based on the laboratory test results, the fill and natural clay soil was assessed to have a highly reactivity to moisture variation. The following is a summary of the Atterberg Limit test results for the samples taken from (BH 2 [0.8-1.0m] and BH 3 [1.8-2.0m]);

<table>
<thead>
<tr>
<th>BH</th>
<th>Liquid Limit (%)</th>
<th>Plastic Index (%)</th>
<th>Plasticity Index (%)</th>
<th>Linear Shrinkage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH 2 (0.8-1.0m)</td>
<td>46</td>
<td>19</td>
<td>27</td>
<td>11.5</td>
</tr>
<tr>
<td>BH 3 (1.8-2.0m)</td>
<td>48</td>
<td>19</td>
<td>29</td>
<td>12.0</td>
</tr>
</tbody>
</table>
5. COMMENTS AND RECOMMENDATIONS

5.1 Platform Resurfacing

The site investigation revealed the station platform to be underlain by a layer of asphalt concrete (i.e. 25mm to 30mm) overlying loosely compacted fill overlying firm to hard natural clay.

We anticipate that the platform resurfacing will require stripping of the existing asphalt concrete and excavation to a depth to suit the design thickness of the proposed new pavement. As the platform fill was assessed to be loose, we recommend the insitu fill be densified prior to construction of new pavement and this may include the following;

- Excavation of the top 0.5m of the fill and stockpiled for reuse as fill at a later stage.

- Rolling of the base of the excavation with a small vibration roller.

- Any soft areas identified during rolling should be further excavated and replaced with select granular fill such as ripped sandstone.

- The excavated clayey fill material may be reuse as fill beneath pavements subject to moisture conditioning. Alternatively, imported good quality fill such as ripped sandstone having a maximum particle size of 40mm may be used.

- The fill material should be compacted in layer not exceeding 250mm loose thickness compacted to a minimum 95% Standard Maximum Dry Density (SMDD) at close to Optimum Moisture Content.

Care should be taken to ensure rolling and compaction of the fill will not destabilise the platform retaining walls.
5.2 New Canopies

We understand that the proposed station upgrade project will include construction of new canopy structures on the platform area. The station platform is elevated about 1.2m above the track level and is retained by brick retaining wall.

The site investigation revealed the station platform to be underlain by a 25mm to 30mm thick layer of Asphalt Concrete overlying poorly compacted fill overlying natural clay. Bedrock was not encountered in the platform boreholes and judging from the borehole drilled on the railway yard, bedrock is expected to be deep, greater than 10m.

The DCP test results indicate the upper 0.7m of the natural clay to be firm to stiff and very stiff to hard clay was encountered at about 2.0m below existing platform level. Groundwater was not encountered in the boreholes during and upon completion of the site investigation.

For the proposed canopies, we are of the opinion that suitable footing should consist of pier taken through the fill and founded on natural very stiff to hard clay expected to be present at about 2.0m below platform level (ie below the existing track level).

For piers taken to a minimum depth of about 2.5m below existing platform surface (i.e. RL 28.0m AHD) and at least 0.5m into natural hard clay, an allowable end bearing of 150kPa may be adopted. Deeper piers taken to a minimum depth of 1.5m into natural very stiff to hard clay may be proportioned to an end allowable bearing capacity of 350kPa.

A shaft adhesion of 20kPa may be adopted for the section of piers within the natural clayey soil stratum. Uplift capacity of the piers should be half of the shaft adhesion. Shaft adhesion of the section of piers within the fill should be ignored.

As the site is underlain by a relatively thick layer (i.e. >10m) of clay assessed to be highly reactive, we recommend that the footings of the proposed structures be adequately designed to accommodate shrink-swell movements proportioned to a Class ‘H’ (Highly Reactive) site in accordance to AS2870 “Residential Slabs and Footings”.

GeoEnviro Consultancy
6. LIMITATIONS

The interpretation and recommendations submitted in this report are based in part upon data obtained from a limited number of boreholes. There is no investigation which is thorough enough to determine all site conditions and anomalies, no matter how comprehensive the investigation program is as site data is derived from extrapolation of limited test locations. The nature and extent of variations between test locations may not become evident until construction.

Groundwater conditions are only briefly examined in this investigation. The groundwater conditions may vary seasonally or as a consequence of construction activities on or adjacent to the site.

In view of the above, the subsurface soil and rock conditions between the test locations may be found to be different or interpreted to be different from those expected. If such differences appear to exist, we recommend that this office be contacted without delay.

The statements presented in this document are intended to advise you of what should be your realistic expectations of this report and to present you with recommendations on how to minimise the risk associated with groundworks for this project. The document is not intended to reduce the level of responsibility accepted by GeoEnviro Consultancy Pty Ltd, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in doing.

Your attention is drawn to the attached “Explanatory Notes” in Appendix D and this document should be read in conjunction with our report.

GeoEnviro Consultancy
APPENDIX A
Borehole Reports

GeoEnviro Consultancy
## Borehole Report

**Client:** Caldis Cook Group Pty Ltd  
**Project:** Proposed Station Upgrade - New Canopy  
**Location:** Cardiff Railway Station

**Borehole no:** 1  
**Job no:** JG09294D  
**Date:** 26/10/2009  
**Logged by:** JC  
**Checked by:** SL

<table>
<thead>
<tr>
<th>Drill Model and Mounting:</th>
<th>P160</th>
<th>Slope: 90 degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hole Diameter:</td>
<td>100 mm</td>
<td>R.L. Surface: -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bearing: -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Datum: -</td>
</tr>
</tbody>
</table>

### Material Description

**Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Classification Symbol</th>
<th>Unified Soil Classification</th>
<th>Moisture Content</th>
<th>Consistency/Density Index</th>
<th>Structure and Additional Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td></td>
<td></td>
<td>M</td>
<td></td>
<td>The fill appears loosely compacted</td>
</tr>
<tr>
<td>1.0</td>
<td></td>
<td></td>
<td>M-W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continued to next page
## Borehole Report

### Client:
Caldis Cook Group Pty Ltd

### Project:
Proposed Station Upgrade - New Canopy

### Location:
Cardiff Railway Station

### Job no:
JG09294D

### Date:
28/10/2009

### Logged by:
JC

### Checked by:
SL

### Drill Model and Mounting:
P160

### Hole Diameter:
100 mm

### Slope:
90 degrees

### Bearing:
-

### R.L. Surface:
~30.1m

### Datum:
AHD

### Material Description

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>Asphalt Concrete: thickness=25mm</td>
</tr>
<tr>
<td>0.5</td>
<td>Fill: Silty Clay/Gravel mixture: brown with some rail ballast</td>
</tr>
<tr>
<td>1.0</td>
<td>Fill: Gravelly Silty Clay: medium to high plasticity, yellow brown with some gravel</td>
</tr>
<tr>
<td>1.5</td>
<td>Fill: Silty Clay: high plasticity, yellow brown with some fine gravel</td>
</tr>
<tr>
<td>2.5</td>
<td>Silty Clay: high plasticity, yellow brown with a trace of gravel</td>
</tr>
<tr>
<td>3.0</td>
<td>As above, but grey</td>
</tr>
<tr>
<td>4.0</td>
<td>End of BH 2 at 2.7m</td>
</tr>
</tbody>
</table>

### Additional Observations

- The fill appears loosely compacted
- Start of DCP test at 0.5m
- End of DCP at 3.1m

---

Form no. R007/Ver/02/08/99
<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Material Description</th>
<th>NC</th>
<th>IC</th>
<th>Classification Symbol</th>
<th>Depth (m)</th>
<th>Notes, Samples, Water, Support Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1.5</td>
<td>Fill: Silty clayey gravel, grey</td>
<td>2</td>
<td>3</td>
<td>S(C)</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>1.5-2.0</td>
<td>Fill: Silty clayey gravel, red brown</td>
<td>2</td>
<td>3</td>
<td>S(C)</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>2.0-2.5</td>
<td>Silty clayey gravel, yellow brown</td>
<td>2</td>
<td>3</td>
<td>S(C)</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>2.5-3.0</td>
<td>Medium to high plasticity, red brown</td>
<td>2</td>
<td>3</td>
<td>S(C)</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>3.0-3.5</td>
<td>Grey modified silty yellow</td>
<td>2</td>
<td>3</td>
<td>S(C)</td>
<td>7.0</td>
<td></td>
</tr>
</tbody>
</table>

**Supplementary Water Notes:**
- Samples, Tests, etc. | Depth (m) | Classification, Soil Type, Field Type, Field Classification, Color, Material Description, R.I., Surface - 3.0 m, Hole Diameter - 100 mm, Slope 50 degrees, R.I., Surface - 3.0 m.
- Field Notes: Wave data, etc.
APPENDIX B
DCP Test Report
# Dynamic Cone Penetration Test Report

**Client/Address:** Caldis Cook Group (Chippendale)  
**Project:** Proposed Station Upgrade - New Canopy  
**Location:** Cardiff Railway Station

**Job No.:** JG09294D  
**Date:** 26-10-09  
**Report No.:** R01A

## Test Procedure
- AS 1289 1.1, 1.2.1, 6.3.2

### Test No: 1

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Blows</th>
<th>Soil Classification: Refer to BH 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.1</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>0.1-0.2</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>0.2-0.3</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>0.3-0.4</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>0.4-0.5</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>0.5-0.6</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>0.6-0.7</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>0.7-0.8</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>0.8-0.9</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>0.9-1.0</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1.0-1.1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1.1-1.2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1.2-1.3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1.3-1.4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>1.4-1.5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1.5-1.6</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1.6-1.7</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1.7-1.8</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>1.8-1.9</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>1.9-2.0</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>2.0-2.1</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2.1-2.2</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>2.2-2.3</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>2.3-2.4</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>2.4-2.5</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2.5-2.6</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2.6-2.7</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>2.7-2.8</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>2.8-2.9</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>2.9-3.0</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:**

- Weight: 9kg
- Drop: 510mm
- Rod Diameter: 16mm

---

This document is issued in accordance with NATA's accreditation requirements  
Accredited for compliance with ISO/IEC 17025  
NATA Accredited Laboratory Number: 14208.

Approved Signatory  
Principal  
Date 26/10/09
APPENDIX C
Laboratory Test Report
# Test Results - Atterberg Limits

<table>
<thead>
<tr>
<th>Sample Identification</th>
<th>BH 2 (0.8-1.0m)</th>
<th>BH 3 (1.8-2.0m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Register No</td>
<td>SR 5596</td>
<td>SR 5597</td>
</tr>
<tr>
<td>Sample Date</td>
<td>06-10-09</td>
<td>06-10-09</td>
</tr>
<tr>
<td>Test Date</td>
<td>12-10-09</td>
<td>12-10-09</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid Limit (%)</td>
</tr>
<tr>
<td>Plastic Limit (%)</td>
</tr>
<tr>
<td>Plasticity Index (%)</td>
</tr>
<tr>
<td>Linear Shrinkage (%)</td>
</tr>
<tr>
<td>Natural Moisture Content %</td>
</tr>
</tbody>
</table>

| Material Description | (CH) Silty Clay: high plasticity, yellow brown | (CI-CH) Silty Clay: medium to high plasticity, grey mottled yellow |

---

This document is issued in accordance with NATA's accreditation requirements
Accredited for compliance with ISO/IEC 17025
NATA Accredited Laboratory Number: 14208

Approved Signatory: Solern Liew
Principal: 28/10/2009
APPENDIX D
Explanatory Notes and Graphic Symbols

GeoEnviro Consultancy
EXPLANATORY NOTES

Introduction

These notes have been provided to amplify the geotechnical report with regard to investigation procedures, classification methods and certain matters relating to the Discussion and Comments sections. Not all notes are necessarily relevant to all reports.

Geotechnical reports are based on information gained from finite sub-surface probing, excavation, boring, sampling or other means of investigation, supplemented by experience and knowledge of local geology. For this reason they must be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods

The methods the description and classification of soils and rocks used in this report are based on Australian standard 1726, the SSA Site Investigation Code, in general descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions. Identification and classification of soil and rock involves to a large extent, judgement within the acceptable level commonly adopted by current geotechnical practices.

Soil types are described according to the predominating particle size, qualified by the grading or other particles present (eg sandy clay) on the following bases:

<table>
<thead>
<tr>
<th>Soil Classification</th>
<th>Particle Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay</td>
<td>Less than 0.002mm</td>
</tr>
<tr>
<td>Silt</td>
<td>0.002 to 0.06mm</td>
</tr>
<tr>
<td>Sand</td>
<td>0.6 to 2.00mm</td>
</tr>
<tr>
<td>Gravel</td>
<td>2.00mm to 60.00mm</td>
</tr>
</tbody>
</table>

Soil Classification

<table>
<thead>
<tr>
<th>Particle Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay</td>
</tr>
<tr>
<td>Silt</td>
</tr>
<tr>
<td>Sand</td>
</tr>
<tr>
<td>Gravel</td>
</tr>
</tbody>
</table>

Cohesive soils are classified on the basis of strength, either by laboratory testing or engineering examination. The strength terms are defined as follows:

Classification | Undrained Shear Strength kPa
Very Soft      | Less than 12
Soft           | 12 - 25
Firm           | 25 - 50
Stiff          | 50 - 100
Very Stiff     | 100 - 200
Hard           | Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer test (CPT), as below:

Relative Dense | SPT ‘N’ Value (blows/300mm) | CPT Cone Value (q-Mpa)
Very Loose     | Less than 5                  | Less than 2
Loose         | 5 - 10                      | 2 - 5
Medium Dense  | 10 - 30                     | 5 - 15
Dense         | 30 - 50                     | 15 - 25
Very Dense    | > 50                        | > 25

Rock types are classified by their geological names, together with descriptive terms on degrees of weathering strength, defects and other minor components. Where relevant, further information regarding rock classification, is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provided information on plasticity, grain size, colour, type, moisture content, inclusions and depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin walled sample tube (normally known as U50) into the soil and withdrawing a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils. Details of the type and method of sampling are given in the report.

Field Investigation Methods

This follows is a brief summary of investigation methods currently carried out by this company and comments on their use and application.

Hand Auger Drilling

The borehole is advanced by manually operated equipment. The diameter of the borehole ranges from 50mm to 100mm. Penetration depth of hand augered bores may be limited by premature refusal on a variety of materials, such as hard clay, gravels or ironstone.

Test Pits

These are excavated with a tractor-mounted backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3.0m for a backhoe and up to 6.0m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Care must be taken if construction is to be carried out near, or within the test pit locations, to either adequately recompact the backfill during construction, or to design the structure or accommodate the poorly compacted backfill.

Large Diameter Auger (eg Pongo)

The hole is advanced by a rotating plate or short spiral auger generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally not more than 0.5m) and are disturbed, but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers and is usually supplemented by occasional undisturbed tube sampling.

Continuous Spiral Flight Augers

The hole is advanced by using 90mm - 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the augers flights, but they are very disturbed and may be highly mixed with soil of other stratum.

Information from the drilling (as distinct from specific sampling by SPT or undisturbed samples) is of relatively low reliability due to remoulding, mixing or softening of samples by ground water, resulting in uncertainties of the original sample depth.
Continuous Spiral Flight Augers (continued)
The spiral augers are usually advanced by using a V-bit through the soil profile refusal, followed by Tungsten Carbide (TC) bit, to penetrate into bedrock. The quality and continuity of the bedrock may be assessed by examination of the recovered rock fragments and through observation of the drilling penetration resistance.

Non-core Rotary Drilling (Wash Boring)
The hole is advanced by a rotary bit, with water being pumped down the drill rod and returned up the annulus, carrying the cuttings, together with some information from the "feet" and rate of penetration.

Rotary Mud Stabilised Drilling
This is similar to rotary drilling, but uses drilling mud as a circulating fluid, which may consist of a range of products, from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg SPT and UU samples).

Continuous Core Drilling
A continuous core sample is obtained using a diamond tipped core barrel. Providing full core recovery is achieved (which is not always possible in very weak rock and granular soils) this technique provides a very reliable (but relatively expensive) method of investigation. In rocks an NMLC triple tube core barrel which gives a core of about 50mm diameter, is usually used with water flush.

Portable Proline Drilling
This is manually operated equipment and is only used in sites which require bedrock core sampling and there is restricted site access to truck mounted drill rigs. The boreholes are usually advanced initially using a tricone roller bit and water circulation to penetrate the upper soil profile. In some instances a hand auger may be used to penetrate the soil profile. Subsequent drilling into bedrock involves the use of NMLC triple tube equipment, using water as a lubricant.

Standard Penetration Tests
Standard penetration tests are used mainly in non-cohesive soils, but occasionally also in cohesive soils, as a means of determining density and strength of or obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289 "Methods of testing Soils for Engineering Purpose" Test F31.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63Kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the "N" value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rocks, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In a case where full penetration is obtained with successive blows counts for each 150mm of, say 4, 6, and 7 blows.
  as 4, 6, 7
  N = 13

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 400mm.
  as 15, 30/40mm

The results of the tests can be related empirically to the engineering properties of the soil. Occasionally the test methods is used to obtain samples in 50mm diameter thin walled samples tubes in clays. In these circumstances, the best results are shown on the bore logs in brackets.

Dynamic Cone Penetration Test
A modification to the SPT test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The cone can be continuously driven into the borehole and is normally used in areas with thick layers of soft clays or loose sand. The results of this test are shown as the "N", on the bore logs, together with the number of blows per 150mm penetration.

Cone Penetrometer Testing and Interpretation
Cone penetrometer testing (sometimes referred to as Dutch Cone-CPT) described in this report, has been carried out using an electrical friction cone penetrometer and the test is described in Australian Standard 1289 test F5.1.

In the test, a 35mm diameter rod with cone tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig, which is fitted with a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 150mm long sleeve, immediately behind the cone. Transducer in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output on continuous chart recorders. The plotted results in this report have been traced from the original records. The information provided on the charts comprises:

- Cone resistance - the actual end bearing force divided by the cross sectional area of the cone, expressed in Mpa.
- Sleeve friction - the frictional force on the sleeve divided by the surface area, expressed in kPa.
- Friction ratio - the ratio of sleeve friction to cone resistance, expressed in percentage.

There are two scales available for measurement of cone resistance. The lower 'A' scale (0-5Mpa) is used in very soft soils where increased sensitivity is required and is shown in the graph as a dotted line. The main 'B' scale (0-50Mpa) is less sensitive and is shown as a full line.

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative frictions in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and very soft clays, rising to 4% to 10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:

\[ q_c \text{ (Mpa)} = (0.4 \text{ to } 0.6) N \text{ (blows per 300mm)} \]

In clays the relationship between undrained shear strength and cone resistance is commonly in the range:

\[ q_c = (12 \text{ to } 18) C \]

Interpretation of CPT values can also be made to allow estimate of modulus or compressibility values to allow calculation of foundation settlements. Inferred stratification, as shown on the attached report, is assessed from the cone and friction traces, from experience and information from nearby boreholes etc.
Cone Penetrometer Testing and Interpretation continued

This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties and where precise information or soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometer (AS1289)

Portable dynamic cone penetrometer tests are carried out by driving a rod in to the ground with a falling weight hammer and measuring the blows per successive 100mm increments of penetration.

There are two similar tests, Cone Penetrometer (commonly known as Scala Penetrometer) and the Perth Sand Penetrometer. Scala Penetrometer is commonly adopted by this company and consists of a 16mm rod with a 20mm diameter cone end, driven with a 9kg hammer, dropping 510mm (AS 1289 Test F3.2).

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedures are given on the individual report forms.

Engineering Logs

The engineering logs presented herein are an engineering and/or geological interpretation of the sub-surface conditions and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, however, this is not always practicable or possible to justify economically. As it is, the boreholes represent only a small sample of the total sub-surface profile. Interpretation of the information and its application to design and construction should take into account the spacing of boreholes, frequency of sampling and the possibility of other than "straight line" variations between the boreholes.

Groundwater

Where groundwater levels are measured in boreholes, there are several potential problems:

- In low permeability soils, ground water although present, may enter the hole slowly, or perhaps not at all, during the investigation period.
- A localised perched water table may lead to a erroneous indication of the true water table.
- Water table levels will vary from time to time, due to the seasons or recent weather changes. They may not be the same at the time of construction as indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole if any water observations are to be made. More reliable measurements can be made by installing stand pipes, which are read at intervals over several days, or weeks for low permeability soils. Piezometers sealed in a particular stratum may be interference from a perched water table or surface water.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal is changed, say to a twenty storey building. If this occurs, the company will be pleased to review the report and sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of sub-surface conditions, discussions of geotechnical aspects and recommendations or suggestions for design and construction. However, the company cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on bore spacing and sampling frequency.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of contractors responding to commercial pressures.

If these occur, the company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the company request immediate notification. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information tender Documents", published by the Institute of Engineers Australia. Where information obtained for this investigation is provided for tender purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or make additional copies of the report available for contract purpose, at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspect of work to which this report is related. This could range from a site visit to confirm that the conditions exposed are as expected, to full time engineering presence on site.

Review of Design

Where major civil or structural developments are proposed, or where only a limited investigation has been completed, or where the geotechnical conditions are complex, it is prudent to have the design reviewed by a Senior Geotechnical Engineer.
### Graphic Symbols For Soil and Rock

<table>
<thead>
<tr>
<th>SOIL</th>
<th>ROCK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill</td>
<td>Shale</td>
</tr>
<tr>
<td>Topsoil</td>
<td>Sandstone</td>
</tr>
<tr>
<td>Gravel (GW, GP)</td>
<td>Siltstone, Mudstone, Claystone</td>
</tr>
<tr>
<td>Sand (SP, SW)</td>
<td>Granite, Gabbro</td>
</tr>
<tr>
<td>Silt (ML, MH)</td>
<td>Dolerite, Diorite</td>
</tr>
<tr>
<td>Clay (CL, CH)</td>
<td>Basalt, Andesite</td>
</tr>
<tr>
<td>Clayey Gravel (GC)</td>
<td>Other Materials</td>
</tr>
<tr>
<td>Silty Sand (SM)</td>
<td>Concrete</td>
</tr>
<tr>
<td>Clayey Sand (SC)</td>
<td>Bitumen, Asphalitic Concrete, Coal</td>
</tr>
<tr>
<td>Sandy Silt (ML)</td>
<td>Ironstone Gravel</td>
</tr>
<tr>
<td>Gravelly Clay (CL, CH)</td>
<td>Organic Material</td>
</tr>
<tr>
<td>Silty Clay (CL, CH)</td>
<td></td>
</tr>
<tr>
<td>Sandy Clay (CL, CH)</td>
<td></td>
</tr>
<tr>
<td>Peat or Organic Soil</td>
<td></td>
</tr>
</tbody>
</table>
MEMORANDUM

To: Project Design Engineer
Civil and Structure Design,
RailCorp
477 Pitt Street
Attn: John Nash / Jonathan Barnes

From: J Singh
Group Leader Geotechnical

Date: 1 March 11
Reference: Proj 8643
Subject: Geotechnical investigation for Platform Extension at Cardiff

1.0 INTRODUCTION

At the request of the Project Design Engineer, RailCorp Geotechnical Services carried out an investigation for the proposed extension of platform at Cardiff Station.

The purpose of the investigation was to provide necessary geotechnical information for the platform footing design.

This report presents the results of the field investigation and provides geotechnical parameters for the platform foundation.

The client informed that the precast concrete U section units will be used for the proposed construction of the platform extension.

2.0 SITE INVESTIGATION

RailCorp Geotechnical Services carried out the fieldwork on the 1st September 2010. This included drilling of three (3) boreholes (BH) using hand auger and proline drilling commencing from the existing ground level.

The Dynamic Cone Penetrometer (DCP) tests carried out in all three test locations.

(See Appendix for test locations and logs).

3.0 BORING

The borehole 1 (BH1) was carried out on the Sydney side of the platform approximately at 154.965 km commenced by using the hand auger method up to a depth of 0.60 m and continued with diamond coring with proline equipment up to a depth of 3.00 m below the ground level.
The borehole 2 (BH2) was carried out on the Sydney side of the platform approximately at 155.010 km by hand auger up to a depth of 0.40 m and continued with coring to a depth of 3.00 m below the ground level.

The borehole 3 (BH3) was carried out on the country side of the platform approximately at 155.150 km by hand auger up to a depth of 3.0 m below the ground level.

The Dynamic Cone Penetrometer test was performed in all three test locations commencing from 500 mm below the ground level at BH1, commencing from the ground level at BH2 and BH3. (See the site plan for BH locations).

4.0 SUBSURFACE CONDITIONS

The substrata encountered during the field investigation is presented in Engineering borehole logs.

The subsurface materials and conditions are given below.

4.1 Borehole 1 (BH1)

The BH 1 was drilled on the Sydney side of the platform approximately at 154.965 km at a distance of about 3.8 m from the Up rail of the Down Main commencing from the ground level to a depth of 3.0 m below the ground level.

The fill material consisting of ballast, trace silt and sands was encountered to a depth of about 500 mm below the ground level and dense in compactness.

Residual soil consisting of medium to coarse grained sand, trace gravels and trace clay was encountered to a depth of about 1.55 m below the ground level.

Conglomerate sandstone bedrock is believed to be encountered at a depth of about 1.55 m below the ground level. There was no recovery up to the depth of the investigation of about 3.00 m below the rail level. This is inferred from the DCP test results and the rock outcrop exposed in the cuttings.

The DCP test commenced at a depth of 500 mm below ground level and indicated loose to medium dense conditions to a depth of about 1200 mm below ground level. The ground conditions then improved from a depth of about 1200mm to the depth of the investigation of about 1550 mm below the existing ground level. The DCP test refused at 1.550 m below the ground level.

4.2 Borehole 2 (BH2)

The BH2 was carried out on the Sydney side of the platform approximately at 155.010 km at a distance of about 4.6m from the Up rail of the Down Main commencing from the ground level to a depth of 3.0 m below the ground level.

Fill material consisting of medium dense silty sand and fine to medium grained coarse grained gravel was encountered to a depth of about 400 mm below the ground level.

The residual soil consisting of medium to coarse grained sand with trace gavels and clay was encountered underlying the fill layer to a thickness of about 400 mm.

Conglomerate sandstone bedrock is believed to be encountered at a depth of about 800 mm below the ground level. There is no recovery up to the depth of the
investigation of about 3.00 m below the rail level. This is inferred from the DCP test results and the rock outcrop exposed in the cuttings.

The DCP test indicated mostly dense ground conditions from the ground level to the depth of the investigation of about 850 mm below the existing ground level.

4.3  **Borehole 3 (BH3)**

The borehole 3(BH3) was carried out on the country end of the platform approximately at 155.150 km at a distance of about 3.34m from the Up rail of the Down Main commencing from the ground level to a depth of 3.0 m below the ground level.

A 5mm thin asphalt concrete layer was encountered on the surface.

The fill material was encountered up to a depth of about 900 mm below the ground level comprises firm to stiff silty clay, trace coal, gravels and medium to coarse grained sand.

Residual soil/fill medium to coarse grained sand, trace gravels, silts and clay was encountered underlying the fill to the depth of the investigation. This layer was medium dense in compactness.

The DCP test indicated medium dense to dense ground conditions from the ground level to the depth of the investigation.

5.0 **DISCUSSION AND RECOMMENDATIONS**

The client has reported that precast concrete U sections will be used for the proposed extension of the platform. The proposed depth of footing for U shaped precast concrete units is about 1.0 m below the Design rail level. The required ultimate bearing capacity at the underside of the unit is 290 kpa.

5.1  **Engineering Considerations**

5.1.1  **Sydney side of the platform**

Based on field test results, it is recommended to remove the material to a depth of 1.5 m below the existing rail level. Proof roll and backfill with cement stabilised roadbase layer compacted to RailCorp standard to the proposed foundation level.

The exposed surface at this depth would be medium dense to dense sands.

Based on borehole data an Ultimate Limit State Design Pressure of 300 kPa is recommended for medium dense to dense sand at a depth of 1.5 m below the rail level.

The material reduction factor for ultimate limit state design can be taken as 0.5.

5.1.2  **Country end of the platform**

Based on field test results, it is recommended to remove the material to a depth of 1.2 m below the existing rail level. Proof roll and backfill with cement stabilised roadbase layer compacted to RailCorp standard to the proposed foundation level.

The exposed surface at this depth will be medium dense sands.
Based on borehole data an Ultimate Limit State Design Pressure of 300 kPa is recommended for medium dense sand at a depth of 1.2 m below the rail level. The material reduction factor for ultimate limit state design can be taken as 0.5.

It is recommended that the founding levels are inspected by a Geotechnical Engineer.

6.0 Other Comments

Interpretation and recommendations given in this report are based on the inspection and testing of the ground and are directly relevant to the locations where the test were carried out and is believed to be reported accurately based on judgement and experience.

However, the characteristics and properties may vary from place to place and can change with time. The report is based on gathering of limited facts in order to make recommendations as practical as possible.

This report is for internal RailCorp use only.

Written By:               Reviewed By:

Priyani Ganewatta         J Singh
Geotechnical Engineer     Group Leader Geotechnical

Enclosed: Borehole logs
               DCP Test Results
               Site Plan

8643 pg.doc
**ENGINEERING BOREHOLE LOG**

**PROJECT**
CARDIFF

**FEATURE**
FOUNDATION INVESTIGATION FOR PLATFORM EXTENSION

**LOCATION**
CARDIFF PLATFORM @ 154.965KM, Sydney end

**HOLE NO.**
8643-1

**SURFACE ELEVATION**
RL 27.578m

**ANGLE FROM HORIZONTAL**
90°

**DIRECTION**
Down

### PHYSICAL DESCRIPTION

<table>
<thead>
<tr>
<th>DEPOSIT TYPE</th>
<th>CHARACTERISTICS</th>
<th>VISUAL WEATHERING</th>
<th>ROCK STRENGTH Field estimation</th>
<th>DEFECTS</th>
<th>ADDITIONAL SOIL/ROCK DATA</th>
<th>SAMPLES (size)</th>
<th>PROGRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FILL</td>
<td>Ballast, trace silty sand, grey.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Damp</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bidim Geofabric @ 500mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESIDUAL SOIL</td>
<td>Sand, medium to coarse grained, trace gravel, trace clay, subrounded gravels to approx 15x10x6mm recovered, light brown.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Damp</td>
<td></td>
</tr>
<tr>
<td>SEDIMENTARY BEDELOCK?</td>
<td>Conglomerate sandstone, fine to coarse grained, trace gravel, rounded gravels to 40x20x20mm recovered, brown.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conglomerate sandstone, fine to medium grained, trace gravel, light brown. (Inferred from DCP results)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### COMMENTS

- **EOH @ 3.00m**

**OVERBURDEN ROCK**

- **DRILL**
  - HAND AUGER

- **BIT TYPE**
  - 110mm DIA

- **DRILLERS**
  - DG/ST

- **COMMENCED**
  - 01/09/10

- **COMPLETED**
  - 01/09/10

- **INCLINOMETER**
  - To

- **RIEZO/STANDPIPE**
  - To

- **CORE PHOTOGRAPHED**
  - To

**REMARDS**

Bore Hole collar 3.80m to Up Rail, Down Main

See Explanatory Notes for abbreviations and explanations.
## ENGINEERING BOREHOLE LOG

**PROJECT**
CARDIFF FOUNDATION INVESTIGATION FOR PLATFORM EXTENSION

**LOCATION**
CARDIFF PLATFORM @ 155.010KM, Sydney end

### PHYSICAL DESCRIPTION

<table>
<thead>
<tr>
<th>TYPE OF DEPOSIT</th>
<th>CHARACTERISTICS</th>
<th>ROCK STRENGTH</th>
<th>DEFECTS</th>
<th>ADDITIONAL SOIL/ROCK DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>FILL</td>
<td>Silty sand, fine to medium grained, some coarse grained gravel, brown.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESIDUAL SOIL</td>
<td>Sand, medium to coarse grained, trace gravels, trace clay, subrounded gravels to approx 15x10x6mm recovered, light brown.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEDIMENTARY BEDROCK?</td>
<td>Conglomerate sandstone, fine to coarse grained, trace gravel, rounded gravels to 40x20x15mm recovered, brown.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### PHYSICAL DESCRIPTION (continued)

<table>
<thead>
<tr>
<th>TYPE OF DEPOSIT</th>
<th>CHARACTERISTICS</th>
<th>ROCK STRENGTH</th>
<th>DEFECTS</th>
<th>ADDITIONAL SOIL/ROCK DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEDIMENTARY BEDROCK?</td>
<td>Conglomerate sandstone, fine to coarse grained, trace gravel, light brown.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SURFACE ELEVATION

RL 28.098m

### ANGLE FROM HORIZONTAL DIRECTION

90°

### DIRECTION

Down

---

**OVERBURDEN**

**ROCK**

**DRILL**

HAND AUGER

**BIT TYPE**

DG/ST

**SIZE**

110mm DIA

**DRILLERS**

OG/ST

**COMMENCED**

31/08/10

**COMPLETED**

31/08/10

**INCLINOMETER**

To ___________m depth

**PIEZO / Standpipe**

To ___________m depth

**CORE PHOTOGRAPHED**

NSW Transport RailCorp

Geotechnical Services

Bore Hole collar 4.60m to Up Rail, Down Main

**EOH @ 3.00m**

Logged: RC Date: 31/08/10

Drawn: HC Date: 05/09/10

Checked: PG Date: 18/02/11

Core Checked: Date: 

**REMARKS**

See Explanatory Notes for abbreviations and explanations.
## ENGINEERING BOREHOLE LOG
### CARDIFF
#### FOUNDATION INVESTIGATION FOR PLATFORM EXTENSION
##### CARDIFF PLATFORM @ 155.150KM, Country end

<table>
<thead>
<tr>
<th>PHYSICAL DESCRIPTION</th>
<th>CHARACTERISTICS</th>
<th>DEFECTS</th>
<th>ROCK</th>
<th>IMPACT</th>
<th>ADDITIONAL SOIL / ROCK DATA</th>
<th>SAMPLES TYPE</th>
<th>PROGRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TYPE OF DEPOSIT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FILL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asphaltic concrete -</td>
<td>Asphalitic</td>
<td>Dense</td>
<td>Medium</td>
<td>BS1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>grey</td>
<td>concrete, grey</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sand, fine to</td>
<td>Dense</td>
<td>Medium</td>
<td>BS2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>medium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>grated, trace</td>
<td>Firm to</td>
<td>BS3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>coarse</td>
<td>Stiff</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>grated gravel,</td>
<td>light</td>
<td>BS4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>brown.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>As above, light</td>
<td></td>
<td>BS5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>grey.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>RESIDUAL SOIL / FILL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand, medium to</td>
<td>Sand, medium to</td>
<td>Medium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>coarse grated,</td>
<td>coarse grated,</td>
<td>Dense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>trace gravel,</td>
<td>trace gravel,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>trace silty clay,</td>
<td>trace silty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>trace clay,</td>
<td>clay,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>light brown.</td>
<td>light brown.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sand, medium to</td>
<td>Medium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>coarse grated,</td>
<td>Dense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>trace gravel,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>trace silty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>clay,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>light brown.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**OVERBURDEN**

**ROCK**

**DRILL**
- HAND AUGER

**BIT TYPE**
- 110mm DI

**SHEET**
- 1 OF 1

---

**Remarks**
- Bore Hole collar 3.34m to Up Rail, Down Main
- See Explanatory Notes for abbreviations and explanations.

---

**Transport RailCorp**

**Geotechnical Services**

---

**Logged:** RC **Date:** 3/1/10

**Drawn:** HC **Date:** 4/16/10

**Checked:** PG **Date:** 11/15/10

**Core Checked:** Date:
RAIL CORP
GEOTECHNICAL SERVICES

DYNAMIC CONE PENETROMETER TEST
(IN ACCORDANCE WITH AS 1289 6.3.2)

DCP No 8643-1

Date: 31/08/10

CARDIFF: Platform Extension Investigation
Cardiff Platform @ 154.965KM - Down Main

BLOWS per 50mm

RL - 27.578m
DYNAMIC CONE PENETROMETER TEST
(IN ACCORDANCE WITH AS 1289 6.3.2)

CARDIFF: Platform Extension Investigation
Cardiff Platform @ 155.010KM - Down Main

Date: 31/08/10

RL - 28.098m
RAIL CORP
GEOTEchnICAL SERVICES

DYNAMIC CONE PENETROMETER TEST
(IN ACCORDANCE WITH AS 1289 6.3.2)

DCP No. 8643-3

Date: 31/08/10

CARDIFF: Platform Extension Investigation
Cardiff Platform @ 155.150KM - Down Main

0.1
0
1
10
100

BLOWS per 50mm

RL - 30.498m
<table>
<thead>
<tr>
<th>Date</th>
<th>Site</th>
<th>Building</th>
<th>Room</th>
<th>Surface</th>
<th>Hazardous Application</th>
<th>Quantity</th>
<th>Solid</th>
<th>Liquid</th>
<th>Gas</th>
<th>Sample ID No.</th>
<th>Photographic Details</th>
<th>Analytical Details</th>
<th>Risk Level</th>
<th>Material Condition</th>
<th>Action Taken</th>
<th>Corrective Action</th>
<th>Date Approved</th>
<th>Review Date</th>
<th>Contractor Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/07/2006</td>
<td>Cardiff</td>
<td>Main Building</td>
<td>Ceiling-Space</td>
<td>Ceiling-Space</td>
<td>Hot water unit</td>
<td>5</td>
<td>1</td>
<td>Fabric</td>
<td>NA</td>
<td>3</td>
<td>N/A</td>
<td>24-Jun-10</td>
<td>Low</td>
<td>Maintain material in current condition. Remove prior to rehabilitation/renovation. Inspected on 7/06/07 by BMM North. Condition unchanged - BMM North.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/07/2006</td>
<td>Cardiff</td>
<td>Main Building</td>
<td>External Panel</td>
<td>External Panel</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>No hazardous materials identified - no further action required.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/07/2006</td>
<td>Cardiff</td>
<td>Main Building</td>
<td>Station Manager's Office</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>No hazardous materials identified - no further action required.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/07/2006</td>
<td>Cardiff</td>
<td>Main Building</td>
<td>Booking Office</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>No hazardous materials identified - no further action required.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/07/2006</td>
<td>Cardiff</td>
<td>Station Manager's Office</td>
<td>Office</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>No hazardous materials identified - no further action required.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/07/2006</td>
<td>Cardiff</td>
<td>External Public Space</td>
<td>Garden</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>No hazardous materials identified - no further action required.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
EXHIBIT G – LIST OF WARRANTIES REQUIRED FROM SUBCONTRACTORS

List of Warranties Required from Subcontractors

<table>
<thead>
<tr>
<th>Description of Equipment</th>
<th>Period of Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roofing and roofing installation</td>
<td>25</td>
</tr>
<tr>
<td>Waterproofing</td>
<td>25</td>
</tr>
</tbody>
</table>
EXHIBIT I – (NOT USED)