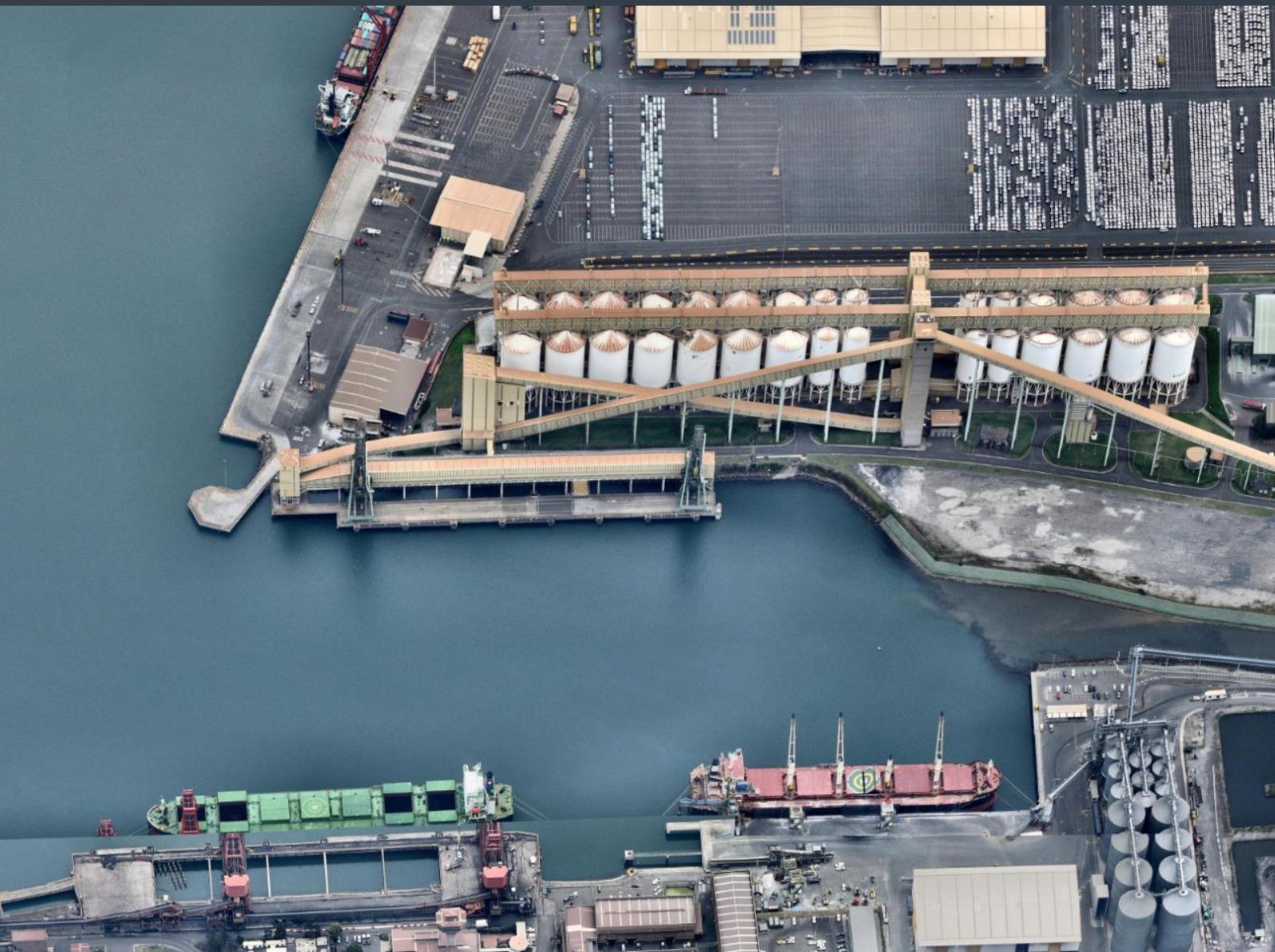


Port Kembla Berth 104 Extension Detailed Design

Construction Specification

WSP



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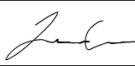
Port Kembla Berth 104 Extension Detailed Design Construction Specification

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Rev	Date	Details
A01	23 rd May 2025	Working Draft
A	11 th June 2025	Issued For Review and Comment
B	15 th August 2025	Issued for Approval
0	18 th September 2025	Issued for Construction

	Name	Date	Signature
Prepared by:	James Chen	18 th September 2025	
Reviewed by:	All disciplines	18 th September 2025	pp. 
Approved by:	Ashleigh Hyland	18 th September 2025	

WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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Abbreviations

AMPP	Association for Materials Protection and Performance
APAS	Australian Paint Approval Scheme
AS	Australian Standard
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing Materials
BFPD	Backflow Prevention Device
CAPWAP	Control and Provisioning of Wireless Access Points
CI	Cast Iron
CEMP	Construction Environmental Management Plan
CPT	Cone Penetration Test
CSP	Concrete Surface Profile
CTL	Chloride Threshold Level
DALI	Digital Addressable Lighting Interface
DCP	Dynamic Cone Penetrometer
DFT	Dry Film Thicknesses
DGPS	Differential Global Positioning System
DIN	Deutsches Institut für Normung
DPHI	Department of Planning, Housing and Infrastructure
DWT	Dead Weight Tonnage
EMP	Environmental Management Plan
EPA	Environmental Protection Authority NSW
FA	Fly Ash
FDCIE	Fire Detection Control and Indicating Equipment
GDA	Geocentric Datum of Australia
GGBS	Ground Granulated Blast-furnace Slag
GPR	Ground Penetrating Radar
GPS	Global Positioning System
HAT	Highest Astronomical Tide
HAZID	Hazard Identification
HDPE	High Density Polyethylene
HSEQ	Health Safety Environment Quality
ICRI	International Concrete Repair Institute

IFC	Issued For Construction
IR	Industrial Relations
ISO	International Standards Organisation
ITP	Inspection and Test Plan
LAT	Lowest Astronomical Tide
LBP	Length Between Perpendiculars
LED	Light-Emitting Diode
LLF	Light Loss Factor
LOA	Length Over All
LV	Low Voltage
MGA	Map Grid Australia
MMO	Mixed Metal Oxide
MSIC	Maritime Security Identification Card
NATA	National Association of Testing Authorities
OS&Y	Outside Screw and Yoke
PDA	Pile Driving Analysis
PPE	Personal Protective Equipment
PIANC	Permanent International Association of Navigation Congresses
PKHD	Port Kembla Harbour Datum
PPV	Peak Particle Velocity
PQP	Project Quality Plan
PTFE	Polytetrafluoroethylene
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
RL	Reduced Level
SCM	Supplementary Cementitious Material
SF	Silica fume
SI	International System of Units
SMDD	Standard Maximum Dry Density
SP	Structural Purpose
T0	Time to corrosion initiation
TA	Ambient temperature
TC	Temperature of concrete as received on-site

TD	temperature differential
TfNSW	Transport for New South Wales
TR	Temperature rise
UCS	Unconfined Compressive Strength
UK	United Kingdom
UNO	Unless Noted Otherwise
UPVC	Unplasticized Poly Vinyl Chloride
VTSC	Vessel Traffic Services Centre
w/b	water to binder ratio
w/c	water to cement ratio
WHS	Work Health and Safety
XLPE	Cross(X)-Linked Polyethylene

1 General Requirements

1.1 Application of Specification

The requirements listed in this Specification are minimum requirements. The Contractor may propose alternatives to any of the minimum requirements for the Principal's approval. Where the Contractor proposes any changes the Contractor shall submit sufficient justification, including supporting technical data and calculations where appropriate, to satisfy the Principal as to the suitability of the proposed change. The Principal shall not be obliged to accept any proposed changes. The acceptance of any proposed changes by the Principal does not relieve the Contractor of their obligation to continue to comply with the Contract and/or relevant local and international standards and regulations.

This specification provides the detail of the Hold and Witness points and the timing for submission of the stated submissions / documentation by the Contractor for approval by the Superintendent. Where the timing of the submissions for a Hold or Witness points has not been expressly stated in this Specification, the submission timing shall be a minimum of 14 days in advance of the planned commencement of the subject work/activity/matter, unless there are longer governing review periods for the Superintendent elsewhere in the Contract documents (e.g. such as for shop drawings, Construction Method Statements, ITP's etc).

1.2 Project Overview

Port Kembla Berth 104 (B104) is a common-user berth located on the coast of New South Wales, approximately 100 km to the south of Sydney as shown in Figure 1.1. The existing berth was constructed in the 1980s. NSW Ports acquired a 99-year lease from the NSW Government to manage and develop the berth and it is currently used primarily as a grain export terminal, along with import of cement and liquid bulk. The existing quay is 274 m long with a 350 m long berth pocket and consists of a concrete deck supported on tubular piles with an under-wharf revetment.



Figure 1.1 Project location

Berth 105 (B105) is located to the South of B104 and is leased by AAT for RORO operations. Qube, of which AAT is a subsidiary of, leases the TQ1 lands to the North of B104 for RORO and general cargo storage. Road access to the berth is through Morton Way which is located to the west of the terminal.

Due to the seasonal nature of the grain market, NSW Ports is seeking to maximise the use of B104 by extending it to support additional trades as follows:

- enable Pure Car Carriers (PCC), Pure Car/Truck Carrier (PCTC) or Roll-on/roll-off cargo (RORO) vessels with quarter ramps to berth and unload/load cargo using Berth B104,
- enable RORO trade to be moved from/to a vessel berthed at B104 wharf to/from the AAT leasehold, TQ1 leasehold and/or Morton Way,
- not significantly impact existing port users to continue their operations during construction and post construction of the project,
- not significantly impact the ability for the B104 wharf to be extended to the north and south in the future.

To facilitate this, NSW Ports is proposing to carry out the following work:

- extending the existing crane beams to the north to make a future provision for a rail mounted slewing crane to support dry bulk operations at the northern end of the site;
- extending the wharf to the north to connect it to the TQ1 lands; and
- extending the wharf to the south to connect it to B105.

1.3 Standards and Codes of Practice

The Standards and Codes of Practice referred to in this Specification are listed within each section in which reference is made to them. All works shall be carried out to conform to the latest relevant Standards and Codes of Practice of the Standards Association of Australia (SAA) or, where such do not exist, the International Standard Organisation (ISO), NACE, SSPC or other approved standards may be used subject to the Superintendent's approval.

Any standard or code of practice referred to in the Contract or any other standard or code of practice that may be substituted therefore shall be held to be the latest edition current one month prior to the latest date for submission of tenders. All relevant particulars and conditions in any Standard or Code of Practice referred to in the Contract relating to material, quality and workmanship shall be complied with and all tests specified shall be conformed to.

The Contractor shall provide and maintain on site copies of all the Standards and Codes of Practice which they consider appropriate together with such additional Standards and Codes of Practice as the Superintendent may direct.

WITNESS POINT

Provision of Standards and Codes of Practices on site, prior to commencement of site activities.

Metric units based on the SI system of units are to be used throughout the Contract except where otherwise approved or instructed by the Superintendent.

1.4 Compliance

The Contractor shall, at their own risk and cost, execute and perform the works described in the Contract and detailed on the Drawings and Specifications provided and supplied to the Contractor for the purpose of the works. The Contractor shall complete the said works in a good and workmanlike manner, utilising the best materials, workmanship and with the utmost expedition in accordance with the Contract Agreement and Drawings, which shall have been signed by the Contractor and the Principal. Additionally, the Contractor shall adhere to such further drawings, details, instructions, and explanations as may be provided from time to time by the Superintendent.

During the progress of the works, the Contractor shall satisfy themselves of the correctness of all drawings and measurements. If the Contractor identifies any discrepancy in the Drawings or between the Drawings and the Specifications, the Contractor shall immediately refer the matter to the Superintendent for a decision on the appropriate course of action.

1.5 Discrepancies and Precedence of Documents

During the progress of the works, the Contractor shall verify the correctness of all drawings, specifications and measurements. If the Contractor identifies any discrepancy, the Contractor shall immediately refer the matter to the Superintendent for resolution. Drawings shall not be scaled.

In the event of any discrepancy between documents, the following order of precedence shall apply:

- 1 Conditions of Contract
 - 2 Specification
 - 3 Drawings
-

1.6 Extent of Contract

The Contractor shall carry out everything necessary for the proper execution of the works, whether shown on the Drawings or described in this Specification, provided the same may reasonably be inferred therefrom. The work specified shall include all general work, requisites, and any matters necessary for the satisfactory construction, completion, and maintenance of the works, in accordance with the true intent and meaning of the Drawings and this Specification, and any further drawings and orders that may be issued by the Superintendent from time to time.

This includes compliance by the Contractor with all the Conditions of Contract, whether specifically mentioned in the Clauses of this Specification or not. The Contractor shall provide all materials, apparatus, plant, machinery, tools, fuel, water, temporary works and roads, strutting, timbering, moulds, and tackle of every description. The Contractor is responsible for transport, offices, stores, workshops, staff, and labour, as well as the provision of proper and sufficient protective works, temporary fencing, lighting, and watching required for the safety of the public and protection of the works and adjoining lands and waterways.

The Contractor shall take all measures necessary to ensure the safety of shipping and shipping operations generally, provide first-aid equipment, mess and sanitary accommodation for staff and workers, maintain all insurances, and pay all wages, salaries, fees, royalties, duties, or other charges arising out of the execution of the works. Additionally, the Contractor shall ensure the regular clearance of rubbish, reinstatement, and clearing up upon completion of the works.

1.7 Access to Site

Contractor access to the Site is via Tom Thumb Road via the NSW Ports Security Gatehouse off Springhill Road through to Morton Way.

Contractor's staff that are permitted to access beyond the NSW Ports Security Gatehouse must have met the requirements of and be in compliance with NSW Ports' Contractor Access Requirements document.

Road access to the B104 Wharf is by Morton Way via the B104 Wharf Access Gate to the B104 Wharf Access Bridge.

The B104 Wharf has been designed in accordance with the load restrictions and extents shown on the drawings and a height restriction of 4.6m from the deck level applies. The Contractor's staff that are permitted to access beyond the B104 Access Gate towards the B104 Wharf and/or the B104 Wharf must have met the requirements of B104 Wharf Access as per the NSW Ports' Contractor Access Requirements document.

Road access to the B105E Wharf is via the B104 Wharf to the B105 Access Gate adjacent to the Southern Conveyor Tower on the B104 Wharf.

The Contractor's staff that are permitted to access beyond the B105 Access Gate must have met the requirements of B105 Wharf Access as per the NSW Ports' Contractor Access Requirements document.

Contractor access to the B104 Wharf and B105E Wharf is restricted to the approved times in the Wharf Shutdown Schedule and subject to the operational requirements of the Superintendent.

Contractor access to the Site can be via the water using Contractor's floating plant, work vessels, etc. The Contractor's staff that are permitted to access the Site or undertake works via the water must have met the requirements of Water Access as per the NSW Ports' Contractor Access Requirements document.

Contractor access to the Site or to undertake works via the water are restricted to the approved times in the Wharf Shutdown Schedule and subject to the operational requirements of the Superintendent.

Under no circumstances shall access to the site be by breaching the terminal security fence.

The construction site works area shall be as shown on the Drawings. No parking of vehicles, storage of equipment or materials, temporary building or structure shall be permitted outside the Site without written approval.

Roads damaged during the works shall be restored to original condition.

The relevant authorities shall be notified of the proposed activities and intended access routes, haul roads, service crossings and such and the Contractor shall provide documents demonstrating such approvals.

A site traffic management plan shall be prepared and submitted for approval by the Contractor.

HOLD POINT

Submission of site traffic management plan and schedule 28 days prior to commencement.

Submission of documentation demonstrating compliance with NSW Ports' Contractor Access Requirements 28 days prior to commencement.

1.8 Works Executed by the Principal or Other Contractors

The Principal reserves the right to execute on the Site works not included under the Contract and to employ for this purpose either their own employees or another Contractor. The Contractor shall ensure that neither their own operations nor trespass by their Employees shall interfere with the operations of the Principal, or their Contractor employed on such works.

1.9 Works and Marine Traffic Cooperation

The Contractor shall programme their operations to comply with all directions from the Superintendent and the Port Authority of NSW. In the event that the Port Authority of NSW does direct the Contractor to undertake an activity, the Contractor is to make a record of the direction and the Contractor shall immediately refer the matter to the Superintendent.

All communications shall be via the Superintendent's Representative. The Contractor shall obtain information on shipping movements through regular contact with the Vessel Traffic Services Centre (VTSC).

The Contractor shall also comply with the instructions and regulations of all relevant authorities with regard to routing or other limitations on their works traffic. They shall also arrange their traffic to minimise inconvenience to the public at large and specifically to the operations around the Port.

The Contractor shall comply with all requirements of and maintain liaison with the Harbour Master in respect to all marine craft and marine operations.

The Contractor shall be held responsible for any damage or injury to shipping or craft of whatever description which may occur during the execution of the Contract through any act or omission or default of the Contractor or of any person in their employ or for whom they are responsible.

The Contractor shall programme their marine works so as to cause minimum interference and disruption to other parties having required or approved access to the Contractor's working areas on the Site or in its approaches.

The Contractor shall submit a programme and schedule of their planned marine works for coordination purposes for approval.

HOLD POINT

Submission of Marine traffic management plan and schedule 28 days prior to commencement.

1.10 Site and Environmental Conditions

The Contractor shall note that the construction of the works may be affected by site and environmental conditions noted within the Contract documents.

The Contractor shall make due allowance for the works being carried out in the marine environment and the effects of weather thereon, considering the likely meteorological conditions in the approaches to, and within, the harbour.

The Contractor shall note that the construction of the works may be affected by tidal conditions and will be aware of the times, ranges and depths of tides, making allowance for these in the proposed mode of working.

1.11 Explosives and Blasting

The use of explosives for blasting for any purpose whatsoever shall not be permitted on this Contract.

1.12 Hot Works

Consideration of hot works are to be included as part of the Contractor's Construction Environmental Management Plan (CEMP) and their Work, Health, Safety and Rehabilitation Plan.

To avoid damage to existing vessel operations at B104, hot works performed whilst vessels are at berth require approval from the Superintendent prior to commencement.

1.13 Notice Boards

Other than for Regulatory, Statutory and other compliance purposes, no signboards, panels or placards are to be erected on the site without the written agreement of the Superintendent.

The Contractor shall remove any notice boards on completion of the project or when directed by the Superintendent and shall make good any excavation or disturbance to the site.

1.14 Materials and Workmanship

Where trade or proprietary names, brands, catalogues or reference numbers are specified in the Contract documents or approved drawings, they are intended to set a minimum standard and sole preference to any particular material or equipment is not intended. Except where noted to the contrary, all permanent works material and items shall be new. All Contractor operatives must have in-date certification of appropriate competencies applicable to the work being undertaken.

Unless otherwise specified, all proprietary materials, plant, and equipment used on the works shall be handled, stored, used, fixed, commissioned, protected and applied strictly in accordance with the manufacturer's instructions. All plant and equipment must have requisite quality information and certification. In all cases where the name of a particular type or make of equipment or item is referred to in the Contract, this indicates the acceptable standard.

The Contractor may offer equipment or materials other than those specified and in all such cases the Contractor's offer shall be demonstrated to be of at least equal quality, performance and reliability. When alternatives are offered the

Contractor shall submit to the Superintendent for approval, a statement of justification detailing the alternatives, and shall include full technical descriptions, Drawings and Specifications including details of material, composition, method of application or fixing and all available information relating to compliance with Standards and the durability, serviceability, maintenance requirements, cleaning and protection of the materials or equipment to be considered, and shall provide such further information as is required to demonstrate to the Superintendent that the alternatives are equivalent to the items specified. When submitting an alternative proposal, the Contractor shall state any modifications to the detailed design or construction or other work, which shall be required due to use of the substitute product as part of the Contractor's submission. The Superintendent shall require 14 days for assessment generally.

If requested by the Superintendent the Contractor shall also submit recent test reports on the substitute product, equipment or materials, or any tests carried out by a registered approved testing laboratory, or alternatively to arrange for such tests at the Contractor's own cost, to the approval of the Superintendent.

Where the Specification requires that approval be obtained, that statement refers to the fact that approval from the Superintendent is required.

HP18 HOLD POINT

Submission of alternative proposals, including recent test reports where specified by the Superintendent.

Materials, plant, equipment or work, which in the opinion of the Superintendent do not comply with the Specification or with previously approved sample(s) of any material, workmanship or component, shall be classified as "rejected materials" or "defective work" and shall be cut out and removed from the works and replaced as directed by the Superintendent at the Contractor's expense.

1.15 Delivery, Handling and Storage of Materials

All materials or manufactured items that are liable to damage shall be delivered in the original packaging, containers, etc. bearing the name of the manufacturer and the brand.

Materials or manufactured items shall be carefully loaded, transported, unloaded and stored in the approved manner, protected from damage and exposure to weather or dampness during transit and after delivery to the Site. Damaged materials or manufactured items damaged during and after fixing in position shall be removed and repaired or replaced by and at the Contractor's expense. All materials or manufactured items shall be clearly and durably marked or tagged to allow error-free cross referencing to the item's quality certification documents.

Within 14 days prior to delivery, one digital copy of a quality certification verifying that the materials or manufactured items meet the specified requirements shall be provided by the Contractor to the Superintendent with each main delivery of materials, e.g. aggregates or cement or as required by the Superintendent, together with the results of any tests that are required by the Specification and the relevant codes and standards.

Materials or manufactured items shall be stored to ensure the preservation of their specified quality and fitness for the work. They shall be placed on a hard, clean surface, and when required, under cover. Stored materials shall be located to facilitate prompt location, identification and inspection.

Stockpile sites shall be prepared by clearing and levelling as directed by the Superintendent. The centre of all rock and soil stockpile areas shall be raised and sloped to the sides as required to provide proper drainage of excess moisture. The material shall be stored in a manner that prevents segregation and coning and ensures proper gradation and moisture content. Rock stockpiles shall be built up and removed in layers not exceeding one meter. The height of such stockpiles shall be limited to four meters and generally maintain a minimum offset of 4m from the nearest crest of any revetment, bank or edge.

HP20 HOLD POINT

Submission of certificates verifying the quality of delivered materials and items and Statement of Compliance 14 days prior to delivery.

1.16 Royalties

The Contractor shall be responsible for all compensation and royalties due in respect of quarried materials. No separate payment shall be made for the compensation of royalties, but all such costs shall be included in the applicable unit price and total of the Tender Schedule.

1.17 Environmental Protection and Control

1.17.1 General Environmental Protection

The Contractor shall observe and comply with all environmental requirements (including all applicable laws, regulations and any requirement of any relevant Authority and any directions of the Superintendent) that apply to the Site or the Port area generally.

The Contractor shall submit a Project Construction Environmental Management Plan (CEMP) prepared for the project 28 days before commencement and shall be the overarching control document for managing the Contractor's environmental obligations. Other individual Management Plans will be required, dealing with Environmental aspects and impacts of the work as specified by NSW Ports and any project Conditions of Consent.

As a minimum, the CEMP is to identify suitable mitigation measures to mitigate environmental impacts from the works. The Contractor shall be responsible for ensuring that all management plans and legislative requirements are implemented on the Site for the duration of the project.

HP4 HOLD POINT

Submission of CEMP 28 days before commencement.

1.17.2 Protection of Land Environment

The Contractor shall be held responsible for and shall keep the Principal indemnified against the cost of all damage caused by their activities, including but not limited to: construction traffic (whether their own, or that of their subcontractors and/or suppliers) or worker's vehicles, plant and the like and shall provide such facilities as are necessary to ensure that coarse aggregates, sand, dirt, cement and rubbish, dust or contaminants is not carried out from the Site onto any roads, public thoroughfares or adjoining property by vehicles leaving the Site and shall promptly remove such material should it be carried out from the Site and clean up to the satisfaction of the Superintendent.

HP17 WITNESS POINT

Site cleaned to satisfaction of Superintendent, case by case basis.

1.17.3 Protection of Marine Environment

Under no circumstances shall any material, including construction debris from the work under the Contract be allowed to pollute, or fall into the waters of the Port. All such material shall be promptly recovered and removed by the Contractor at no cost to the Principal. The Contractor shall keep the Principal indemnified against the cost of any clean-up due to pollution of the marine environment or any pollution.

The Principal may, at their discretion, undertake Port seabed clearance surveys to ensure compliance with this paragraph. Should any material be found, the Contractor shall, without delay, remove such material at their own cost. The Contractor shall bear the cost of subsequent Port seabed clearance surveys to ensure that such material has been removed to the Superintendent's satisfaction.

1.17.4 Submission of Construction Environmental Management Plan Erosion and Sediment Control Plan

28 days before commencement, erosion and sediment control plans are to be prepared by the Contractor. Plans are to be in line with the requirements set out in Managing Urban Stormwater: Soils and construction - Volume 1 4th edition (The Bluebook).

HP5 HOLD POINT

Submission of Erosion and Sediment Control Plan 28 days before commencement

The following requirements are to be integrated into the project erosion and sediment control plan.

Landside Works Erosion and Sediment Control:

- Material is not to be stockpiled within the intertidal zone.
- Minimise disturbance of existing vegetation or foreshore areas.
- Install sediment controls downslope of disturbance footprint to contain any site soils on site.
- For periods of shutdown or if heavy rain is forecast, then bare soils are to be temporarily stabilised.
- A stable site access and mitigation measures to minimise tracking of sediment onto roads.
- Mitigation measures such as water spraying implemented shall be applied to mitigate dust generation from the works.
- Progressive stabilisation including permanent and temporary measures to mitigate erosion.
- Existing stormwater infrastructure is to be maintained and protected with sediment controls for duration of works.
- Ensure that no damage occurs to watercourse or intertidal rocks and the organisms that live on them by equipment, machinery or any other activity any areas of seagrasses or marine vegetation.
- Always store suitable spill control materials for terrestrial and marine spill response in easily accessible locations during construction works.

Northern and Southern Wharf Extension Erosion and Sediment Control:

- As per the Bluebook requirements for works in waterbodies Section 5.3.2 protection of riparian/foreshore/intertidal areas.
- Where required, floating plant will be used for marine works to avoid intertidal zone disturbance.
- Existing marine bed material is partially covered by existing riprap and is a highly disturbed environment due to long operational port location.
- Most likely source of sedimentation will be from site re-grading and excavation works and run-off.
- The Contractor is to assess risk of sedimentation from the works within the harbour environment.

Floating silt curtains may be deployed for duration of works as a secondary line of defence to contain disturbed sediment locally and allow to settle back out and deposit within the works zone as well as contain any potential spills if risk assessment identifies need and shall comprise the following considerations/requirements:

- The floating silt curtain (if required) is to fully contain the disturbance area as indicated in the proposed site layout.
- Drop is to be as per the recommended nominal depths stipulated for a Class 2 (For deep harbour applications) silt curtain from Geofabrics or equivalent.
- Nominated manufacturer drop from Geofabrics or equivalent shall be a depth that is to remain at least 500mm clear of the harbour floor at lowest forecast tide at 0.0m PKHD.

- Material is to be woven or non-woven type geotextile with chain weight incorporated at the base of curtain.
- Chain to have suitable weight to maintain drop for curtain depth (such as 10-3mm galvanised chain 2-3kg/lm).
- Float to be as per manufacturer recommendation (nominal 150-200mm float diameter for this depth).
- Freeboard to be as per manufacturers recommendations for this location (nominal 200-300mm) is adequately anchored to the shore and harbour floor to maintain intended coverage area.
- Should be regularly inspected and maintained to ensure function throughout works.
- Construction Contractor is to seek any relevant approvals for installation of a floating silt curtain in the harbour.
- If access is needed from outside to inside the enclosed area, then it is an overlap is to be incorporated into the silt curtain to allow boat access to site.
- Removal of the floating silt curtain can be undertaken at completion of works, once disturbed sediment has settled back to the harbour floor.
- Ensure that adequate clearances are available to prevent disturbances to seabeds.
- Materials being transported on, and off barges must be adequately secured, and spill containment and response measures are to be implemented for all barge works.

1.18 Setting Out and Survey

Throughout the duration of the construction works the Contractor shall be responsible for the establishment, maintenance and protection of suitable permanent and temporary benchmarks and control points for the setting out of the works and for the correctness of all setting out.

The Contractor shall appoint and employ the necessary qualified and experienced staff to survey and set out the work accurately. Benchmarks and control stations which may be used for setting out of the works shall be nominated by the Contractor. Should any difference be found between the dimension(s) shown on the Drawings and the measurements taken on site, such difference shall be immediately reported to the Superintendent.

All survey and control equipment shall be made available for use by the Superintendent at any time. This shall include Total Station, GPS and other ancillary equipment. The Contractor shall provide necessary labour and attendance to the Superintendent for its use.

Levels for the works are to be related to Port Kembla Harbour Datum (PKHD). Locations shall be set out to GDA 2020 MGA 56.

HOLD POINT

Report of difference between dimension shown on the Drawings and the measurements taken on site, 28 days before commencement.

Lines and levels for setting out of the works are shown on the Contract Drawings. Set out shall be based on the control co-ordinates and other data. "As-Built" and progressive surveys of the completed works shall be carried out by the Contractor to demonstrate that the installation work conforms to the installation tolerances shown on the Drawings or this Specification. Included in such setting out shall be the supply, installation, maintenance and removal of all survey and positioning equipment, tide gauges and additional beacons, buoys and lights used by the Contractor.

Before the works or any part thereof are commenced, the Contractor shall survey and take levels of the Site, in the presence of the Superintendent, both above and below water level, and obtain the Superintendent's agreement on them.

The Contractor shall give the Superintendent not less than 24 hours' notice in writing of an intention to set out or give levels for any part of the works in order that arrangements may be made for checking. Work shall be suspended for such time as may be necessary for checking the lines and levels of any part of the works.

WITNESS POINT

Survey and levels of the site prior to commencement of the works.

1.19 Contractor's Superintendence

The Contractor's Representative, who shall have full authority in respect of the works, and at least two of their technical assistants, shall be able to write and speak English fluently and all supervisors and foremen shall also have a working knowledge of the English language.

1.20 Radio Communication

The Contractor shall install and maintain radio communication between all cranes, vessels and barges engaged in the execution of the works and one base unit and three handheld units in the Superintendent's office.

Compliance with local laws and regulations for the supply, installation and use of such equipment and any fees payable thereto shall be the responsibility of the Contractor.

The Contractor shall be responsible for obtaining all authorisations, licenses etc., in connection with radio communication facilities.

Supplementing the use of radio communication, and subject to satisfactory reception being available, the Contractor may rely on mobile phone use. In such case all cranes, vessels and barges shall be provided with mobile phones.

1.21 Port Operations and Navigation

The Contractor shall programme their operations to comply with all directions from the Harbour Master. All communications shall be via the Superintendent's Representative. The Contractor shall obtain information on shipping movements through regular contact with the VTSC.

Vessels shall require regular access to all the berths and channels surrounding the Site.

The Contractors shall be required to develop protocols and physical communications systems to ensure that full liaison and coordination with the Harbour Master, VTSC, GrainCorp and AAT takes place. Weekly meetings with these authorities/organisations shall be required.

During execution of the works, the Contractor shall ensure that its floating craft, plant and equipment, and any staging or other temporary works provide minimal interference with port traffic and in no way prevent or obstruct the navigation of vessels. The Contractor shall in all cases attach buoys to all anchors of barges and exhibit proper and necessary lights and signals as required by the Harbour Master. All lights provided by the Contractor shall be so placed and screened as not to interfere with any signal lights or navigation lights.

The Contractor shall inform and obtain approval of the Superintendent whenever any floating plant needs to be moved to such positions as to obscure or in any way affect lights, signal buoys or navigation aids.

Should the Contractor damage or displace any navigation markers or buoys outside the area of the works they must be replaced by the Contractor at their cost to the satisfaction of the Harbour Master.

Any temporary watching, lighting, navigation, buoys and flagging requirements that may be required during the course of the Contract shall be provided by the Contractor.

Structures, services and surfaces adjacent to demolition work, which are to remain, shall be protected from damage due to demolition work. All damage to adjacent facilities occasioned by inadequate protection shall be made good.

The Wharf Shutdown Schedule provides the minimum duration per month and associated details regarding Contractor access to the Site.

In planning the work and sequence of concrete pours connecting to the existing B104 structure, the Contractor must ensure that all concrete elements in the Contract works will achieve at least 32MPa strength before the end of the berth shutdown period.

1.22 Contractor Submissions and Plans

1.22.1 Progress Photographs

The Contractor shall be responsible for adequately recording the works. The Contractor shall provide colour record photographs for the purposes of both recording the overall progress of the works and details of each aspect of the works. Photos shall be taken using a digital camera with resolution of more than 15 mega pixels and type that shall automatically record the date of the photograph.

The Contractor shall provide to the Superintendent, on a weekly basis, digital copies of a sufficient number of photos sufficiently annotated to convey progress, such that a record of all site activities is maintained.

1.22.2 Submissions to the Superintendent

Wherever the Specification requires that the Contractor shall submit to the Superintendent plans, proposals, details, drawings, calculations, information, literature, materials, test reports and certificates, the Superintendent shall consider each submission and, if appropriate, shall reply to the Contractor in accordance with the relevant provision of the Conditions of Contract. Unless a defined period of time is stated in the Specification, each submission shall be made by dates to be agreed with the Superintendent having regard to the approved programme and the need, to give the Superintendent adequate time to consider each submission, but in no case less than fourteen (14) calendar days.

Documents shall be submitted digitally in pdf format in A4 page size, other than drawings (A3 or A1 size as appropriate) and manufacturer's literature. All documents shall be in English, and any abbreviations shall be explained. All calculations and technical information shall be in units conforming to the International System of Units (SI).

All drawings shall include the title of the Contract at the bottom of the drawing followed by the title of the drawings concerned. All drawings shall have the appropriate scales drawn on them.

The approval of the Superintendent of any submission shall not relieve the Contractor from their responsibilities under the Contract.

1.22.3 Construction Programme

A comprehensive Programme shall be created and submitted to the Principal by the Contractor in accordance with the Conditions of Contract.

The Contractor shall also submit its Cash Flow Forecast to the Superintendent, in accordance with the Conditions of Contract, 28 days before Commencement Date.

HOLD POINT

Submission of Construction Programme and Cash Flow Forecast.

The Programme shall be Microsoft Project native file format and show the critical paths for completion of the works, and shall indicate all major work activities, their sequence of work and expected duration, sequence and relation of all major operations or activities, and shall clearly identify all critical operations or activities which directly affect the Time for Completion.

The Programme shall include a schedule for obtaining all required approvals, permits, authorisations and licenses in relation to the execution of the works, from Authorities and a proposed schedule for the organisation of site meetings with the Superintendent and /or the Principal, detailing frequency, agenda to deal with, etc.

1.22.4 Method Statements and Risk Assessments

The method of construction and the maintenance of safety during construction are the responsibility of the Contractor. If any element of the works presents difficulty in respect of constructability or safety, the matter shall be referred to the Superintendent for resolution before proceeding with the work.

The Contractor shall submit detailed Safe Work Method Statements and risk assessments, at least 28 days prior to activities commencement, for all construction activities, materials, equipment and plant to be utilised; labour requirements, time frame and schedule including Subcontractors, prerequisite conditions, details and order of activities for each technical operation, safety measures and any other relevant aspects. The method statements shall include a description of testing and inspection records, reporting channels and frequency, and actions where records indicate non-conformance with the specification.

HOLD POINT

Submission of Safe Work Method Statements submitted 28 days before work commencement.

Any amendment to the approved method statements and risk assessments shall be submitted to the Superintendent for approval at least 7-days before the activities are due to commence and construction on any section of the works shall not be commenced until the Method Statement has been approved by the Superintendent. Preliminary works may be commenced before a part of the Method Statement is approved by seeking specific approvals for the proposed activities.

HOLD POINT

Submission of amendments to Work Method Statements.

Once the Method Statement has been approved by the Superintendent, two hard copies and one electronic copy in MS Word shall be issued to the Superintendent. The Contractor shall also be responsible for issuing approved copies to its supervision staff to ensure that they are fully familiar with the Method Statement to be used in order to complete the works in accordance with the Contract.

The method statements and risk assessments shall describe any requirements for co-ordination and interfaces with marine operations and other sections of the Work, including any special features of the work such as geotechnical conditions, adverse weather, wave climate etc. which might affect the execution of the works. The purpose of a Method Statement is to aid the planning and integration of activities and correct technical execution of the works within the requirements of the Contract.

Any aspect of a proposed Method Statement which does not conform with the requirements of the Contract shall be brought to the attention of the Superintendent. The Method Statement shall be prepared in sufficient detail to allow the Contractor's and Superintendent's field staff to clearly understand the work methods to be adopted for the Site.

Acceptance by the Superintendent of a Method Statement does not relieve the Contractor of its obligation to comply fully with the Contract.

1.22.5 Road Traffic Management Plan

The Contractor shall prepare and submit to the Superintendent a Road Traffic Management Plan for the management of all land transport on the roads to and from the Site. This shall include the transport of labour, as well as plant and materials to and from the Site.

HOLD POINT

Submission of Road Traffic Management Plan to be submitted 28 days before work commencement.

Information shall include details of the vehicles to be used and their frequency, routing and timing.

The Plan shall be prepared with a view to minimising interference with the movement of traffic in the vicinity of the existing facilities. The loading of vehicles used on paved roads to and around the Site shall comply with the rules and regulations of all Authorities.

The Road Traffic Management Plan shall identify such facilities as are necessary to ensure that rock, sand, dirt, and rubbish is not spilt or carried onto any roads, public thoroughfares or adjoining property by vehicles coming to or leaving the Site and shall promptly remove such material should it be spilt or carried and clean-up to the satisfaction of the Superintendent.

After the Road Traffic Management Plan has been agreed to by the Superintendent, the Contractor shall be responsible for ensuring that the details of the Plan are observed and adhered to.

Any request by the Contractor to change the agreed proposals shall be subject to the agreement of the Superintendent.

HOLD POINT

Submission of changes to Road Traffic Management Plan to be submitted 28 days before work commencement.

The Contractor shall be held responsible for and shall keep the Principal indemnified against the cost of all damage caused by their construction traffic (whether their own, or that of their subcontractors and/or suppliers) or workmen's vehicles, plant and the like.

Any damage caused by the Contractor to any road used by the Contractor shall be rectified as soon as practicable.

1.22.6 Work Health, Safety and Rehabilitation Plan

The Contractor shall prepare a Work Health, Safety and Rehabilitation Plan for the management of the safety and security of all aspects of work on the Site. The Work Health, Safety and Rehabilitation Plan shall comply with all statutory safety requirements and implement adequate safety measures to protect workers and visitors to the site, and to ensure that unauthorised visitors are not permitted on to the site.

All personnel on the Site shall at all times be equipped with and use the following minimum level of Personal Protective Equipment ("PPE"). The Contractor shall be responsible for any additional / correct PPE issued to their Operatives in accordance with their safe work method statements, particular to the activities being undertaken:

- Hard hat.
- Safety glasses.
- Steel-capped work boots.
- High visibility safety vest.
- Life jackets (for over water work; works from floating plant; works near an unprotected edge from the deck of a waterside asset; works near the crest of the revetment; and other works near water)

These must always be worn by all personnel on the Site.

The Contractor to carry out a risk analysis of each work activity to determine the Safe Work Methods and PPE required for each activity and the outcomes shall be incorporated in the Work Health, Safety and Rehabilitation Plan.

The Work Health, Safety and Rehabilitation Plan shall also address security of the Site, including fencing, lighting, watchmen, safety signage and the like.

The Plan shall include the system for reporting details of any accident.

The Contractor shall appoint as a Safety Officer one of their senior staff who shall have specific knowledge of safety regulations and have had experience of safety procedures and precautions on similar works and who shall advise the Contractor on all aspects of safety and health on site.

HOLD POINT

Submission of Project level Work Health, Safety and Rehabilitation Plan 28 days before work commencement.

1.22.7 Compliance with Approved Plans

The Contractor shall ensure that they, and all of their Subcontractors, meets with the requirements of any approved plans or method statements. The Contractor shall remain responsible for all construction activities, notwithstanding any approval given by the Superintendent.

1.22.8 Monthly and Weekly Reporting

Monthly reports shall be prepared and submitted by the Contractor in .pdf format. The monthly report shall address the following aspects:

- Contract Program status of the Work for each activity
- Critical items report and critical path summary narrative
- Details on any activities which are late compared to the Contract Program and mitigation measures
- Any opportunities related to future activities on the Contractor's Program
- Resources (plant and labour) used on the project during the month presented on a weekly basis
- Progress achieved against the planned work for the month measured by volumes of materials produced for the project, delivered to site and placed in the works
- Identification of any non-conforming works and non-conformance register of open items
- Performance against the EMP
- Performance against Work Health, Safety Plan
- Include the weekly photo sets for the month
- Forecast of next two months, noting the proposed works, resources (plant and labour) to be mobilised or demobilised, scheduling of works in accordance with the Wharf Shutdown Schedule
- Industrial relation or supplier issues affecting (or which may affect) progress of the works
- Contractor's safety statistics and evidence of compliance with the Contractor's Project WHS Management Plan
- Any other matter requested by the Principal or Superintendent
- Request for Information Register of Open items
- Register of materials or equipment that is vested in the Principal

A weekly report shall be submitted by the Contractor in .pdf format covering the following:

- Resources (plant and labour) used on the project during the week
- Progress achieved against the planned work for the week measured by volumes of materials produced for the project, delivered to site and placed in the works
- 4 weeks look ahead for all offsite fabrication witness and hold point inspections required by the Superintendent
- Identification of any non-conforming works
- Performance against the EMP
- Performance against Work, Health and Safety Plan
- Deviations from the forecasted works in the previously monthly report
- Outstanding actions on the Contractor with close by date
- Outstanding actions on the Principal or Superintendent with close by date
- Progress photos

1.23 Notice of Operations

The Contractor shall give the Superintendent not less than 24 hours' notice in writing of its intended operations to enable the Superintendent to make its arrangements for the supervision of operations on the Site. It shall also give to the Superintendent at least seven (7) days written notice of the preparation or manufacture at a place not within the Site of any article or material to be used in the works, whether by themselves or by subcontractors, stating the time and place of preparation or manufacture so that the Superintendent may arrange to make whatsoever inspection or tests that may be required.

1.24 Site Meetings

The Superintendent shall conduct site meetings at one-week intervals or as appropriate, which the Contractor's Representative shall be required to attend. The meetings shall be chaired by the Superintendent's Representative who shall also prepare and issue minutes of the meetings.

The purpose of the meetings is to facilitate the administration of the Contract and the completion of the works. The agenda shall be agreed between the two representatives prior to the first meeting and thereafter adjusted as necessary by the Superintendent to reflect the progress of the works and any matters that require particular attention. The meetings shall also address all interface issues with other contracts and works by the terminal operator.

1.25 Temporary Works

The Contractor is responsible for all aspects of temporary works, unless specifically shown on the drawings. The Contractor shall provide and maintain and remove on completion of the works all temporary works, unless otherwise approved by the Superintendent. These shall include but not limited to temporary traffic-diversions, roadways, footpaths, accesses, drains, sheet-piling, jetties, revetments, stagings, scaffoldings and other temporary supports and other temporary bunds used during the course of the works including the items as listed in section 1.25.1.

The Contractor shall make all temporary works safe and suitable in every respect to carry all plant required for the work or for providing access or for any other purpose connected with the works, to the satisfaction of the Superintendent. Complete details of the temporary works proposed, shall be submitted to the Superintendent for its consent a minimum of 28 working days prior to the execution of such temporary works.

Temporary works shall be designed and certified by appropriately qualified parties and this documentation shall be provided with the Contractor's submissions.

HOLD POINT

Submission of details of temporary works 28 days before work commencement.

Materials for the permanent works shall not be used for temporary works unless otherwise approved by the Superintendent.

The Contractor shall make all arrangements for and shall provide temporary moorings for their floating craft and plant. The location and details of these temporary moorings shall comply with the requirements of the Superintendent and the Harbour Master.

1.25.1 Details and Design of Temporary Works

The Contractor shall submit details and design of the temporary works including but not limited to the following, for the approval by the Superintendent 28 days prior to the commencement of the works:

- Temporary slopes and temporary shoring, if required.
- Temporary falsework and formwork for the construction of the permanent works.

- Ground stability and bearing support for heavy cranes and loads.
- The construction of piling working and support platforms.
- Details of the temporary drainage works.
- Temporary standby barge anchoring, if required.
- Temporary pontoon and gangways, if required.

1.26 Diving Operations

If the Contractor deems that Diving Operations are required, then particular permission from the Superintendent shall be sought 28 days before commencement of diving operations. Refusal of permission by the Superintendent for diving operations shall not relieve the Contractor of their obligations under the contract.

If permission is granted, diving and compressed air operations shall be carried out in accordance with the requirements and recommendations of AS 2299.1. Before any diving is undertaken, the Contractor is to supply the Superintendent with two copies of the Code of Signals to be employed and is to have a copy of such Code prominently displayed on the craft or structure from which the operations take place. A Safe Work Method statement and Work Afloat permit shall need to be obtained from the Harbour Master.

HOLD POINT

Application for Diving Works and Safe Work Method Statement 28 days before commencement.

1.27 Contractor's Amenities and Site

The Contractor's entire site establishment shall be confined within the Site. The Site shall contain all site offices, ablution huts, staff facilities, material laydown areas, vehicle parking and the like. The boundary of the Site is as shown on the Drawings.

The Site shall also be the storage area for the storage of goods and materials to be consumed within the project.

No plant, equipment or material shall be parked or stored other than within the designated Site unless permission is granted in writing by the Superintendent.

The Contractor shall, 28 days prior to commencement, submit to the Superintendent for approval a plan detailing the layout and extent of the Contractor's facilities required for the duration of the contract.

HOLD POINT

Submission of plan for Contractor's facilities 28 days before work commencement.

1.27.1 *Temporary Services*

All temporary services shall be removed and made good at the completion of the works. Any conduits, pipes and the like that remain due to construction constraints shall be clearly indicated on the "as constructed" Drawings.

28 days before the installation of temporary services, the Contractor shall arrange and obtain permission from the Principal for the installation, connection and disconnection of other temporary services such as, sewerage, telephones and any other services the Contractor deems necessary to execute the works.

Where work is being carried out at times when there is insufficient natural light to carry out the work safely and to the required quality, the Contractor shall provide adequate lighting where work is being executed and shall provide and install any additional lighting, which the Superintendent may require in order to watch and supervise the works and to carry out any testing and examination of materials.

HOLD POINT

Temporary services 28 days before the installation.

All temporary services shall be removed and made good at the completion of the works, unless permission is granted in writing by the Superintendent. Any conduits, pipes and the like that remain due to construction constraints shall be clearly indicated on the “as constructed” Drawings.

1.28 Superintendent's Facilities

This section outlines the minimum requirements that the Contractor shall meet in relation to the facilities provided to the Superintendent of the project. It is noted that the Specifications and minimum requirements of these facilities are subject to change at the discretion of the Principal.

The Contractor shall supply and maintain for the exclusive use of the Superintendent the Superintendent's office, which will be separate, secure, fully functional, air-conditioned, weatherproof office and of a suitable design for the climate having a floor area of not less than 28 m². The Contractor shall provide adequate furniture in the office comprising:

- Desks and chairs – 4
- Plan lay off table – 1
- Visitors chairs – 4
- Bookshelf – 4
- 4 drawer filing cabinet – 4
- Exhaust fan – 1
- White board – 2
- Fridge – 1
- Mini-boil – 1
- Microwave oven – 1
- Sink with running water – 1
- CO2 type fire extinguisher and other fire protection devices as required.
- Blinds to all windows
- Communication cabinet with connection to a 63 mm communication conduit riser from external connection.
- The office shall have a minimum of ten double power points reasonably positioned around the building.

The Contractor shall supply and maintain for use of the Superintendent a Superintendent's toilet, which will be a separate, secure and weatherproof toilet facilities. The toilet shall include male and female facilities. Male facilities will include 1 toilet, 1 urinal, 1 sink, 1 shower and 1 single power point. Female facilities will include 1 toilet, 1 sink, 1 shower and 1 single power point. Toilets shall be separately ventilated from the office space. The Superintendent's toilets shall generally be located next to the Superintendent's office.

The Contractor shall supply and maintain for shared use by the Superintendent, a meeting room of suitable design with air-conditioning for suitable design climate of 28m². The Contractor shall provide adequate furniture in the meeting room comprising of ten chairs, a table of dimensions 3 m x 1.5 m, a whiteboard, six double power points for the full duration of the Contract. This room shall be used for weekly contract meetings and other briefings and presentations.

The Superintendent's office, Superintendent's toilet and shared meeting room shall be provided, maintained and cleaned by the Contractor for the Contract period and for one month after the date of Practical Completion. Cleaning shall be on a weekly basis. Rubbish removal is to be twice a week, generally on Tuesdays and Fridays.

The layout and location of the Superintendent's office, Superintendent's toilet and shared meeting room is to be approved by the Superintendent in the general area shown on the Drawings. The office shall have an uninterrupted view of the site and be provided with 4 dedicated car park spaces for the Contract duration and one month after practical completion. A covered pathway shall be provided between the Superintendent's office, Superintendent's toilet, shared meeting room and the Contractor's office.

The Contractor shall provide and maintain the following services to the facilities:

- Electricity, air conditioning, telephone supplies, potable water supply, adequate lighting and adequate sewer and wastewater drainage for the Superintendent's office.
- Electricity, potable water supply, adequate lighting and adequate sewer and wastewater drainage for the Superintendent's toilet.
- Electricity, air conditioning and telephone supplies and adequate lighting for the shared meeting room.

The office with the furniture and equipment shall be complete and ready for occupation 28 days after the issue of the Notice to Commence, unless permission is granted in writing by the Superintendent. The Contractor shall maintain the office until the issue of the Certificate of Practical Completion or until such time as directed by the Superintendent. At that date the Contractor shall remove all furniture and equipment which shall revert to the Contractor.

The Contractor shall also repair or replace damaged or unusable services, furniture and equipment without delay when instructed by the Superintendent.

1.29 Removal of the Contractor's Establishment

At the completion of the project, the Contractor shall remove its entire establishment including offices, buildings, workshops, parking facilities and the Superintendent's facilities and equipment and restore the site to its original condition.

The Contractor shall undertake a Site Dilapidation Survey prior to work commencing and a repeat survey on completion of the project within 24hrs after removal of its establishment. The Superintendent will accompany the Contractor whilst undertaking the surveys. The Contractor shall rectify all damage arising from the reports.

HOLD POINT

Submission of Site Dilapidation Survey Reports before commencement and after completion.

1.30 Inspection by Superintendent during Defects Liability Period

The Superintendent shall give the Contractor due notice of their intention to carry out any inspections during the Defects Liability Period and the Contractor shall upon receipt of such notice arrange for a responsible representative to be present at the time and dates named by the Superintendent. This representative shall render all necessary assistance and take note of all matters and things to which their attention is directed by the Superintendent.

The Contractor shall submit sufficient reports, details and surveys demonstrating satisfactory completion of the Works, as sequential Handover Reports matching the Contract schedule. Any defects, remedial or other work identified by the Superintendent arising from the Handover Inspections shall be executed forthwith to the Contractor's account.

A final Handover Report will be issued by the Contractor within 28 days after the completion of such remedial work.

HOLD POINT

Submission of Handover Reports within 28 days after completion of the work.

1.31 Fitness for Work

The Site and Work Area shall be drug and alcohol free and the Contractor shall ensure all operatives are fit for work.

1.32 Construction Loads on Existing Structures

Construction loads on existing structures shall be submitted for approval 28 days prior to works proceeding and shall be compliant with the loading plans provided in the Contract Drawings.

HOLD POINT

Submission for approval of construction loads on existing structures 28 days before commencement.

1.33 Removal and Dumping of Unused Materials

All demolished and excavated material, excess building materials and waste, other than material designated to be stockpiled for use on the site, shall be removed from site and disposed of in a legal manner. All permits and approvals necessary for the removal and disposal of demolition materials shall be obtained 28 days in advance of the use of those facilities.

HOLD POINT

Submission of permits and approvals for waste disposal.

All unused material shall be removed from site in a progressive manner either by use of a weekly emptied dump hopper or similar removal arrangement. The work site and surrounds shall be always kept tidy.

Plastics and rubber shall not be disposed of by burning. Asbestos shall be disposed of in accordance with all relevant regulations. Materials infested by vermin, pests or rot shall be destroyed in a way that shall minimise the risk of infecting other materials. Hazardous wastes shall be destroyed or otherwise disposed of in compliance with the relevant regulations.

1.34 Measurement and Payment

The Contract shall be awarded on a lump sum basis. The Contractor is expected to make their own estimates of quantities. Any quantity estimates by the Principal are for their tender comparison purposes only.

The Contractor shall measure the works progressively for the purpose of quantifying progress against the delivery schedule and for the purposes of monthly lump sum progress payment claims in accordance with the relevant schedules provided in the Contract.

No payment shall be made for excess material placed outside the lines and levels shown. The Contractor shall include in their price for all labour, plant, survey and materials necessary for the completion of the work.

Sections relating to measurement and payment in TfNSW specifications are to be used for guidance on measurement for purposes of progress payments only and shall not be used as measurement for payment for the final payment due to the Contractor under the lump sum contract.

1.35 Issued for Construction Drawings

IFC Drawings are provided in the suite of Contract documents.

All works shall be constructed in accordance with the Drawings. Scaling of dimensions from these Drawings is not permitted. The Contractor shall request in writing from the Superintendent any required clarification of the Drawings or any additional information needed to construct the works or to place orders for materials or supplies.

Details of existing structures and other existing elements shown on the Drawings are intended to convey in outline the arrangement and form of construction of existing structures and provide an interpretation of details. It shall be the Contractor's responsibility to satisfy themselves through surveys as to the accuracy of the information shown.

1.36 As-Built Drawings and Records

As each section of the works is completed, the Contractor shall supply to the Principal As-Built drawings and all required records and documentation.

Prior to completion of the works or each section of the works, full As-Built drawings shall be provided as detailed elsewhere in this specification. As a minimum the full As-Built drawings will include consolidated PDF files and AutoCAD files (dwg).

Mark ups in the PDF files are to be shown in red to show any as-built variations and not be flattened in the PDF files. Mark ups in the AutoCAD files are to be shown in red to show as-built variations and based in new drawing layers separated from the base file layers.

HOLD POINT

Submission of As-built drawings, records and documentation within 28 days after completion of those works.

1.37 Hold and Witness Points Summary

Table 1.1 Hold/witness Point Summary

DESCRIPTION	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD POINT
Commencement of site activities	1.3	WITNESS	Provision of Standards and Codes of Practices on site, prior to commencement of site activities	The Superintendent will ensure all documents have been provided, prior to authorising the release of the Witness Point.
Commencement of site activities	1.7	HOLD	Site traffic management plan and schedule & NSW Ports' Contractor Access Requirements, at least 28 days prior to commencement	Acceptance by Superintendent prior to authorising the release of the hold point
Commencement of site activities	1.9	HOLD	Marine traffic management plan and schedule, at least 28 days prior to commencement	Acceptance by Superintendent prior to authorising the release of the hold point.
Commencement of site activities	1.17.4	HOLD	Submission of Erosion and Sediment Control Plan, at least 28 days before commencement	Acceptance by Superintendent prior to authorising the release of the hold point

DESCRIPTION	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD POINT
Commencement of site activities	1.18	HOLD	Site survey and setting out, at least 28 days before commencement	Acceptance by Superintendent prior to authorising the release of the hold point
Commencement of site activities	1.17.1	HOLD	Construction Environmental Management Plan (CEMP), at least 28 days before commencement	Acceptance by Superintendent prior to authorising the release of the hold point
Commencement of site activities	1.22.3	HOLD	Construction Programme and Cash Flow Forecast, at least 28 days before commencement of site activities	Acceptance by Superintendent prior to authorising the release of the hold point
Commencement of site activities	1.22.4	HOLD	Safe Work Method Statements, at least 28 days before commencement of those works	Acceptance by Superintendent prior to authorising the release of the hold point
Commencement of site activities	1.22.5	HOLD	Road Traffic Management Plan, at least 28 days before commencement	Acceptance by Superintendent prior to authorising the release of the hold point
Commencement of site activities	1.22.6	HOLD	Work Health, Safety and Rehabilitation Plan, 28 days before commencement	Acceptance by Superintendent prior to authorising the release of the hold point
Commencement of site activities	1.25	HOLD	Temporary works plans, 28 days before commencement of those works	Acceptance by Superintendent prior to authorising the release of the hold point
Commencement of site activities	1.26	HOLD	Diving Works, at least 28 days before commencement	Diving works not to be used on the site. Subject to particular approval process.
Commencement of site activities	1.27	HOLD	Contractor's facilities plans, at least 28 days before commencement	Acceptance by Superintendent prior to authorising the release of the hold point

DESCRIPTION	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD POINT
Commencement of site activities	1.27.1	HOLD	Temporary services details, at least 28 days before commencement	Acceptance by Superintendent prior to authorising the release of the hold point
Commencement of site activities	1.33	HOLD	Permits and approvals for waste disposal, at least 28 days before commencement of those facilities	Acceptance by Superintendent prior to authorising the release of the hold point
Commencement of works on existing structures	1.32	HOLD	Construction loads on existing structures, at least 28 days before commencement	Acceptance by Superintendent prior to authorising the release of the hold point
Site cleanliness	1.17.2	WITNESS	Regular inspections	Case by Case for acceptance
Continuation of activities relating to alternative proposals	1.14	HOLD	Submission of alternative proposals, at least 14 days for assessment	Submissions on a case by case basis.
Continuation of work related to set out	1.18	WITNESS	Checking of lines and levels, at least 24 hours before work continues	The Superintendent will inspect all lines and, prior to authorising the release of the Witness Point.
Delivery of materials & items	1.15	HOLD	Certificates verifying the quality of delivered materials and items, at least 14 days prior to delivery	Submissions on a case by case basis.
Acceptance	1.29	HOLD	Submission of Dilapidation survey reports prior to commencement and within 24 hours after removal of Contractor's establishment.	Acceptance by Superintendent prior to authorising the release of the hold point
Acceptance	1.30	HOLD	Handover Reports, < 28 days after completion of the work	Acceptance by Superintendent prior to authorising the release of the hold point

DESCRIPTION	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD POINT
Acceptance	1.36	HOLD	As-built drawings, records and documentation, at least 28 days after completion of those works	Acceptance by Superintendent prior to authorising the release of the hold point

2 Quality

2.1 General

A Quality System shall be planned, developed, implemented and maintained in accordance with ISO 9002 and the requirements of this Specification. The Purchaser as defined in AS 8402 will be the Principal, which has delegated its responsibilities to the Superintendent.

The Superintendent will have representation on Site (and elsewhere as necessary) to inspect the works as stated elsewhere in the Specification.

The purchaser-supplied products for this Contract shall be taken to be limited to the Contract Documentation. Goods and services provided by the customer will be in conformance with ISO 9002.

2.2 Quality System Requirements

The quality system shall incorporate quality system elements as follows:

- The quality system elements for all prepared designs for all permanent and temporary work incorporated in the works, and the design of approved alternative designs for parts of the permanent works shall be to ISO 9001, Design Control.
- The quality system elements for the construction shall be to ISO 9002, except for minor works such as landscaping, which may be to ISO 9003.

The following additional requirements apply to the quality system:

- All design work, which is undertaken for permanent and temporary works incorporated in, or associated with, shall be verified internally prior to submission.
- Traceability is not required except for the special materials as follows:
 - Geotextiles,
 - Revetment and rock materials, and
 - all such synthetic and natural materials imported for the works on this contract.
- The trace shall start at the manufacturer or quarry/stockpile/source and finish at the location of the materials in the works. All appropriate testing and batch records shall be kept on site.
- Documentation and records to be supplied are detailed herein.

2.3 Quality System Documents

2.3.1 General

The Contractor shall document, implement and maintain a Quality Assurance system in full compliance with the requirements of ISO 9001. The Quality Assurance system shall be sufficient to ensure that the full requirements specified in the Contract Documents are met, and the Contractor shall produce documentary evidence to demonstrate the adequacy of their Quality Assurance system in this respect, when requested to do so by the Superintendent.

The Contractor shall ensure that all Subcontractors working on the project, whether nominated, appointed by themselves or appointed by their own Subcontractors, shall be subject to the full requirements of their own Quality Assurance system, without exception.

The Contractor shall allow for the regular audit of this Quality Assurance system, by representatives of the Superintendent, at times defined by the Superintendent and shall rectify any deficiencies reported to them, because of such audits.

Project Quality System documents shall be prepared in accordance with ISO 9002 and shall cover all work under the Contract, both on-site and off-site. The individual documents shall conform to the following requirements.

2.3.2 *Quality Plan*

The Contractor shall prepare and submit a Project Quality Plan to the Superintendent 28 days prior to commencement. It shall contain as a minimum a description of the Contractor's overall and site management organisations, and all procedures that will be applied by the Contractor to achieve the quality requirements of this Contract.

The Project Quality Plan shall be Contract-specific and shall include specific quality practices, resources, activities and responsibilities relevant to the Contract.

HOLD POINT

Submission of Project Quality Plan 28 days before work commencement.

2.3.3 *System Element Procedures*

Quality System Procedures and Instructions shall be prepared to meet the requirements of ISO 9002. These Procedures and Instructions shall be submitted for approval 14 days prior to the commencement of the relevant activity.

HOLD POINT

Submission of Quality System Procedures and Instructions, meeting the requirements of ISO 9002.

2.3.4 *Hold Point & Witness Points*

Hold Points are those points beyond which the work may not proceed without review and comment by the Superintendent. Witness Points are those points beyond which the work may not proceed without advising the Superintendent prior to commencement.

As a minimum requirement, the specified hold points shall be included in the Inspection and Test Plans where identified in the technical Clauses of the Specification by the words "to the approval of the Superintendent", "Superintendent for Approval", "agreement of the Superintendent" or similar.

The Superintendent may nominate additional witness and hold points in the Contractor's Inspection and Test Plans. Where hold points are nominated, no work shall proceed unless agreed by the Superintendent.

The review by the Superintendent of a hold point will not relieve the Contractor of responsibility for the satisfactory execution or performance of the work that is the subject of the review.

2.4 Additional Quality System Requirements

2.4.1 *General*

The preparation of Quality System Procedures and Instructions shall take into account the following additional requirements for the following System Requirements:

2.4.2 *Documentation*

In addition to the documentation required by ISO 9002, copies of all relevant Codes of Practice, Test Methods and Standards referred to in the Specification including a copy of ISO 9002 shall be kept on Site.

2.4.3 Measuring and Testing Equipment

All measuring and testing equipment required for the project shall be defined

2.4.4 Inspection and Test Plan(s)

Inspection and Test Plans (ITPs) shall be prepared for each of all on-and-off the Site operations and including production or manufacture of any material, components, and samples for which the Contract requires inspections or tests to be performed. ITPs shall describe all inspections and test required, the criteria for acceptance and the person in charge and responsible for each inspection or test. ITPs shall note as a hold point on any stage or activity which requires the Superintendent's approval or presence.

The Inspection and Test Plan(s) shall cover all inspection and testing required by the Contract and shall include surveying and measuring verification processes, as well as sampling procedures. All quality control laboratory tests shall be performed by laboratories conforming to the standards of the National Association of Testing Authorities (NATA) or other standards approved in writing by the Superintendent for the relevant test. Test reports shall be certified by an approved signatory.

Proforma ITPs shall be issued in time for the Superintendent's review and at least 28 days before the relevant operation is first undertaken. Failure to issue such Proforma ITP within the specified time may result in the rejection of the material or component. Operations which are subject to inspection or test shall not commence until the ITP is agreed by the Superintendent.

ITPs shall clearly state the times within which each activity shall be completed. Two copies of all test reports and/or certificates shall be made available to the Superintendent immediately after they are produced. All costs of testing and obtaining of certificates shall be borne by the Contractor. The Superintendent or its representative may be present at tests. Failure to produce satisfactory test reports within the specified time may be considered to demonstrate that the work to which the test report relates is unsatisfactory, and the Superintendent may reject and order remedial works to be undertaken to the Contractor's account.

The Inspection and Test Plan(s) (ITP) shall clearly state the times within which each activity will be completed. All test reports shall be made available to the Superintendent immediately after they are produced. Failure to produce satisfactory test reports within the specified time may be considered to demonstrate that the work to which the test report relates is unsatisfactory, and remedial works may be ordered to be undertaken forthwith.

HOLD POINT

Preparation of Inspection and Test Plans for all on and off site operations, to be submitted 28 days before work commencement.

2.5 Inspection

Access shall be given to all laboratories and other facilities used for quality control tests so that it can verify that the specified requirements are being met.

2.5.1 Identification and Traceability

Unless otherwise specified, the acceptance of work shall be based on testing of the works in lots. All required samples and test results shall be identified with the precise field locations and lots to which they relate. Traceability is not a requirement.

2.5.2 Records

Unless otherwise specified, the acceptance of work shall be based on testing of the works in lots. All required samples and test results shall be identified with the precise field locations and lots to which they relate. Traceability is not a requirement.

2.5.3 *Non-conformance*

Any product and service non-conformance shall be notified immediately. Notification shall be submitted as Non-conformance Reports and shall indicate the proposed method of rectification. The Contractor shall prepare Standard forms shall be utilized for use as Non-conformance Reports.

HOLD POINT

Submission of standard forms for Non-conformance Reports.

HOLD POINT

Submission of Non-conformance Reports.

Work, which is the subject of a Non-conformance Report, shall not be covered prior to inspection

2.5.4 *Surveillance and Audit*

Quality surveillance and audits shall be carried out to ensure conformance to the requirements of the Contract. These will involve system element audits, product and service audits, and process and technical procedure audits.

The audits to be undertaken will be in addition to the Contractor's audits and will not relieve the Contractor of its responsibilities under the Contract. The Superintendent will carry out audits in accordance with AS 3911.1/ISO 10011.1 at times to be determined by the Superintendent. The Contractor will be given at least five day's notice that a quality audit is to be carried out. The Contractor shall make or arrange to be available all necessary facilities, documents etc including subcontractors etc. for audits.

The Superintendent may delegate all or part of its responsibilities to a Quality Assurance Officer. The Contractor will be advised in writing of the name of this person, its organisational position and authority, and of the delegations, which will apply.

2.6 Subcontractors

The Contractor shall be fully responsible for integrating all Subcontractor's quality systems into its own Quality System or alternatively for arranging for the Subcontractor to work within a quality system developed and provided by the Contractor.

The Contractor shall be the single point of responsibility for the production, implementation and auditing of the quality system required under the Contract.

2.7 Summary of Hold/witness Points

Table 2.1 Hold/witness Point Schedule

Process held	Section reference	Hold or witness point	Submission Details	Release of hold point
Project commencement	2.3.2	HOLD	Project Quality Plan, at least 28 days before work commencement.	Acceptance by Superintendent prior to authorising the release of the hold point
Project commencement	2.3.3	HOLD	Quality System Procedures and Instructions, at least 28 days before commencement of those works	Acceptance by Superintendent prior to authorising the release of the hold point

Process held	Section reference	Hold or witness point	Submission Details	Release of hold point
Project commencement	2.4.4	HOLD	Project Inspection and Test Plans, at least 28 days before work commencement.	Acceptance by Superintendent prior to authorising the release of the hold point
Project commencement	2.5.3	HOLD	Standard forms for Non-conformance Reports, at least 28 days before work commencement.	Acceptance by Superintendent prior to authorising the release of the hold point

3 Demolition

3.1 General

The demolition work shall be undertaken in accordance with relevant Work Health and Safety Legislation and ensure no damage to existing infrastructure outside of the scope or site. The Contractor shall make good any connections between new and existing infrastructure. The extent of the demolition works work is shown on the drawings. The methods and scope of demolition works is the responsibility of the Contractor.

3.2 Standards, Codes and Guidelines

The following Standards shall be complied with for demolition work to the extent that they are relevant and not overridden by this Specification:

- Transport for NSW (TfNSW) QA Specification B341 Demolition of Existing Structure.
 - AS 2601 The Demolition of Structures.
 - Code of Practice: Demolition Work (Safe Work Australia, 2015).
-

3.3 Demolition Works

The following Specification shall apply to the scope of demolition works of this specification to the extent that they are relevant and not overridden by TfNSW B341 Demolition of Existing Structures, noting that the hold points of this section are to be adhered to.

28 days prior to commencement of demolition work, the Contractor shall submit a Demolition Plan and Method Statement and Safety Report to the Superintendent for approval which shall include a hazardous material assessment, details of all plant, equipment, and techniques to be used for demolition including details of temporary works.

The Contractor shall inspect the structures to be demolished and shall ensure their methods and extents of demolition do not jeopardise the structures to be retained, nor adjacent structures and the methods of demolition provide for safe demolition. The outcomes of the Contractor's investigations and reviews shall be summarised in a Contractor's demolition safety plan.

The Contractor is to be and shall remain solely responsible for the demolition methods, procedures, approvals and practices.

HOLD POINT

Submission of demolition plan, safety report and work method statements 28 days before commencement of these works.

The Contractor shall appoint a full time suitably certified demolition supervisor during all demolition operations. Existing structures to be demolished may be in a deteriorated condition and the Contractor shall inspect and make allowance for the condition of the items being demolished. The Contractor shall take all steps and all precautions as required by the appropriate regulations when dealing with hazards. The Contractor shall protect workers, pedestrians, vehicles and others from demolition activities in accordance with their site method statements ensuring suitable people and plant separation and exclusion zones.

During demolition or construction activities, the Contractor shall prevent damage to adjoining services structures, as may potentially arise from impact and/or vibrations. The Contractor shall undertake vibration monitoring during demolition and piling installation to control the risk of damage to existing structures.

Due to its proximity to the proposed new wharf extensions on northern and southern end, the existing wharf is most likely to be affected by ground vibrations from impact pile driving at the site. The following vibration limits are considered applicable to the existing wharf:

- PPV 25 mm/s for continuous vibration (e.g. vibratory driving)
- PPV 50 mm/s for transient vibration (e.g. impact/percussive driving).

Note that these thresholds assume that the existing wharf structure is in good condition. The current structural condition/integrity of the existing wharf is a factor in PPV thresholds and if the existing wharf is in poor condition, then lower thresholds shall be adopted.

The existing masonry structures at the northern and southern end of the wharf are also to be protected against damage, the vibration level at their location is limited to:

- PPV 7.5 mm/s for continuous vibration (e.g. vibratory driving)
- PPV 15 mm/s for transient vibration (e.g. impact/percussive driving).

The Contractor shall carry out the demolition with all precautions necessary to prevent any materials falling into sea. Such materials shall be recovered by the Contractor. Under no circumstances shall demolished materials be left or disposed into the water.

3.4 Demolition Method

Demolition must be undertaken utilising the methods and sequences specified in the approved method statement. The Contractor must obtain prior approval from the Superintendent before deviating from the requirements of the approved work plan. No claim shall arise should approval be refused.

3.5 Surface Treatment

All existing concrete surfaces in contact with the new in-situ concrete pour shall be roughened to expose aggregates. Formwork to be installed and surfaces to be thoroughly cleaned with pressured water before placing new concrete.

Where existing reinforcement is exposed during demolition and will be enclosed in the new works with repair mortar (in accordance with Section 13.9.6.1 or as otherwise detailed in the drawings), the existing reinforcement shall be painted with zinc rich primer such as Fosroc Nitoprime or equivalent approved, application shall be in accordance with manufacturer's specification and data sheets.

3.6 Records

The schedule of identified records should be followed as per Annexure B341/C of TfNSW QA B341 to be provided by the Contractor are below.

With regards Clause 8.2 Underwater inspection report, the purpose of this survey is to confirm that no demolition arisings, rubbish, tools, parts, etc., have fallen to and have been left on the seabed. The scope of the underwater inspection specification (TfNSW QA Specification B350) is modified to include the following elements only:

1. The area of survey to include the areas immediately underneath the demolition areas on the existing structure, plus a zone of 15 m away from the edge of the demolition areas or perimeters.
2. The Contractor shall be responsible for the following:
 - a. Permits, approvals and permissions for undertaking the survey
 - b. Liaison and coordination with Port Harbour master

- c. Approval of survey methodology, methods, etc., including providing the survey contractor with safe access to the survey areas
 - d. Costs of survey
3. The Contractor shall provide an inspection report in .pdf format to include:
- a. Survey methodology, team names, qualifications and supervisor name, date of survey(s)
 - b. Location plan (GA) showing survey extents and locations of items found and type of item and cross reference to tabulated summary
 - c. Tabulated summary of items found, including photographs / images with location reference
4. The Contractor shall provide copies of survey photographs provided in native .jpg format.

Table 3.1 Schedule of Identified Records

Clause	Description
2.2	Licences, notifications, approvals and permits
3.1.1	Preliminary investigation report
3.1.6	Demolition Designer's Safety Report
3.5	Demolition Plan, incorporating Blast Management Plan
8.1	Final survey report
8.2	Underwater inspection report

The final survey and underwater inspection reports shall be submitted 14 days after completion of these surveys

WITNESS POINT

Submission of survey and inspection reports no later than 14 days after completion of the surveys / inspection

3.7 Summary of Hold/witness Points

All hold and witness points during demolition are outlined in Table 3.2.

Table 3.2 Hold/witness Point Schedule

Process held	Section reference	Hold or witness point	Submission Details	Release of hold point
Demolition	3.3	HOLD	Demolition plan, safety report and work method statements, at least 28 days before commencement of those works.	Acceptance by Superintendent prior to authorising the release of the hold point
Records	3.6	HOLD	Licences, notifications, approvals and permits, preliminary investigation report, at least 28 days before commencement of those works	Acceptance by Superintendent prior to authorising the release of the hold point

Process held	Section reference	Hold or witness point	Submission Details	Release of hold point
Records	3.6	Witness	Inspection and Survey Reports	

4 Earthworks

4.1 General

Generally, the earthworks must be constructed to comply with the TfNSW and Australian Standard specifications. Where necessary for the works, if changes have been made to these specifications, those and any additional requirements are documented in the following sections of this report.

The Contractor shall provide an overall Quality Management Plan for Earthworks in accordance with TfNSW Quality Management requirements 28 days before commencement.

HOLD POINT

Submission of Quality Management Plan for Earthworks, to be submitted 28 days before work commencement.

4.2 Standards and Codes

The following standards and specifications must be followed and adhered to unless agreed with the Superintendent:

- TfNSW Specification QA R44 – Earthworks
- Australian Standard AS 3798-2007 – Guidelines on earthworks for commercial and residential developments

4.3 Revetment

The existing revetment is constructed at various batter slopes and comprises materials protected by filter and armour layers. The Contractor shall execute the works in such a manner so as not to adversely affect the revetment. The Contractor shall be responsible for rectifying and making good any damage to the revetment caused by the execution of the works.

HOLD POINT

Submission of revetment survey (revetment elevations plan)

The Contractor shall reinstate such section for the revetment as are disturbed in connection with construction of the onshore works (e.g., piling, stormwater treatment outlet, light tower footings). The fill, filter layer and armour materials and details employed in such reconstruction works shall match the existing revetment materials. Existing armour shall be reused where possible.

Where the existing revetment is displaced as a result of installation of cross beams in access bridge, temporary excavations shall be provided with a maximum slope of 1:1.5 to allow placement of pile capitals and cross beams. Any concrete surfaces in contact with ground shall be protected with geotextile as shown on the drawings. Existing revetment shall then be reinstated around the cross section of the beams.

It is anticipated that a joint survey of the finished revetment levels be undertaken after replacement of filter and armour materials around piling. This is to be undertaken in accordance with TfNSW Specification QA R44 – Earthworks as illustrated in the extract in Figure 4.1.

The Contractor shall develop an Inspection and Test Plan (ITP) for these works. The Superintendent will Witness the disturbance and reinstatement of the works. The Contractor shall provide 24 hours notice of Witness points.

WITNESS POINT

The Superintendent will Witness the disturbance and reinstatement of the works, 24 hours notice.

HOLD POINT

Submission of revetment rectification (Photographs) and revetment survey (as-built plan).

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Earthworks**R44****ANNEXURE R44/A – PROJECT SPECIFIC DETAILS****A1 SURVEY**

Refer to Clause 1.6.

Carry out the surveys listed in the table below. Where so specified, the survey must be carried out as a joint survey in accordance with TfNSW G71.

NOTES TO TENDER DOCUMENTER: (Delete this boxed text after completing Annexure R44/A1)

Delete whichever of the “Yes / No” options shown below that is not applicable.

Review the default values shown below for “Joint Survey”, and amend if appropriate. Prior to completing the table, consult TfNSW Survey Section whether TfNSW survey resources are available for undertaking the joint surveys shown in the table below.

Clause	Area To Be Surveyed	Requirements	
		Joint Survey	Model File ⁽¹⁾
2.5.1	Surface of existing ground before commencing construction of bridging layer where topsoil is not required to be removed	Yes	Yes / No
2.5.2	Surface at each topsoil stockpile location before commencing stockpiling	No	Yes / No
2.5.3	Surface after stripping of topsoil	No	Yes / No
2.6.4	Surface before and after removal of unsuitable material	Yes	Yes / No
3.2, 7.7.1	Floor of cutting before placing material for foundation treatment or formation	Yes	Yes / No
5.1.3, 6.1.1	Surface before and after placing imported material	Yes	Yes / No
6.1.2	Surface before placing Selected Material	No	Yes / No
6.2	Surface before placing verge material	Yes	Yes / No
7.7.1	Top of finished formation	Yes	Yes / No
7.8, 7.9	Completed batter in cutting and embankment prior to topsoiling, vegetation or other treatments	No	Yes / No

Note:

- ⁽¹⁾ If this requirement is “Yes”, the survey report must include an electronic file in a format suitable for creating accurate models using standard TfNSW CADD software.

Figure 4.1 Extract from TfNSW Specification QA R44 Earthworks Annexure A1 regarding Survey

4.4 Surface Preparation

The in-situ subbase material on the underside of the pavement should consist of minimum California Bearing Ratio 10% suitable existing granular material or imported granular fill.

HOLD POINT

Submission of initial inspection of subbase to be proof rolled (Superintendent initial inspection document).

HOLD POINT

Submission of final inspection of subbase to be prepared (Superintendent final inspection document).

Once the final surface is trimmed to level, tyne, moisture control and re-compact the uppermost 300 mm in all areas below pavements to 98% Standard Maximum Dry Density (SMDD).

The Superintendent shall inspect the final level prior to placement of pavement layers. As noted in Table 4.2, areas are to be proof rolled and tested in accordance with TfNSW Test Method T198. Any areas of unsuitable materials to be removed and replaced with suitable granular fill compacted in 300 mm loose layers to 98% SMDD or 75% Density Index. Where water has softened the subgrade, the soil to be dried and recompacted prior to placement of upper layers.

HOLD POINT

Submission of notification that unsuitable material has been removed as directed.

HOLD POINT

Submission of proposed source locations, quantities and types of material, and verification of conformity.

Dynamic Cone Penetrometer (DCP) to be used in accordance with AS 1289.6.3.2 to confirm density of in-situ materials min. 1 m below underside of pavements. The minimum acceptable blow count of 5 blows / 100 mm to be demonstrated. Testing to be carried out at a minimum rate of 1 test per 50 m².

Ground improvement is required beneath the transition slab edge beam in the form of geosynthetic reinforcement. The existing ground should be excavated to a depth of 1 m below the underside of the edge beam. A geosynthetic reinforcement with a minimum ultimate tensile strength of 400 kN (e.g. Mirafi PET 400-50 or approved equivalent) should be installed and backfilled in layers not exceeding 300 mm thickness, using well-graded granular material (select fill in accordance with AS 3725:2007) compacted to 98% SMDD. Geosynthetic reinforcement to be installed in accordance with the drawings.

Backfill trench bed, side, haunch and overlay zones with select fill in accordance with AS 3725:2007:

- To a level of 150 mm above the collars of pipework. In 150 mm maximum layers throughout depth of trench. To 100% Standard Maximum Dry Density in accordance with AS 1289.0, Test E3.1 or E3.3. Ensure all conditions, such as moisture content within the soil and correct grade or quality of soil for backfilling, are correct prior to compaction.
- Select backfill materials for trench widths greater than 450mm to comply with: No stones greater than 25 mm occurring within 150 mm of the service, well graded, inorganic, non-perishable material maximum size 75 mm, plasticity index greater than 55%. Under roadway, paved areas – coarse sand, controlled low strength material or fine crushed rock. In reactive clay – in sites classified M, H or E to AS 2870.1, use an impervious material if trenches fall toward footings. In topsoil areas – complete with at least 50 mm topsoil.
- Select backfill materials for trench widths less than 450 mm to comply with: Under roadways and paved areas – stabilised sand using a 7% by weight cement/sand mix, poured into the service trench to match the level of the road sub grade. Not under roadways and paved areas – sand or coarse sands as approved in 150 mm maximum layers throughout depth of trench and to match the level of the surface sub grade prior final surface finish.
- The Contractor shall develop an Inspection and Test Plan (ITP) for these works. The Superintendent will Witness the disturbance and reinstatement of the works. The Contractor shall provide 24 hours' notice of Witness points.

WITNESS POINT

The Superintendent will Witness the disturbance and reinstatement of the works.

HOLD POINT

Photographs of any pollution control systems shall be submitted.

4.5 Summary of Hold/witness points

All hold and witness points during earthworks are outlined in Table 4.1, and all required tests are outlined in Table 4.2.

Table 4.1 Hold/Witness Point Schedule

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINTS	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Construction commencement	4.1	HOLD	Quality Management Plan for Earthworks submitted 28 days before commencement	Acceptance by Superintendent prior to authorising the release of the hold point
Construction continuance	4.3	WITNESS	Superintendent to witness revetment disturbance reinstatement. 24 hours' notice is required.	The Superintendent will inspect the reinstatement, prior to authorising the release of the Witness Point.
Earthworks	4.3	HOLD	Submission of revetment survey (revetment elevations plan), at least 2 weeks prior to earthworks	The Superintendent will examine details and may inspect the revetment survey prior to authorising the release of the Hold Point.
Initial subbase preparation	4.4	WITNESS	Submission of initial inspection of subbase to be proof rolled (Superintendent initial inspection document), at least 1 week prior to initial subbase preparation	The Superintendent will witness the proof rolling of any lot, done in accordance with Test Method TfNSW T198

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINTS	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Final subbase preparation	4.4	HOLD	Submission of final subbase preparation (Superintendent final inspection document), at least 1 week prior to final subbase preparation	The Superintendent will examine the proposed insitu stabilisation testing details and may inspect the final subbase preparation prior to authorising the release of the Hold Point.
Replacement of each Lot of unsuitable material.	4.4	HOLD	Notification that unsuitable material has been removed as directed	The Superintendent will inspect the excavation and may require removal of further material as unsuitable material prior to authorising the release of the Hold Point.
Delivery of site won material and imported material for the Upper Zone of Formation	4.4	HOLD	Proposed source locations, quantities and types of material, and verification of conformity, at least 2 weeks prior to procurement	The Superintendent will examine details and may inspect the source and stockpiles of material prior to authorising the release of the Hold Point.
Acceptance	4.4	HOLD	Submission of sediment and erosion control systems photographs prior to acceptance	The Superintendent will examine details and may inspect the sediment and erosion control system prior to authorising the release of the Hold Point.
Site clearance	4.3	HOLD	Submission of revetment rectification (Photographs), at least 1 week prior to site clearance	The Superintendent will examine details and may inspect the revetment prior to authorising the release of the Hold Point.
Site clearance	4.3	HOLD	Submission of revetment survey (As-built plan), at least 1 week prior to site clearance	The Superintendent will examine details and may inspect the revetment survey (as built plan) prior to authorising the release of the Hold Point.

Table 4.2 Works Testing

ACTIVITY	TEST METHODS	MINIMUM FREQUENCY	ACCEPTANCE CRITERIA
Proof roll and visual check of final surface prior to insitu stabilisation. To be witnessed by a suitably qualified Geotechnical Engineer	TfNSW T198		No perceptible deformation or visual differences to already tested material. Refer WSP report ref. PS208203-WSP-SYD-GEO-REP for results of laboratory testing
Density of insitu material, uppermost 1m layer	DCP in accordance with AS 1289.6.3.2	1 test per 50 m ²	Min 5 blows / 100 mm

5 Pavements

5.1 General

The pavements must be constructed to comply with the TfNSW and Australian Standard specifications. Where necessary for the works, some amendments have been made to these specifications. These changes and additional requirements are documented in the following sections of this report.

The following works items and related specifications are required to complete the pavement works

- Materials testing: The existing pavement quality gravels must be tested to ensure that they comply with TfNSW QA specifications R71; R75; and 3051 for incorporation as subbase and insitu stabilised material.
- One of the following spray seals are to be used: 10mm low cutter seal, AMC0 Prime and 10mm C170 seal, or 10mm emulsion primerseal.

Three boreholes were drilled by WSP, unveiling the existing granular material is suitable for the subbase and insitu stabilisation. The Contractor shall verify that this material exists for the full extents of the pavement area identified and that those materials meet or exceed the nominated specification requirements.

The subgrade beam is to be constructed using N32 or R83 base concrete with steel float finish and mesh SL92 centrally placed.

For subsurface drains, the minimum trench, carrier pipe and interface drain grade is 0.5%. Otherwise, trench drain depth is to be increased. The grades are nominated on the Drawings.

The Contractor shall provide an overall Quality Management Plan for pavements in accordance with TfNSW Quality Management requirements 28 days before commencement.

HOLD POINT

Submission of Quality Management Plan for Pavements, to be submitted 28 days before work commencement.

5.2 Standards and Codes

The following standards and specifications (not limited to) must be followed and adhered to unless agreed with the Superintendent or their delegated representative:

- TfNSW Specification QA R15 – Kerbs and Channels (Gutters)
- TfNSW Specification QA R33 – Trench Drains
- TfNSW Specification QA R53 – Concrete for General Works
- TfNSW Specification QA R54 – General Concrete Paving
- TfNSW Specification QA R63 – Geotextiles
- TfNSW Specification QA R71 – Construction of Unbound and Modified Pavement Course
- TfNSW Specification QA R75 – In situ Pavement Stabilisation Using Slow Setting Binders
- TfNSW Specification QA R83 – Concrete Pavement Base
- TfNSW Specification QA R106 – Sprayed Bituminous Surfacing (with Cutback Bitumen)
- TfNSW Specification QA R111 – Sprayed Bituminous Surfacing (with Bitumen Emulsion)
- TfNSW Specification QA R116 – Heavy Duty Dense Graded Asphalt

- TfNSW Specification QA 3051 – Granular Base and Sub-Base Materials for Surfaced Road Pavements
- TfNSW Specification QA 3151 – Aggregates for Sprayed Bituminous Surfacing
- TfNSW Specification QA 3152 – Aggregates for Asphalt
- TfNSW Specification QA 3154 – Granulated Glass Aggregate
- TfNSW Specification QA 3204 – Preformed Joint Fillers for Concrete Road Pavements and Structures
- TfNSW Specification QA 3211 – Cementitious Materials, Binders and Fillers
- TfNSW Specification QA 3222 – No Fines Concrete (for Subsurface Drainage)
- TfNSW Specification QA 3253 – Bitumen for Pavements
- TfNSW Specification QA 3254 – Bitumen Emulsion
- TfNSW Specification QA 3258 – Aggregate Precoating Agent (for Bitumen)
- TfNSW Specification QA 3259 – Bitumen Adhesion Agent (for Bitumen)
- TfNSW Specification QA 3261 – Cutback Bitumen
- TfNSW Specification QA 3263 – Hot Poured Elastomeric Joint Sealant for Roads
- TfNSW Specification QA 3552 – Subsurface Drainage Pipe (Corrugated Perforated and Non-Perforated Plastic)
- TfNSW Specification QA 3557 – Flexible Strip Filter Drains
- AS 3798-2007 – Guidelines on earthworks for commercial and residential developments

5.3 Hold Points, Witness Points and Identified Records

The following sections of this specification provide the required Hold and Witness Points and Identified Records for the pavement components for each of the individual specifications required for the works.

5.3.1 QA Specification R15

The HOLD POINT in QA Specification R53 applies.

5.3.2 QA Specification R33

C1 SCHEDULE OF HOLD POINTS

Clause	Description
3.5	Covering drainage pipe with filter material

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
2	Brand, supplier and compliance records for each type of material
3.5	Notification that pipe laying, jointing and bedding are complete and conforming
6	Work-as-executed drawings of the completed drainage system

5.3.3 QA Specification R53

C1 SCHEDULE OF HOLD POINTS AND WITNESS POINTS

Clause	Type	Description
2.4.3	Hold	Production of each concrete strength grade
3.3.1	Hold	Provision of notice of expected time of completion of formwork and reinforcement and commencement of placing of concrete
3.6	Witness	Provision of notice of expected time of commencement of placing of mortar, grout and sprayed concrete

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
2.4.3	Production assessment report in accordance with AS 1379 Clause 6.4.2
3.3.2	Concrete and air temperature

5.3.4 QA Specification R54

C1 SCHEDULE OF HOLD POINTS

Clause	Description
3.2 and R44 Clause 2.4.1	Unsuitable material
4.3 and R53 Clause 3.3	Placing of concrete
4.4.2	Submission of drawing showing proposed joint layout and reinforcement details
5.2.1	Submission of patterned concrete paving details
6.1	Submission of details of proposed tactile indicator tiles, associated materials and installation method

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
4.4.2	Drawing showing the proposed joint layout and reinforcement details
6.1	Details of the proposed tactile indicator tiles, associated materials and installation method

5.3.5 QA Specification R63

C1 SCHEDULE OF HOLD POINTS AND WITNESS POINTS

Clause	Type	Description
2.4.2	Witness	Site sampling of geotextile on site
2.5	Hold	Supply of geotextile
4.1	Hold	Placement of geotextile

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
2.4	Site sampling test results
2.5	Certificate of Compliance from Supplier verifying that geotextile complies with all requirements of Specification for its specified usage together with test results

5.3.6 QA Specification R71

C1 SCHEDULE OF HOLD POINTS AND WITNESS POINTS

Clause	Type	Description
2.2	Hold	Certification of stockpiles
4.2	Hold	Submission of Contractor nominated mix design
5.2.2	Hold	Submission of details of proposed Alternative Construction Method
6.5.1	Witness	Construction of trial section of pavement
6.5.1	Hold	Submission of documentation verifying conformity of trial section of pavement
6.8	Hold	Submission of reports verifying conformity of level, thickness, surface deviation and compaction prior to placing bituminous seal
7.2	Hold	Submission of schedule of levels of underlying surface
8.12.1	Hold	Submission of Nonconformity Report and rectification proposal

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of the Identified Record
2.2	Certification of stockpiles
3.3	Safety Data Sheets
4.2	Approved Contractor nominated mix design
4.3	Variation to approved Contractor nominated mix design
5.2.2	Details of Alternative Construction Method
5.2.3	Contractor's Design and Field Target Spread Rates
6.3	Target moisture content envelope
6.5.1	Conformity documentation for trial section of pavement
7.2	Underlying surface levels
7.3	Pavement course finished surface levels
8.2	UCS sampling locations and test results
8.5	Thickness of subbase/base course
8.11	Certificate of conformity

5.3.7 QA Specification R75

C1 SCHEDULE OF HOLD POINTS AND WITNESS POINTS

Clause	Type	Description
2.3	Hold	Certification of stockpiles
4.2.3	Hold	Submission of Contractor nominated mix design
5.5.2	Hold	Submission of details of proposed Alternative Construction Method
5.8.1	Hold	Locations and types of construction joints, treatment of overlaps and irregular shaped Lots, locations of unsupported edges and details of rolling pattern
5.11.1	Witness	Construction of trial section of pavement
5.11.1	Hold	Submission of documentation verifying conformity of trial section of pavement
5.13	Hold	Priming, primersealing or sealing of surface of bound pavement course
7.11.1	Hold	Submission of Nonconformity Report and rectification proposal

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
2.3	Certification of stockpiles
3.1.3	Verification records of blended binder proportions
4.2.3	Approved Contractor nominated mix design details
4.3	Supplementary Information and test results
4.4	Variation to approved Contractor nominated or Principal nominated mix design
5.5.2	Details of Alternative Construction Method
5.5.3	Completed Table R75/E.2 and calculations
5.6	Target moisture content envelope
5.8.1	Locations and types of joints, treatment of overlaps and irregular shaped Lots, locations of unsupported edges and details of rolling pattern
5.11.1	Conformity documentation for trial section of pavement
7.2	UCS sampling locations and test results
7.5	Thickness of bound pavement course
7.10	Certificate of conformity

5.3.8 QA Specification R83

C1 SCHEDULE OF HOLD POINTS AND WITNESS POINTS

Clause	Type	Description
3.2	Hold	High subbase levels
3.2 and TfNSW G71	Hold	Survey Report verifying subbase conformity
3.8.1	Hold	Submission of nominated mix
3.8.1	Witness	Trial mix
4.1.1	Hold	Placing concrete around steel reinforcement
4.2.1	Hold	Results from process control charts
4.2.2.2	Hold	Results for mixer uniformity testing
4.3.3	Hold	Submission of names of personnel involved in concrete paving operations and evidence that at least half of them hold a TfNSW Concrete Paving Crew Grey Card
4.4.8.4	Hold	Trafficking of base
4.5	Hold	Base paving subject to paving trial
4.6.1	Witness	Testing of joints and silicone sealants
5.2.4	Hold	Voids above inserted tiebars
5.4.2 and TfNSW G71	Hold	Survey Report verifying base conformity
5.6.1	Hold	Removal and replacement of nonconforming concrete base

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
2.8	Certify by written report that the curing compound conforms to this Specification, and submit NATA endorsed test results
2.9	Certify that the proposed sealant conforms to this Specification and provide all relevant test results
2.9	Certify compliance of each production batch of sealant
2.10	Evidence that steel reinforcement material supplier and reinforcement fabricator are certified by ACRS
3.2	Schedule of base invert levels and relevant nonconformity report
3.8.1	Certify that each nominated mix and its constituents meet the requirements of this Specification, submit NATA endorsed test results for all relevant tests (except Vebe) and submit a copy of the verification checklist
3.8.2	Notification of variations to a nominated mix
4.1.1	Certificate of compliance covering the installation of reinforcement and embedments
4.2.1	Results for compressive and flexural strength, relative compaction and thickness for the same sub-Lot plus proposal for Corrective Action to achieve conformity
4.3.3	Names of personnel for carrying out concrete paving operations, together with evidence of relevant training and experience
4.4.8.4	In situ strength test results of the base
4.5	Submission of checklists and test results, excluding results for compressive and flexural strength
5.6.1	Nonconformity report for each location of removal and replacement of concrete base with the proposed method and precautions to prevent damage

5.3.9 QA Specification R106

C1 SCHEDULE OF HOLD POINTS

Clause	Description
3.3.3	Submission of planning documents and proposed design.
3.4	Aggregate details and target application rates.

C2 SCHEDULE OF WITNESS POINTS

Clause	Description
9	Final sweeping and loose aggregate measurement prior to opening to traffic.

5.3.10 QA Specification R111

C1 SCHEDULE OF HOLD POINTS AND WITNESS POINTS

Clause	Type	Description
3.2.3	Hold	Submission of planning documents and details for nominated materials and sprayed surfacing design using bitumen emulsion.
3.3	Hold	Submission of details for target application rates for each work location
9	Witness	Final sweeping and loose aggregate measurement prior to opening to traffic.

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
3	Proposed bituminous surfacing design together with certification for the nominated materials and design verification documentation
3.3	Aggregate Lot details and target application rates
4.4	Copy of completed forms showing details of binder and aggregate applied for every sprayer run, signed by your representative as a true record of the work performed.

5.3.11 QA Specification R116

C1 SCHEDULE OF HOLD POINTS

Clause	Description
2.3.5	Submission of nominated mix design details
3.5.1	Submission of paving and compaction temperature details to achieve conformity
3.6.3	Placing of asphalt in nonconforming layer thicknesses
3.8.6	Submission of verification checklists and test results from trial section
5.8.5	Submission of Nonconformity Report and proposed dispositions
Annex B2.3	Submission of test results for insitu air voids and other properties, and proposed corrective actions
Annex F	Progression to higher RAP Level

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q.

Clause	Description of Identified Record
2.1.4 (a)	RAP Management Plan
2.1.6	Documentary evidence of binder conformity for asphalt used in the Works
2.3.3	Nominated mix design details
2.4.3, 2.4.5	Asphalt manufacturing process parameters including process temperatures
3.2.4	Daily record of average tackcoat application rate in each Lot
3.3.1	Surface temperature and weather conditions at time of paving
3.5	Asphalt temperature at time of initial compaction
3.8	Verification checklist and all listed test reports of trial section for each combination of materials, mix proportions, equipment, rate of paving and methods for placement, compaction and finishing

5.3.12 QA Specification 3051

C1 SCHEDULE OF HOLD POINTS

Clause	Description
8.2.3	Acceptance of Proposed Mix as a shear strength based material
10.6	Acceptance of recycled and/or manufactured constituent materials

5.3.13 QA Specification 3151

C1 SCHEDULE OF HOLD POINTS

Clause	Description
6.2	Supply of nominated aggregate

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
7.1	Records verifying conformity of aggregate delivered
7.3	Summary of test results for each Lot

5.3.14 QA Specification 3152

C1 SCHEDULE OF HOLD POINTS

Clause	Description
5.3	Where fine aggregate is produced from a different source rock to that used to produce coarse aggregate, verification that source rock conforms to specified strength and durability requirements for coarse aggregate.
6.3	Submission of nominated aggregate details.

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
5.2, 5.3	Nominated coarse and fine aggregate grading envelope
6.1	Nominated aggregate submission
6.2	Proprietary information not submitted, and alternative method of risk management
8.3.1	Test reports of all specified properties and characteristics

5.3.15 QA Specification 3154

C1 SCHEDULE OF HOLD POINTS

Clause	Description
7.1.4	Submission of nominated granulated glass details

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
5	All records verifying compliance with the “exemption” and “order”
7.1	Nominated granulated glass submission details, including any proprietary information which are identified but not submitted
8.1.2	Test reports for all specified properties and characteristics at the minimum frequency of testing

5.3.16 QA Specification 3204

Nil Required

5.3.17 QA Specification 3211

Nil Required

5.3.18 QA Specification 3222

C1 SCHEDULE OF HOLD POINTS

Clause	Description
6.1	Submission of nominated mix design details.

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
6.1	Nominated mix design.

5.3.19 QA Specification 3253

ANNEXURE 3253/C – SCHEDULE OF IDENTIFIED RECORDS

Refer to Clause 2.2.

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
6.2	Certificate of conformity of the bitumen at terminal
8.3.1	Test results of samples taken at point of delivery

5.3.20 QA Specification 3254

ANNEXURE 3254/C – SCHEDULE OF IDENTIFIED RECORDS

Refer to Clause 2.2.

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Records
6	Verification that the production batch complies with all relevant requirements together with test results on NATA endorsed test documents
7	Certificate of compliance verifying that the bitumen emulsion complies with the Specification together with results for all tests reported on NATA endorsed test documents
8.4	Safety Data Sheet
9	Test results demonstrating compliance with AS 1160 on NATA endorsed test documents

5.3.21 QA Specification 3258

ANNEXURE 3258/C – SCHEDULE OF IDENTIFIED RECORDS

Refer to Clause 2.2.

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Records
5.7	Average and minimum value of concentration of active component and details of related tests.
6	Certificate of compliance verifying that the precoating agent complies with Clause 5 together with test results reported on NATA endorsed test documents.
7	Certificate of compliance and Safety Data Sheet to be supplied with each delivery.
8	Materials Data Sheet.

5.3.22 QA Specification 3259

ANNEXURE 3259/C – SCHEDULE OF IDENTIFIED RECORDS

Refer to Clause 2.2.

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Records
5.5	Average and minimum value of concentration of active component and details of related tests
6	Certificate of compliance verifying that the adhesion agent complies with Clauses 5.2 and 5.4 together with test results reported on NATA endorsed test documents
7	Certificate of compliance and Safety Data Sheet to be supplied with each delivery
8	Materials Data Sheet

5.3.23 QA Specification 3261

ANNEXURE 3261/C – SCHEDULE OF IDENTIFIED RECORDS

Refer to Clause 2.2.

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
6	Certification at point of delivery that every batch of cutback bitumen complies with Clause 5.2 together with test results reported on NATA endorsed test documents

5.3.24 QA Specification 3263

ANNEXURE 3263/C — SCHEDULE OF IDENTIFIED RECORDS

Refer to Clause 2.2.

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
5	Certificate of conformity verifying that the joint sealing material complies with this Specification, together with tests results reported on NATA endorsed test documents
6	Certificate of conformity, Materials Safety Data Sheet and Materials Data Sheet to be supplied with each delivery

5.3.25 QA Specification 3552

ANNEXURE 3552/C – SCHEDULE OF IDENTIFIED RECORDS

Refer to Clause 2.2.

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
6	Certificate of compliance

5.3.26 QA Specification 3553

ANNEXURE 3553/C – SCHEDULE OF IDENTIFIED RECORDS

Refer to Clause 2.2.

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
7	Certificate of compliance

5.3.27 QA Specification 3557

ANNEXURE 3557/C – SCHEDULE OF IDENTIFIED RECORDS

Refer to Clause 2.2.

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
7	Certificate of compliance

QA Specification

5.4 Testing Requirements

The following minimum frequency of testing requirements are needed for the pavement components

5.4.1 QA Specification R15 Testing

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
3.3, 4.1	Bedding layer:	AS 2876, Survey	Every 10 m
	Surface irregularities		
	Level		
3.6, 4.1	Profile dimensions:	AS 2876	
	Using fixed forms		Every 10 m
	Machine placed		Once for each batch of concrete delivered
4.1	Finished K&C:	AS 2876, Survey	Every 10 m
	Horizontal alignment		
	Level		
	Deviation from 3 m straightedge		
	Deviation on vertical curve		

5.4.2 QA Specification R33 Testing

Clause	Characteristics Tested	Test Method	Minimum Frequency of Testing
2	Material properties	As per relevant materials specification	As per relevant materials specification
4.3	Relative compaction of Selected Material adjacent to batter outlets	TfNSW T166	One per 15 batter outlets or part thereof
5.2	Relative compaction of Selected Material in pavement interface drains	TfNSW T166	One per pavement interface drain

5.4.3 QA Specification R53 Testing

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
Production Assessment			
2.4.3	As specified in AS 1379		
Project Assessment			
4.1, Annex E	Compaction of sprayed concrete	AS 1012.12.2	One pair of test specimens per 50 m ³ of concrete, minimum 2 pairs per pour, when required by Principal
4.1, Annex E	Grout compressive strength	AS 1012.9	One pair of test specimens per 20 m ³ of grout, minimum 2 pair per pour
Annex E	Concrete slump	AS 1012.3.1	For each homogeneously manufactured grade per day, one on each of the first three batches at the start of the day and after a nonconforming batch, then one per four batches
Annex E	Concrete compressive strength	AS 1012.9	Sampling, testing and assessment for compliance must be in accordance with AS 1379
Annex E	Air content of fresh concrete ⁽¹⁾	AS 1012.4.2, with compaction by internal vibration ⁽²⁾	In mix design, and first load on each day of concrete placing

Notes:

⁽¹⁾ Required only for slipformed concrete.

⁽²⁾ Use the same vibration pattern and duration as for cylinders in accordance with TfNSW T304.

5.4.4 QA Specification R54 Testing

Clause	Characteristic Analysed	Test Method	Minimum Frequency Of Testing
2.1.1	PI of Select Fill Type U	T109	One per 200 m ³ prior to placement
3.4	Compaction	As per TfNSW R44	As specified in TfNSW Q Annexure Q/L

5.4.5 QA Specification R63 Testing

G3 Trench drains, edge drains, counterfort drains and drainage layers To provide the combined functions of separation and filtration	Nominal maximum stone size in fill, D ₉₀	No Fines Concrete QA Specification 3222
	Maximum trench depth	1.0 metres
	Site subgrade CBR 15%
	Site soil type	Pervious granular / Low to medium permeability granular/ Clays & silts

Table R63/E.1 (continued) – Geotextile Strength and Filtration Requirements

Application	Strength Requirements		Filtration Requirements (6, 7)			Geotextile Filtration Class
	Nominal Maximum Stone Particle Size D ₉₀ (mm) ⁽¹⁾	Geotextile Strength Class ⁽²⁾	EOS and Flow Rate Requirements for D ₅₀ < 75 µm ⁽³⁾ (predominantly silt and clay soils) ⁽¹¹⁾	EOS and Flow Rate Requirements for D ₁₅ ≥ 75 µm and D ₁₅ ≤ 75 µm ⁽³⁾ (predominantly granular soils with low permeability) ⁽¹²⁾	EOS and Flow Rate Requirements for D ₁₅ > 75 µm ⁽³⁾ (predominantly pervious granular soils) ⁽¹³⁾	
G3 Trench drains, edge drains, counterfort drains, and Drainage Layers To provide the combined functions of separation and filtration	Trench drains, edge drains, counterfort drains	Depth < 2 m Depth < 3 m				
	≤ 37.5	A B				
	≤ 75	B C				
	≤ 200	C D				
	Drainage Layers	CBR > 3 CBR ≤ 3				
	≤ 37.5	B C				
	≤ 75	C D				
	≤ 200	D E				
	≤ 400	E E ⁽⁹⁾				
	≤ 600	N/A ⁽¹⁰⁾ N/A ⁽¹⁰⁾				

5.4.6 QA Specification R71 Testing

ANNEXURE R71/L – FREQUENCY OF TESTING

Clause	Characteristic	Test Method/ Specification	Minimum Frequency of Testing
2.1	Properties of unbound material and Material To Be Modified	TfNSW 3051	As per TfNSW 3051
3.1.1	Quality of binder	TfNSW 3211	As per TfNSW 3211
3.2	Quality of water: Chloride ion concentration Sulfate ion concentration Undissolved solids Concentration of thermo-tolerant coliforms	TfNSW T1004 TfNSW T1014 AS 3550.4 TfNSW T1015	1 per contract per source 1 per contract per source 1 per contract per source 1 per contract per source
8.2	Unconfined compressive strength	TfNSW T116	One pair per 400 tonnes or part thereof
8.3	Spread rate of binder	As per Clause 8.3	1 per 200 metres for each spreader run
8.3	Percentage of binder	As per Clause 8.3	1 per 200 tonnes or part thereof
8.4.2	In situ density	TfNSW T119 or T173	As per TfNSW Q for specified relative compaction
8.4.3	Maximum wet or dry density	TfNSW T111, T112 or T162	As per TfNSW Q for specified relative compaction
8.4.4	Relative compaction	TfNSW T166	As per TfNSW Q for specified relative compaction
8.4.5	Field moisture content	TfNSW T120, T121 or T180	As per TfNSW Q for specified relative compaction
8.5	Pavement course thickness	As per Clause 8.5	At least one site per 75 metres, with a minimum of 2 per Lot
8.6	Surface level	As per Clause 8.6	As per Clause 7
8.7	Deviation from straight edge	As per Clause 8.7	Minimum 1 per 20 m ²
8.8	Ride quality	TfNSW T182 or T188	Continuous reading per Lot
8.9	Pavement width	As per Clause 8.9	Minimum of 1 per 20 linear metres

5.4.7 QA Specification R75 Testing

ANNEXURE R75/L – MINIMUM FREQUENCY OF TESTING

Clause	Characteristic Tested	Test Method	Minimum Frequency of Testing
2.2	Properties of imported MTBB	TfNSW 3051	As per TfNSW 3051
3.1.1	Quality of binder	TfNSW 3211	As per TfNSW 3211
3.1.2	Proportion of blended binder	Verify proportion of constituents	1 per binder delivery
3.2	Quality of water:		
	Chloride ion concentration	TfNSW T1004	1 per contract per source
	Sulfate ion concentration	TfNSW T1014	1 per contract per source
	Undissolved solids	AS 3550.4	1 per contract per source
	Concentration of thermo-tolerant coliforms	TfNSW T1015	1 per contract per source
3.3	Quality of retarder	Conformity with AS1478 or other standard appropriate to the particular retarder	1 per contract per source
7.2	Unconfined compressive strength	TfNSW T116	As per TfNSW Q for specified relative compaction
7.3	Spread rate	As per Clause 7.3	As per Clause 7.3
7.4.1	Insitu density	TfNSW T173	As per TfNSW Q for specified relative compaction
7.4.2	Maximum wet density	TfNSW T162	As per TfNSW Q for specified relative compaction
7.4.3	Relative compaction	TfNSW T166	As per TfNSW Q for specified relative compaction
7.4.4	Field moisture content	TfNSW T120, T121 or T180	As per TfNSW Q for specified relative compaction
7.5	Pavement course thickness	As per Clause 6.3	At each location as defined in Clause 6.3
7.7	Deviation from straight edge	As per Clause 7.7	Minimum 1 per 20 m ²
7.8	Ride quality	TfNSW T182 or T188	Continuous reading per Lot
7.9	Width	As per Clause 7.9	Minimum of 1 per 20 linear metres

QA Specification R83 Testing

ANNEXURE R83/L – MINIMUM FREQUENCY OF TESTING

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
Fine aggregate:			
2.3	Material < 75 µm	AS 1141.11	One per 5,000 t (TF) ⁽⁴⁾ for the first 15,000 t and thereafter one per 10,000 t
2.3	Material < 2 µm	AS 1141.13	One per 5000 t (TF) ⁽⁴⁾ for the first 15,000 t and thereafter one per 10,000 t
2.3	Methylene Blue Adsorption Value (MBV)	TfNSW T659	One per 20,000 t (Ind) ⁽⁴⁾
2.3	MBV75 value		One per 20,000 t (Ind) ⁽⁴⁾
2.3	Bulk Density (compacted)	AS 1141.4 Clause 7.2	Trial mix submission ⁽³⁾
2.3	Water Absorption	AS 1141.5	Trial mix submission ⁽³⁾
2.3	Soundness (sodium sulphate)	AS 1141.24	One per 5000 t (Ind) ⁽⁴⁾ for the first 15,000 t and thereafter one per 10,000 t
2.3	Organic impurities	AS 1141.34 and AS 1289.4.1.1. See Table R83.2 Note 4.	One per 2000 t (TF) ⁽⁴⁾ for the first 10,000 t and thereafter one per 10,000 t
2.3	Sugar content	AS 1141.35	One per 5000 t (Ind) ⁽⁴⁾
2.3	Acid insoluble residue	TxDOT Tex-612-J	Trial mix submission ⁽⁴⁾ (TF) ⁽⁴⁾
2.3	Micro-Deval loss ⁽⁶⁾	ASTM D7428	Trial mix submission ^(4,6) (TF) ⁽⁴⁾
2.3	Flow Cone time ⁽⁵⁾	TfNSW T279	One per 10,000 t (TF) ⁽⁴⁾
2.3	Hardness	Vickers Hardness (macro) ASTM E384-11e1	Trial mix submission ⁽⁴⁾ (TF) ⁽⁴⁾
2.3	Glass content	TfNSW 3154	Trial mix submission ⁽³⁾ (TF) ⁽⁴⁾
Coarse aggregate:			
2.4	Bulk and particle density	AS 1141.4, AS 1141.6	In the trial mix
2.4	Water absorption	AS 1141.6	Trial mix submission ⁽³⁾ (TF) ⁽⁴⁾
2.4	Material < 75 µm	AS 1141.11	One per 5000 t (TC) ⁽⁴⁾ for the first 15,000 t and thereafter one per 10,000 t
2.4	Particle shape	AS 1141.14	One per 10,000 t
2.4	Ratio AGD/ALD	TfNSW T275 and T278	One per 10,000 t
2.4	Wet strength	TfNSW T215	One per 10,000 t ⁽¹⁾
2.4	Wet/dry strength variation	TfNSW T215	One per 10,000 t ⁽¹⁾
2.4	Weak particles	AS 1141.32	One per 20,000 t
2.4	Light particles	AS 1141.31	One per 20,000 t

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
2.4	Fractured faces	TfNSW T239	One per 10,000 t
2.4	Foreign materials content	TfNSW T276	One per 4000 t
2.5.1	Alkali-aggregate reactivity	See Clause 2.5.1	Trial mix submission ⁽³⁾
Other Materials:			
2.6	Cementitious materials	TfNSW 3211	
2.8	Conformity of curing compound	AS 3799	As per Clause 2.8
2.9	Joint sealant	See Clause 2.9	
2.11	Water	AS 1379	At the trial mix and thereafter one per 5000 m ³ of concrete
Placing Concrete in Base			
3.7	Shrinkage	AS 1012.13	Trial mix submission ⁽³⁾
3.7.2	Chloride ion content	See Clause 3.7.2	One per 30,000 m ³ of concrete
3.7.2	Sulphate ion content	See Clause 3.7.2	One per 30,000 m ³ of concrete
3.7.2	Bleeding	AS 1012.6	At the trial mix
3.7.2	Coefficient of Thermal Expansion (CTE)	AASHTO T336	Trial mix submission ⁽³⁾ . Report only.
4.1.2	Tiebars; pull-out testing		As per Clause 4.1.2.1
4.1.2	Tiebars; location and compaction		As per Clause 4.1.2.2
4.1.2	Tiebars; concrete cover		As per Clause 4.1.2.3
4.1.3	Dowels; pull-out testing	TfNSW T366	Trial mix submission ⁽³⁾ , 3 dowels and as per Clause 4.1.3
4.2.1	Particle size distribution of combined aggregate: either - by calculation or - by wet-sieving ⁽³⁾	AS 1141.11 By calculation TfNSW T329 ⁽³⁾	One per 500 m ³ for the first 5,000 m ³ and thereafter one per 2,500 m ³ . In the Paving Trial and thereafter one per 1500 m ³ of concrete ⁽⁵⁾
4.2.1	Flexural strength	AS 1012.11	As per Clause 4.2.1.2
4.2.1	Water content		In the Paving Trial and thereafter one per 500 m ³ for the first 5000 m ³ and thereafter one per 2500 m ³
4.2.2	Concrete slump	AS 1012.3 Method 1	As per Clause 4.2.2
4.2.2	Air content of concrete	AS 1012.4 Method 2	As per Clause 4.2.2
4.2.2	Mixer Uniformity	AS 1379 and Clause 2.4.4	As per Clause 4.2.2

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
4.4.6	Average depth of surface texture		
	(a) Hessian drag only	TfNSW T240 or T192	Only where tining and/or grooving is not specified, one per 2000 m ² of Base.
4.4.7	(b) Combined surface texture	TfNSW T240 or T192	One per 2000 m ² of base
	Application rate of curing compound	See Clause 4.4.7	As per Clause 4.4.7.2
4.4.8.4	In-situ compressive strength (for trafficking purposes)	Cylinders as per TfNSW T367, or Cores as per Clause 4.4.8.4	As per Clause 4.4.8.4
	Cylinder compressive strength of concrete at:		As per Clause 4.4.8.4
4.2.1	- 7 days	AS 1012.9	As per Clause 5.3.2
5.3.2	- 28 days	AS 1012.9	As per Clause 5.3.2
4.6.1	Joints and sealants	TfNSW T379 and T380	As per Clause 4.6.1
5.2	Relative compaction of concrete	TfNSW T381	As per Clause 5.2.1
5.4	Surface level and alignment	Various	As per Clause 5.4
5.4.3	Thickness	Survey and Core length	As per Clause 5.4.3
5.5.2	Surface profile	See Clause 5.5	As per Clause 5.5
5.5.3	Ride Quality	TfNSW T188 or T369	As per Clause 5.5.3
Steel fibre reinforced concrete			
6.3.2	Compressive strength	AS 1012.9	As per Clause 6.3.2
6.3.3	Consistence	AS 1012.3 Method 1	As per Clause 4.2.2
6.6.2	Flexural strength	AS 1012.11	As per Clause 6.3.2
6.7	Thickness	Survey and Core length	As per Clause 5.4.3
6.8	Relative compaction of concrete	TfNSW T381	As per Clause 5.2.1

Notes:

- (1) Provided that all of the six previous tests have met specification requirements for both wet strength and wet/dry strength variation then the following reduced frequency may apply:
- where all wet/dry variation results are < 25% : 1 per 15,000 t.
- (2) Only the + 1.18 mm fraction need be tested; Clause 4.2.1(b) refers.
- (3) As tested within 18 months prior to the commencement of paving and to be included in the trial mix submission.

- (4) Frequencies are based on aggregate quantities as follows (consistent with Tables R83.2 & R83.3):
 - Ind: individual aggregate quantities
 - TF: total fine aggregate quantities
 - TC: total coarse aggregate quantities
- (5) Where a plant produces less than 1000 t per day of Fine or Coarse aggregate for use in the project, the minimum of one test per day is required for grading.
- (6) See Table R83.2 Note 6 regarding the warrant for testing.

5.4.8 QA Specification R106 Testing

ANNEXURE R106/L – MINIMUM FREQUENCY OF TESTING

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
1.1	Surface Texture	TfNSW T240	Five measurements every 250 m and at changes in aggregate size or heavy patches (shoulder, wheelpaths, between wheelpaths and centre line) per lane of sprayed bituminous surfacing work ⁽¹⁾
2.1	Properties of Residual Bitumen	AS 2341	As set out in TfNSW 3253
2.1	Properties of Cutback Bitumen	AS 2341	As set out in TfNSW 3261
2.2	Resistance to Stripping of Adhesion Agent	TfNSW T230	As set out in TfNSW 3259
2.2	Initial Adhesion and Resistance to Stripping of Precoating Agent	TfNSW T238 TfNSW T230	As set out in TfNSW 3258
2.3	Properties of Cutter Oils and Flux Oils	ASTM D611 ASTM D1319 ASTM D1298 ASTM D86 AS 2106 AS 2341.9 ASTM D445	As set out in AS 3568
2.4	Aggregate Properties	TfNSW T203 TfNSW T230 TfNSW T238 TfNSW T239 AS 1141.11 AS 1141.6.1 AS 1141.14 AS 1141.20.1 AS 1141.20.2 AS 1141.22 AS 1141.41	1 per 250 m ³ of aggregate ⁽¹⁾ 1 per 6 months and at change of quarry face 1 per 6 months and at change of quarry face 1 per 250 m ³ of aggregate ^{(1), (3)} 1 per 250 m ³ of aggregate ⁽¹⁾ 1 per 6 months and at change of quarry face 1 per 250 m ³ of aggregate ⁽¹⁾ 1 per 250 m ³ of aggregate ⁽¹⁾ 1 per 250 m ³ of aggregate ⁽¹⁾ 1 per 500 m ³ of aggregate ^{(1), (2)} 1 per 6 months and at change of quarry face
8	Measurement of Aggregate Spread Rate	TfNSW T274	2 per day

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
9	Measurement of Loose Aggregate on Sprayed Seals	TfNSW T277	1 per 500 m lane length or part thereof

Notes:

- (1) Frequency of testing may be reduced in accordance with TfNSW Q subject to the Principal's agreement.
- (2) Provided that all of the six previous tests have met specification requirements for both wet strength and wet/dry strength variation then the following reduced frequencies apply:
 - where all wet/dry variation results < 25% : 1 per 6,500 m³
 - where all wet/dry variation results < 30% : 1 per 2,500 m³
 - where all wet/dry variation results < 35% : 1 per 1,250 m³
- (3) Aggregate sourced from 'drill and blast' quarries may be exempted providing that all other tests have met Specification requirements.

5.4.9 QA Specification R111 Testing

ANNEXURE R111/L – MINIMUM FREQUENCY OF TESTING

Table R111/L.1 - Minimum Frequency of Testing

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
1.1	Surface Texture	TfNSW T240	Five measurements every 250 m and at changes in aggregate size or heavy patches (shoulder, wheelpaths, between wheelpaths and centre line) per lane of sprayed bituminous surfacing work ⁽¹⁾ .
2.1	Properties of Bitumen Emulsion	AS 2341.2 AS 2341.3 AS 2341.4 AS 2341.5 AS 2341.8 AS 2341.9 AS 2341.25 AS 2341.28 AS 2341.29 AS 2341.30 AS 3568 AS/NZS 2341.22 AS/NZS 2341.23 AS/NZS 2341.24 AS/NZS 2341.26 AS/NZS 2341.27 ASTM D244 BS 2586 TfNSW T560	As set out in TfNSW 3254
2.1	Properties of Polymer Additives and the Binder Residue of the Polymer Modified Bitumen Emulsion	AS 2341.12 MBT11 MBT22 MBT23 MBT27 TfNSW T511 TfNSW T741 TfNSW T742	As set out in TfNSW 3252
2.3	Aggregate Properties	TfNSW T203 TfNSW T230 TfNSW T238 TfNSW T239 AS 1141.6.1 AS 1141.11 AS 1141.14 AS 1141.20.1 AS 1141.20.2 AS 1141.22 AS 1141.41	1 per 250 m ³ of aggregate ⁽¹⁾ 1 per 6 months and at change of quarry face 1 per 6 months and at change of quarry face 1 per 250 m ³ of aggregate ^{(1), (3)} 1 per 6 months and at change of quarry face 1 per 250 m ³ of aggregate ⁽¹⁾ 1 per 500 m ³ of aggregate ^{(1), (2)} 1 per 6 months or change of quarry face
2.4	Compatibility of Emulsion with Water	TfNSW T569	One each 10,000 litres of water

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
8	Measurement of Aggregate Spread Rate	TfNSW T274	2 per day
9	Measurement of Loose Aggregate on Sprayed Seals	TfNSW T277	1 per 500 m lane length or part thereof

Notes:

- (¹) Frequency of testing may be reduced in accordance with TfNSW Q subject to the Principal's agreement.
- (²) Provided that all of the six previous tests have met specification requirements for both wet strength and wet/dry strength variation then the following reduced frequencies apply:
 - where all wet/dry variation results < 25% : 1 per 6,500 m³
 - where all wet/dry variation results < 30% : 1 per 2,500 m³
 - where all wet/dry variation results < 35% : 1 per 1,250 m³
- (³) Aggregate sourced from 'drill and blast' quarries may be exempted providing that all other tests have met Specification requirements.

5.4.10 QA Specification R116 Testing

ANNEXURE R116/L – MINIMUM FREQUENCY OF TESTING

The minimum frequency of testing of constituent materials, and of asphalt during production, placing and in the finished pavement are listed in Tables R116/L.1 to R116/L.5.

Table R116/L.1 – Constituent Material Properties

Clause	Constituent	Minimum Frequency of Testing
2.1.2	Coarse aggregates	As per TfNSW 3152
2.1.3	Fine aggregates	
2.1.4 (a)	RAP material	As per TfNSW 3153 and Annexure R116/F
2.1.4 (b)	Granulated glass aggregates	As per TfNSW 3154
2.1.5	Added fillers	As per TfNSW 3211
2.1.6	Binder	As per TfNSW 3252 and TfNSW 3253
2.1.8	Bitumen emulsion tackcoat	As per AS 1160

Table R116/L.2 – Production Asphalt Properties

Clause	Characteristic	Test Method	Minimum Frequency of Testing
2.1.5	Total filler in asphalt		
	- Dry compacted voids	AS/NZS 1141.17	One per 10,000 tonnes or part thereof used in asphalt production, and at change in source of mineral matter
	- Methylene blue value	TfNSW T659	
2.2.1 (a)	Combined particle size distribution	AS/NZS 2891.3.1	As per Table R116/L.3
2.2.1 (b)	Binder content		
2.2.2	Filler-binder ratio		
2.2.2	VMA at 120 cycles	AS/NZS 2891.2.2, AS/NZS 2891.7.1 or AS/NZS 2891.7.3, AS/NZS 2891.8, AS/NZS 2891.9.2	
2.2.2	Air voids in laboratory compacted mix		As per Table R116/L.3
	- at 120 cycles		
	- at 350 cycles		One per shift per mix type
2.2.2	Moisture content	AS/NZS 2891.10	One per shift per mix type
2.2.2	Moisture sensitivity, measured by TSR	AG:PT/T232 or TfNSW T640	One test for up to 2,000 tonnes or part thereof and thence one test per 5,000 tonnes or part thereof of the production mix
2.4.5	Production temperature of asphalt	Your documented procedure	As per PROJECT QUALITY PLAN
	Despatch temperature of asphalt		Each delivered load

Table R116/L.3 – Minimum Frequency of Testing of Asphalt

Quantity of Asphalt Supplied in Each Shift⁽¹⁾	Minimum Frequency of Testing
Less than 100 tonnes	One per 50 tonnes or part thereof
101 to 300 tonnes	One per 100 tonnes or part thereof
301 to 600 tonnes	One per 150 tonnes or part thereof
Over 600 tonnes	One per 200 tonnes or part thereof

Note:

⁽¹⁾ Refer Clause 1.3.1 for definition of “shift”.

Table R116/L.4 – Asphalt Placing

Clause	Property	Test Method	Minimum Frequency of Testing
3.2	Tackcoat application rate	Your documented procedure	Each paving Lot
3.3	Surface temperature		One measurement every 2 hours
	Wind velocity		
3.5	Temperature at initial compaction		Each delivered load

Table R116/L.5 – Placed Asphalt Properties

Clause	Property	Test Method	Minimum Frequency of Testing
5.2	Homogeneity	Visual assessment	Each paving Lot
5.3	Insitu air voids	Clause 4.2	As specified for relative compaction > 100.0% in TfNSW Q Clause L3.1
5.4	Course thickness	Clause 4.3	From cores: as for insitu air voids above By survey: as for course position below
5.5	Course position	Clause 4.4	TfNSW G71 Clause 5.3.3
5.6	Surface shape	TfNSW T183	
	- Within lane		One measurement in longitudinal direction and 1 measurement in transverse direction every 60 m ²
	- Longitudinal joint excluding crowns		One measurement per 20 lineal metres or adjacent to within lane measurements whichever is the lesser
	- Transverse joint		One measurement in each wheel path in each lane except at the boundaries of the Site
5.7	Ride quality	TfNSW T188	Each Lot as defined in TfNSW T188

5.4.11 QA Specification 3051 Testing

ANNEXURE 3051/L – FREQUENCY OF SAMPLING AND TESTING

Minimum sampling and testing requirements are shown in Table 3051/L.1. The maximum Lot size is 4,000 tonnes.

Where process control has achieved a consistent product as demonstrated by six consecutive Lots conforming to specification requirements, or two consecutive Lots for permeability testing to AS 1289.6.7.2, the Principal may allow a reduced frequency of testing as specified in Table 3051/L.1.

Table 3051/L.1 - Minimum Sampling and Testing Requirements

MINIMUM NUMBER OF SAMPLES TO BE TAKEN				
Total Size of Lot Represented (tonnes)	1 – 500	501 – 1000	1001 – 2000	2001 – 4000
Minimum Number of Bulk Samples per Lot	2	3	4	5
MINIMUM TOTAL NUMBER OF TESTS TO BE CARRIED OUT ON EACH LOT				
Property and Test Method	No of Tests			
Coarse Particle Distribution TfNSW T106	2	3	4	5
Fine Particle Distribution TfNSW T107	2	3	4	5
Particle Size Distribution AS 1289.3.6.1	2	3	4	5
Permeability - Falling Head Method ⁽ⁱ⁾ AS 1289.6.7.2	1 (φ)	1 (φ)	1 (φ)	1 (φ)
Liquid Limit TfNSW T108	2 (1)	3 (2)	4 (2)	5 (2)
Plasticity Index (PI) TfNSW T109	2 (1)	3 (2)	4 (2)	5 (2)
Maximum Dry Compressive Strength ⁽ⁱⁱ⁾ TfNSW T114	1 (φ)	1 (φ)	2 (φ)	3 (φ)
Unconfined Compression Strength TfNSW T116	2	3	4	5
Texas Triaxial Compression Test ⁽ⁱⁱ⁾ TfNSW T171	1 (φ)	1 (φ)	2 (φ)	3 (1)
Particle Shape ⁽ⁱⁱ⁾ TfNSW T213	1 (φ)	1 (φ)	2 (1)	3 (1)
Aggregate Wet Strength ⁽ⁱⁱⁱ⁾ TfNSW T215	1 (φ)	1 (φ)	2 (1)	3 (1)
Wet/Dry Strength Variation ⁽ⁱⁱⁱ⁾ TfNSW T215	1 (φ)	1 (φ)	2 (1)	3 (1)
Acid Soluble Sulphate ^{(iv), (v)} TfNSW T219	1 (φ)	1 (φ)	1 (φ)	1
Fractured Faces of Coarse Aggregate ^{(ii), (v)} TfNSW T239	1 (φ)	1 (φ)	2 (φ)	3 (1)
Foreign Materials Content ⁽ⁱⁱ⁾ TfNSW T276	1 (φ)	1 (φ)	2 (1)	3 (1)

Notes:

The number or symbol φ shown within brackets “()” in the second part of the table represents the permitted reduced frequency of testing.

Where the minimum total number of tests for each Lot is the same as the minimum number of samples to be taken, then each test must be done on a different sample.

Where the reduced rate of testing under Table 3051/L.1 is shown as (φ), then, regardless of Lot size, the following minimum frequencies of testing apply:

- (i) for AS 1289.6.7.2 Permeability of a Soil - Falling Head Method: 1 per 8,000 tonnes
- (ii) for Test Methods TfNSW T114, T171, T213, T239, T276: 1 per 4,000 tonnes
- (iii) for Test Method TfNSW T215, provided that for the six previous Lots actually tested, all tests have met specification requirements for both Wet Strength and Wet/Dry Strength Variation, then:
 - where all Wet/Dry Strength Variation results are < 25%: 1 per 10,000 tonnes
 - where all Wet/Dry Strength Variation results are < 30%: 1 per 4,000 tonnes
 - in all other cases: 1 per 2,000 tonnes

- (iv) for Test Method TfNSW T219:
 - where test results are < 0.1%: 1 per 10,000 tonnes
 - where test results are < 0.3%: 1 per 4,000 tonnes
- (v) for Test Methods TfNSW T219 and T239, the Principal may grant an exemption to carry out test upon request in accordance with the footnotes for Table 3051.3.

5.4.12 QA Specification 3151 Testing

ANNEXURE 3151/L – FREQUENCY OF TESTING

Refer to Clause 2.3.

Characteristic Analysed	Test Method	Minimum Frequency of Testing
Particle size distribution	TfNSW T201	1 per 250 m ³ of aggregate
Material finer than 75 µm by washing	TfNSW T203	1 per 250 m ³ of aggregate
Particle shape	TfNSW T213	1 per 250 m ³ of aggregate
Average Least Dimension (ALD)	TfNSW T235 or TfNSW T275	1 per 250 m ³ of aggregate
Fractured faces	TfNSW T239	1 per 250 m ³ of aggregate
Wet strength	TfNSW T215	1 per 500 m ³ of aggregate ⁽¹⁾
Wet/Dry strength variation	TfNSW T215	1 per 500 m ³ of aggregate ⁽¹⁾
Polished Aggregate Friction Value (PAFV)	TfNSW T231 and TfNSW T233	1 per 6 months and at change of quarry face
Water absorption	AS 1141.6.1	1 per 6 months and at change of quarry face

Notes:

- ⁽¹⁾ Provided that all of the six previous tests have met the requirements of this Specification for both Wet strength and Wet/Dry strength variation, then the following reduced frequencies apply:

Wet/Dry strength variation	Frequency of testing
< 25%	1 per 6,500 m ³
< 30%	1 per 2,500 m ³
< 35%	1 per 1,250 m ³

5.4.13 QA Specification 3152 Testing

ANNEXURE 3152/L – MINIMUM FREQUENCY OF TESTING

Refer to Clause 2.3.

L1 COARSE AGGREGATES

Total Mass of Material Represented (tonnes)		1 - 500	501 - 1000	1001 - 2000	2001 - 4000
Test Method	Characteristic Analysed	Minimum Frequency of Testing			
AS 1141.11	Particle size distribution	1	1	2	3
AS 1141.12	Material finer than 75 µm by washing	1	1	2	3
AS 1141.14	Particle Shape ⁽¹⁾	1	1	2	3
TfNSW T278	Ratio of greatest to least dimension ⁽²⁾				
TfNSW T239	Fractured Faces	1	2	3	4
TfNSW T215	Wet Strength ⁽³⁾	1	1	2	3
TfNSW T215	Wet/Dry Strength Variation ⁽³⁾	1	1	2	3
AS 1141.41, AS 1141.42	PAFV	1 per 12 months and at change in quarry face			
AS 1141.6.1	Water Absorption	1 per 6 months and at change in quarry face			
AS 1141.6.1	Density	1 per 6 months and at change in quarry face			
ASTM C114-10	Free lime content ⁽⁴⁾	2	3	4	5

Notes:

- (1) Any change in production parameters must initiate the commencement of a new Lot.
- (2) Only for aggregates to be used in SMA (refer Specification TfNSW R121).
- (3) Refer Clause 8.3.1. Provided that for the six previous Lots actually tested, all tests have met specification requirements for both Wet Strength and Wet/Dry Strength Variation, then the following reduced frequencies apply:

Wet/Dry Strength Variation	Frequency of Testing
< 25%	1 per 10,000 tonnes
< 30%	1 per 4,000 tonnes
< 35%	1 per 2,000 tonnes

- (4) BOS and EAF steel furnace slag aggregates must be tested from certified stockpile Lots at the supplier's premises. Sampling must be carried out using a sampling tube as described in AS 1141.3.1 with all samples taken from at least 300 mm away from the face of the stockpile. Use the sampling technique detailed in Annexure A5 in AS 1141.3.1. Alternative sampling may be carried out using AS 1141.3.1 Section 9.3 "Backblading method" but the samples must not be mixed to form an average from the Lot.

L2 FINE AGGREGATES

Total Mass of Material Represented (tonnes)		1 - 500	501 - 1000	1001 - 2000	2001 - 4000
Test Method	Characteristic Analysed	Minimum Frequency of Testing			
AS 1141.11	Particle size distribution	1	1	2	3
AS 1141.12	Material finer than 75 µm by washing	1	1	2	3
AASHTO T304-96 Method A	Angularity ⁽¹⁾	1	1	2	3
AS 1141.5	Water Absorption	1 per 6 months and at change in quarry face			
AS 1141.24	Soundness	1 per 6 months and at change in quarry face			
AS 1141.5	Density	1 per 6 months and at change in quarry face			
ASTM C114-10	Free lime content ⁽²⁾	2	3	4	5

Notes:

- ⁽¹⁾ Any change in production parameters must initiate the commencement of a new Lot.
- ⁽²⁾ Only for aggregates to be used in SMA (refer Specification TfNSW R121).
- ⁽³⁾ BOS steel furnace slag aggregates must be tested from certified stockpile Lot at the Supplier's premises. Sampling must be carried out using a sampling tube as described in AS 1141.3.1 with all samples taken from at least 300 mm away from the face of the stockpile. Use the sampling technique detailed in Annexure A5 in AS 1141.3.1. Alternative sampling may be carried out using AS 1141.3.1 Section 9.3 "Backblading method" but the samples must not be mixed to form an average from the Lot.

5.4.14 QA Specification 3154 Testing

ANNEXURE 3154/L – MINIMUM FREQUENCY OF TESTING

Refer to Clause 2.4.

Property	Test Method	Minimum Frequency of Testing
Particle size distribution		
Nominated particle size distribution	AS 1141.11	2 per Lot
Material finer than 75 µm	AS1141.12	2 per Lot
Dry density	TfNSW T279	1 per Lot
Percentage of oversize material		
Flow time		
Uncompacted void content		
Dry particle density	AS 1141.5	One test every 3 months
SSD density		
Water absorption	AS 1141.5	One test every 3 months

5.4.15 QA Specification 3204 Testing

Nil required

5.4.16 QA Specification 3211 Testing

ANNEXURE 3211/L – SAMPLING AND TESTING

L1 GENERAL

Sample the material in conformity with the relevant Australian Standards.

Obtain samples of materials as individual randomly chosen samples, rather than composite samples.

The Principal may carry out surveillance of the sampling and testing, and may obtain samples at any stage and location for audit testing.

L2 FREQUENCY OF SAMPLING AND TESTING

L2.1 Cementitious Materials for Concrete

The minimum frequency of sampling and testing must be in accordance with ATIC SP43 Appendix A “Product Conformity & Conformity Assessment”, amended as shown in Table 3211/L.1, for the following materials.

- (a) general purpose and blended cements to AS 3972;
- (b) fly ash to AS 3582.1;
- (c) GGBFS to AS 3582.2;
- (d) amorphous silica to AS/NZS 3582.3.

Table 3211/L.1 – Modifications to ATIC SP43 Appendix A

SP43 Appendix A Clause	Modifications
A2 Conformity Assessment	Delete: Clause A2 in its entirety.
Table A1	Delete: Autoclave expansion limits given in ASTM C151; to AS/NZS 2350.17 or AS 3583.4 Add: Autoclave expansion less than 0.8%; to ASTM C151
A3.15 Blend Verification	Delete: Wording from “to $\pm 3\%$ proportions” to “.... from a grab sample” Add: A blend tolerance of $\pm 3\%$ must be observed for each of the nominated cementitious materials. Each cementitious material must conform to the relevant Australian Standard. Verification of blend accuracy by chemical composition must be conducted on a weekly grab sample.
A3.16 Sampling Plan	Delete: Clause A3.16
A3.17 Type Testing (TT)	Delete: Clause A3.17

L2.2 Powdered Glass for Concrete

The minimum frequency of sampling and testing for powdered glass must be as shown in Table 3211/L.2.

Table 3211/L.2 – Minimum Frequency of Testing – Powdered Glass

Property	Test Method	Minimum Frequency
% passing 45 µm sieve	AS 2350.9	Each 500 tonnes or weekly
Loss on ignition	AS 3583.3	
Major oxides (Na ₂ O, CaO, Al ₂ O ₃ , K ₂ O, Fe ₂ O ₃ , MgO)	AS/NZ 2350.2	
Silicon oxide (SiO ₂)	AS/NZ 2350.2	
Sulphur trioxide (SO ₃)	AS/NZ 2350.2	
Sugar	AS 1141.35	
Chloride content	AS 3583.13	
Strength Index	AS 3583.6	
Lead	BS 6748	

L2.3 Binders for Granular Pavements

The minimum frequency of sampling and testing for binders for granular pavements must be as shown in Table 3211/L.3.

Table 3211/L.3 – Minimum Frequency of Testing – Binders for Granular Pavements

Property	Test Method	Minimum Frequency
Hydrated Lime		
Available lime	AS 4489.6.1	1 per 600 tonne per source of supply
Residue on sieving	AS 4489.2.1	
Moisture content	AS 4489.8.1	
Quicklime		
Available lime	AS 4489.6.1	1 per 600 tonne per source of supply
Particle size (% passing)	AS 4489.2.1	
Active slaking time	AS 4489.3.1	
Temperature rise on slaking	AS 4489.3.1	
Fly Ash		
Fineness	AS 3583.1	1 per Contract
Loss on Ignition	AS 3583.3	1 per Supplier's production day

Property	Test Method	Minimum Frequency
GGBFS		
Glass content of GGBFS	ASTM C295	
Sulphuric anhydride content	AS 3583.8	
Fineness index	AS 2350.9	1 per 600 tonne per source of supply

L2.4 Added Fillers for Asphalt

The minimum sampling and testing plan for added fillers for asphalt must be as set out in Table 3211/L.4.

Table 3211/L.4 – Added Fillers for Asphalt

Property	Test Method	Minimum Frequency
Particle size distribution (cement works flue dust and ground limestone)	AS 1141.11	One per 500 tonnes of production of each added filler type
Fineness (fly ash)	AS 3583.1	One per 500 tonnes of fly ash production
Water soluble fraction (fly ash and cement works flue dust)	AS 1141.8	
Loss on ignition (fly ash and cement works flue dust)	AS 3583.3	One per 500 tonnes of production of each added filler type
Available lime (hydrated lime)	AS 4489.6.1	
Sieve residue (hydrated lime)	AS 4489.2.1	
Moisture content (hydrated lime, flue dust, ground limestone, cement and GGBFS)	AS 4489.8.1	One per 500 tonnes of hydrated lime production

5.4.17 QA Specification 3222 Testing

L1 MINIMUM FREQUENCY OF TESTING

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
5.1.2	Particle size distribution	AS 1141.11	One per 400 tonnes
5.1.1	Bulk density	AS 1141.4	One per the trial mix
5.1.1	Water absorption	AS 1141.6	Once within previous 12 months ⁽²⁾
5.1.1	Particle shape, 2:1 and 3:1 ratios	AS1141.14	One per 2,000 tonnes
5.1.1	Fractured faces	T239	One per 1,000 tonnes
5.1.1	Wet strength	T215	One per 2,000 tonnes ⁽¹⁾
5.1.1	Wet/dry strength variation	T215	One per 2,000 tonnes ⁽¹⁾
6.2	Permeability	T377	One per trial mix and then one per 400 tonnes

Notes:

- (1) Provided that all of the six previous tests have met the Specification requirements for both wet strength and wet/dry strength variation, the following reduced frequency may apply:
 - (a) where all wet/dry variation results are less than 25 percent: 1 per 10,000 tonnes
 - (b) where all wet/dry variation results are less than 30 percent: 1 per 4,000 tonnes
- (2) Within previous 12 months before the date of closing of tenders, or else in conjunction with the trial mix.

5.4.18 QA Specification 3253 Testing

ANNEXURE 3253/L – MINIMUM FREQUENCY OF TESTING

Minimum frequency of testing must be in accordance with Table 3253/L.1.

Table 3253/L.1 – Minimum Frequency of Testing

Property	Conformity Requirements ⁽¹⁾		Sampling Frequency	Testing Frequency
	C450	Other Classes		
For bitumen used in sprayed sealing or foam bitumen stabilisation				
Viscosity at 60°C Pa.s	As per Table 3253.1		One sample per shift whenever there is at least one delivery during the period ^(2,3)	1 per 200,000 litres (or part thereof)
Penetration at 25°C 0.1 mm				
For bitumen used in asphalting				
Viscosity at 60°C Pa.s	360 – 520	As per Table 3253.1	One sample per 24 hours whenever there is at least one delivery during the period ⁽²⁾	The greater of: 1 per 500,000 litres (or part thereof); or 1 per 3 months
Penetration at 25°C 0.1 mm	35 min	As per Table 3253.1		

Legend: min = minimum

Notes:

- (1) Conformity values shown are applicable only for testing of sample taken at point of delivery.
- (2) Samples are to be taken at the point of delivery.
- (3) A "shift" is a period of continuous work not exceeding 12 hours.

5.4.19 QA Specification 3254 Testing

Nil required

5.4.20 QA Specification 3258 Testing

Nil required

5.4.21 QA Specification 3259 Testing

Nil Required

5.4.22 QA Specification 3261 Testing

Nil Required

5.4.23 QA Specification 3263 Testing

Nil Required

5.4.24 QA Specification 3552 Testing

ANNEXURE 3552/L – MINIMUM FREQUENCY OF TESTING

Clause	Characteristics Tested	Test Method	Minimum Frequency of Testing
5	Perforation dimensions and area	TfNSW T1505	One per 2,000 m or part thereof
5	Pipe Stiffness	TfNSW T1506	One per 2,000 m or part thereof
5	Characteristics nominated in AS 2439.1 Table A1 (with the exception of Perforation dimensions and area and Pipe Stiffness)	As per AS 2439.1	As per AS 2439.1

5.4.25 QA Specification 3557 Testing

ANNEXURE 3557/L – MINIMUM FREQUENCY OF TESTING

Clause	Characteristics Tested	Test Method	Minimum Frequency of Testing
5	Load bearing characteristic	T1507	One per 2,000 m or part thereof
4	Low temperature resistance during straightening	T1508	One per 2,000 m or part thereof
4	High temperature impact resistance	T1509	One per 2,000 m or part thereof
4	Low temperature impact resistance	T1510	One per 2,000 m or part thereof

5.5 Amendments to TfNSW Standard Specifications

The following Sections of this report amend the TfNSW Standard Specifications for suitability for this specific project.

5.5.1 TfNSW R75 Specification

The following Clauses are amended:

5.5.1.1 Clause 4.1 (b) (i)

Original Clause – *An unconfined compressive strength (UCS) at 28 days normal curing or 7 days accelerated curing, of at least 3 MPa*

Amended to – *An unconfined compressive strength (UCS) at 28 days normal curing or 7 days accelerated curing, of at least 4 MPa*

5.5.1.2 Clause 4.1 (b) (Last Paragraph)

Original Clause - *Where imported MTBB to top up the existing pavement is required, the imported MTBB after stabilisation must also have a UCS of at least 3 MPa and have UCS strength gain of at least 1 MPa.*

Amended to – *Where imported MTBB to top up the existing pavement is required, the imported MTBB after stabilisation must also have a UCS of at least 4 MPa and have UCS strength gain of at least 1 MPa.*

5.5.1.3 Annexure A2 – Table R75/A.3

Annexure completed as follows:

Table R75/A.3 – Other Project Specific Requirements

Clause	Description	Requirement
2.4	Preparation of stockpile site by Contractor	Yes / No
4.1	Minimum Nominated Working Time ⁽¹⁾6.... hours
4.2.1	Mix design nominated by	Principal / Contractor
2.1, 5.2	Incorporation of patches into pavement course required	Yes / No
5.11.1	Trial section of pavement required	Yes / No
5.13	Application of the following bituminous sealing layer required:	
	Prime	Yes / No
	Primerseal	Yes / No
	Seal	Yes / No
5.13	Application of prime, primerseal or seal to be in accordance with	R106 / R107
7.8	Measurement of ride quality required	Yes / No
	Ride quality incentives/deductions in Table R75/B.2 applicable	Yes / No

Note:

⁽¹⁾ If different to the 6 hours specified in Clause 4.1

5.5.2 TfNSW R83 Specification

As per TfNSW R83:

- Deformed SL82 mesh reinforcement (strength – 500), will be required for all slabs
- Dowels must be straight, round galvanised bars as per AS/NZA 4680 (strength – 250) and be free of any irregularities. Dowels must be coated at one end with a tough debonding agent.

The following Clause is amended:

5.5.2.1 Clause 3.5 Table R83.7

Original Table

Table R83.7 - Minimum Concrete Strengths

Description		Compressive Strength	Flexural Strength⁽¹⁾
Non-SCM Mixes⁽²⁾	In the Trial Mix	45.0 MPa ($F_{28\text{Min}}$)	5.0 MPa ($F_{f28\text{Min}}$)
	In the Works	40.0 MPa ($f_{c\text{Min}}$)	4.8 MPa ($f_{f\text{Min}}$) ⁽³⁾
SCM Mixes⁽²⁾	In the Trial Mix	40.0 MPa ($F_{28\text{Min}}$)	4.8 MPa ($F_{f28\text{Min}}$)
	In the Works	35.0 MPa ($f_{c\text{Min}}$)	4.5 MPa ($f_{f\text{Min}}$) ⁽³⁾
Test specimen size		cylinder 100 mm diameter	beam 100 × 100 × 350 mm
Test methods		AS 1012.8 except: TfNSW T304 for moulding; AS 1012.9 for testing	AS 1012.8 except: TfNSW T304 for moulding; AS 1012.11 for testing

Notes:

- (1) Applicable to base pavement mixes only. Not applicable to non-pavement mixes such as anchors and kerbs.
- (2) SCM: Mixes containing supplementary cementitious material(s). See TfNSW 3211 Annexure 3211/D.
- (3) Specified only for process control, not specified for sub-Lot acceptance. For SFCP, refer to Clause 6.6.

Amended Table

Table R83.7 - Minimum Concrete Strengths

Description		Compressive Strength	Flexural Strength⁽¹⁾
Non-SCM Mixes⁽²⁾	In the Trial Mix	45.0 MPa ($F_{28\text{Min}}$)	5.0 MPa ($F_{f28\text{Min}}$)
	In the Works	40.0 MPa ($f_{c\text{Min}}$)	4.8 MPa ($f_{f\text{Min}}$) ⁽³⁾
SCM Mixes⁽²⁾	In the Trial Mix	40.0 MPa ($F_{28\text{Min}}$)	4.8 MPa ($F_{f28\text{Min}}$)
	In the Works	<u>40.0</u> MPa ($f_{c\text{Min}}$)	<u>4.8</u> MPa ($f_{f\text{Min}}$) ⁽³⁾
Test specimen size		cylinder 100 mm diameter	beam 100 × 100 × 350 mm
Test methods		AS 1012.8 except: TfNSW T304 for moulding; AS 1012.9 for testing	AS 1012.8 except: TfNSW T304 for moulding; AS 1012.11 for testing

Notes:

- (1) Applicable to base pavement mixes only. Not applicable to non-pavement mixes such as anchors and kerbs.
- (2) SCM: Mixes containing supplementary cementitious material(s). See TfNSW 3211 Annexure 3211/D.
- (3) Specified only for process control, not specified for sub-Lot acceptance. For SFCP, refer to Clause 6.6.

5.6 Summary of Hold/witness points

A summary of hold/witness points for the construction of pavement are outlined in Table 5.1. These exclude items identified in Section 5.3.

Table 5.1 Hold/witness Point Schedule (aside from those identified in Section 5.3)

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD / WITNESS POINT
Construction commencement	5.1	HOLD	Pavements Quality Management Plan to be submitted at least 28 days before commencement	Acceptance by Superintendent prior to authorising the release of the hold point

6 Fencing and Gates

6.1 Temporary Fencing

Temporary fencing shall be installed and maintained by the Contractor for the security of plant, equipment and materials used in connection with the works. The Superintendent may direct that additional fencing be installed.

- The temporary fence shall be completed as soon as practical following initial Possession of the Site and removed immediately prior to Practical Completion of that portion of the works.
 - Temporary fencing shall consist of 2.1m high chain mesh fence consisting of interlinked fencing panels. The panels are to be effectively coupled to prevent pedestrian access through the fence. The fence is to be of a type that is easily relocated if required by the Superintendent. The temporary fence shall be supplied complete with a dedicated access gate.
 - Where the temporary fencing is used to define a boundary with a MSIC zone, the temporary fencing is to security grade temporary fence include a minimum of 3 rows of barbed wire at the top.
 - Work shall be confined to the fenced area except with the Superintendent's prior written approval.
 - Safety signs indicating required Personal Protective Equipment (PPE) are to be erected onto the fences at all site entrances.
 - Any fencing removed during the works shall be restored if applicable, to the Specifications of the Superintendent.
- The fencing arrangements noted above are the minimum standards of fencing that the Superintendent shall accept.

It remains the responsibility of the Contractor to establish the type of fencing that the Contractor requires to separate the construction area from public areas, other sites and port operational areas and to provide the level of site security the Contractor deems necessary for the Site and Work Area. Works outside the Site are not permitted except with the Superintendent's prior written approval.

6.2 Permanent Fencing

Any fencing arrangements related to any permanent fencing should be in accordance with TfNSW QA Specification – R201 Fencing, unless specified otherwise by the Superintendent, the Drawings or this document, with reference to the following sections that are relevant to the project:

- Section 2.1: Concrete and Mortar Materials
- Section 2.2: Steel Materials
- Section 2.3: Timber Materials
- Section 2.5: Paint Materials
- Section 3.1.2: Manufacture of Prestressed Concrete Post Components
- Section 3.2.2: Protective Treatment for Steel Tubular Posts, Stays and Rail Components
- Section 3.3.1: Brackets and Other Steel Components
- Section 3.4: Timber Posts and Stay Components
- Section 3.5.1: Coated Wire Fencing Product Components
- Section 3.5.2: Wire Strand Components

- Section 3.6.2: Gates for Security Fencing
- Section 3.11: Certificate of Compliance (Hold Point) – provide the Superintendent with a signed Certificate of Compliance, verifying that the materials and components to be used comply with the requirements of specification R201, the design drawings and other sections of this document.

HOLD POINT

The Superintendent will consider the submitted documents and may request further information prior to authorising the incorporation of fencing and gates into the proposed works. Submission 28 days before commencement.

- Section 4: Construction of Fencing (Hold Point) – Construct fencing in accordance with specification R201 and the design drawings, including specifications in Section 4.1 General.

HOLD POINT

The Superintendent will consider the submitted documents prior to authorising the connection of new fencing to existing fencing.

- Section 4.3: Set Out of Fence Lines for Construction.
- Section 4.9: Construction of Security Fencing
- Section 4.14: Construction of Fence Gates
- Section 5: Removal of Existing Fencing and Disposal of Material

Material used below 2.5m PKHD is to be stainless steel. Hot dipped galvanised steel to AS/NZS 4680 to be used elsewhere. Isolation is to be provided between dissimilar metals. Any damage to the galvanised coating is to be reinstated by applying two coats of zinc rich primer in accordance with supplier's guidelines.

Security fence to comply with AS1725.1.

6.3 Fencing Posts

Generally, fencing posts are to comply with the following:

- Posts are to be grade 250mpa or higher complying with AS1163.
- Brace posts are required at all ends, corner or gate posts.
- Posts are to be class 1 type 2 in accordance with AS1725.1.
- All posts to be coated with black powder coating complying with AS3972.
- Posts are to be straight (not cranked).
- All posts shall be fitted with a black powder coated tightly fitting steel cap.
- A minimum post hole depth of 900 mm for corner posts or posts nominated on the Drawings, and 600 mm for intermediate posts, with a minimum 250 mm diameter post hole. Corner posts apply to change in angle in horizontal alignment exceeding 20 degrees. Anchors are to be Hilti HST4 Stud Anchor with 130 mm embedment, M16 stainless steel, or approved equivalent, installed to manufacturers specification. Anchors should be installed square to the fence line and not be rotated to adjust for the reinforcement. Anchors are to have a minimum 65mm horizontal clearance from slab edges and pavement joints.
- Where concrete pavement is greater than 200 mm thick, footing holes for drop bolts are to be drilled 150 mm into the concrete pavement.
- All brackets, hinges, catches, clamps and similar steel items must be standard proprietary manufactured items fabricated from grade 250/300 structural steel complying with AS/NZS 3678 and AS/NZS 3679.1 as applicable and then hot-dip galvanised in accordance with AS/NZS 4680, with a minimum load rating of 300kg.

- Posts are to be positioned centrally in the post hole and be positioned to have a minimum 100 mm clearance from the base of the hole.
- All posts footings are to be constructed with minimum 20 MPa concrete.
- All posts shall be vertical. Deviation in millimetres from vertical is to be less than the height of the post in millimetres divided by 240.

Posts with are installed down the revetment slope are as above, with the following changes:

- Anchors are to be Hilti Hit-RE 500 V3 Stud Anchor with 150 mm embedment, M12 stainless steel, or approved equivalent, installed to manufacturers specification. Anchors should be installed square to the fence line, in the centre of revetment rocks with a minimum diameter of 500 mm.
-

6.4 Fencing and Gate Wire Material

- All chain link fencing fabric, single strand fencing wire, tie wire and other wires are to be black PVC coated. Barbed wire does not need to be black PVC coated.
 - Chain link fencing fabric to be 50 mm pitch with heavy duty core wire.
 - Minimum 3.15 mm diameter with selvedge KB (knuckle bottom and barb top).
 - Chain link fencing fabric to be 2.1 m high or match existing.
 - Tension wire to be added at the top and middle.
 - Lacing wire shall be a 2 mm diameter core wire.
 - Tie wire for posts shall be double strand 1.57 mm core wire.
 - Tie wire to secure chain link fencing fabric to cables shall be 2.0 mm diameter core wire netting clips.
 - Chain link fencing fabric is to be placed on the outside of the posts and strained taut and secured to each support cable and all posts and bracing rails with tie wires except at the end posts and gates posts.
 - At the end posts and gate posts the chain link fencing fabric is to be fully laced to end posts, internal corner posts and gate posts.
 - The chain link fencing fabric shall be fully laced through each diamond with 2.0 mm diameter core wire, to each rail at the selvedge edge.
 - Ties to secure to chain link fabric to bracing rail to be a maximum of 480 mm spacing. A minimum of 2 ties per post shall be used to secure the chain link fence fabric to the posts.
 - Tie wires to cable wire shall be at a maximum of 480 mm spacing. Netting clips to cable wire shall be firmly clamped together and fully closed and overlapped with suitable pliers at a maximum spacing of 320 mm.
 - Tie wire shall be twisted twice, and the ends cut off neatly and bent over to avoid injury.
-

6.5 Fencing and Gate Bracing Stays and Rails

- All bracing stays, rails and other elements are to be grade 250 MPa or higher complying with AS1163.
- All bracing stays, rails and other elements are to be coated with black powder coating complying with AS3972.
- All bracing stays and rail to be provided without joints.

- Fence to consist of a bottom rail only, no top rail.
-

6.6 Vehicular Gates

- Each gate is to include a single drop bolt made from 16 mm diameter round steel grade 300m MPa to AS3679.1 and fitted to each gate leaf.
 - Drop bolt to have sufficient length to secure 150 mm into the concrete pavement or concrete kerbing in a drilled hole. The bolt is to be coated with black powder coating complying with AS3972.
 - Steel Base Plates of 20 mm thickness are to be installed where fence and gate posts are located on proposed pavement or wharf structures. They are to be fixed into position level with pavement using a nominal 10 mm mortar section between the steel plate and the pavement. Anchors are to be Hilti HST4 Stud Anchor with 130mm embedment, M16 stainless steel, or approved equivalent, installed to manufacturers specification. Anchors should be installed square to the fence line and not be rotated to adjust for the reinforcement. Anchors are to have a minimum 65 mm horizontal clearance from slab edges and pavement joints.
 - Each gate is to include a single handhole in each gate leaf.
 - Each gate is to include a locking chain which is to be welded to the gate post. Locking chain is to be suitable for a padlock. The locking chain is to be coated with black powder coating complying with AS3972.
 - The Principal will supply the padlocks for all gates.
-

6.7 Pedestrian Gates

- Each gate is to include a single handhole.
 - Each gate is to include a shoot bolt suitable for padlock made from 12 mm diameter round steel grade 300 MPa to AS3679.1 and fitted into a hand hold. The bolt is to be coated with black powder coating complying with AS3972.
 - The Principal will supply the padlocks for all gates.
-

6.8 Isolated Fencing

- Fencing within 5 m of the Endeavour Energy padmount substation is to be installed to prohibit metal structures being erected within this area. A fencing detail has been provided in the Drawings with all metallic elements to be installed 50 mm clear of the ground surface at a minimum.
- Posts are to be timber with a minimum strength class of SD6, in compliance with AS2878
- Timber species to be of timber that are listed in Appendix A of AS 5604. Hardwood must have a natural durability class of heartwood for in-ground contact (D_{ig}) of 1, 2 or 3. Softwood of any durability class is acceptable. Season all timber used.
- Where the species of timber has a D_{ig} of 1 or 2 and less than 20% of the cross-sectional area comprises sapwood, no preservative treatment is required. If 20% or more of the cross-sectional area is sapwood, carry out preservative treatment to the timber in accordance with AS 1604.1 to hazard class H4 except that, for timber rails, palings and other above ground items, carry out the treatment to hazard class H3. Where the species of timber has a D_{ig} of 3 for hardwood or D_{ig} of 3 or 4 for softwood, carry out preservative treatment to the timber in accordance with AS 1604.1 to hazard class H4 except that, for timber rails, palings and other above ground items, carry out the treatment to hazard class H3. The preservative used must not contain any chromium or arsenic. After treatment, do not resaw, dress, plane or otherwise alter the original dimensions of the timber.

- Timber, round nominal minimum diameter of 150 mm, or rectangular 150 mm by 100 mm minimum.
- Fence to consist of a top and bottom rail between timber posts and for the panel when transitioning back to typical security fence.
- Warning signage is to be fixed into the timber posts with screws as per the Drawings.

6.9 Summary of Hold/witness points

All hold and witness points for fencing and gates are outlined in Table 6.1.

Table 6.1 Hold/Witness Points

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Construction commencement	6.2	HOLD	Certificate of Compliance for materials and components, submitted at least 28 days before commencement.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Construction commencement	6.2	HOLD	Connection arrangement of new fencing to existing fencing, submitted at least 28 days before commencement.	The Superintendent will consider the documents prior to authorising the release of the Hold Point.
Construction commencement	6.2	HOLD	Detailed design drawings of fencing arrangement, submitted at least 28 days before commencement.	The Superintendent will consider the documents and may audit the Quality Records prior to authorising the release of the Hold Point.

7 Stormwater

7.1 Drainage Notes General

All construction materials and workmanship shall be in accordance with the relevant specification for the works, together with the requirements of all relevant codes of practice referred to therein and the requirements of the statutory authorities, where applicable.

All locations, orientation, and levels shall be verified on site before commencing any construction or fabrication work. Refer discrepancies to the Superintendent for clarification before proceeding with work. Do not obtain dimensions from scaling. Existing or natural surface levels shown on the Drawings are indicative only.

HOLD POINT

Submission of discrepancies between locations, orientation and levels between design and measurements on site.

The documented drainage system is detailed only for the permanent road configuration. Unless noted otherwise, construction requirements shall be the responsibility of the Contractor.

The control and management of existing stormwater flows through and around all work sites during construction shall be the responsibility of the Contractor.

Any required permits for dewatering, diversion works, or release of waters during construction shall be obtained by the Contractor.

All references to TfNSW specifications shall be taken as references to the current versions. Unless noted otherwise in the proceeding sections, the TfNSW specifications shall remain applicable in its entirety as published by TfNSW.

The Contractor shall procure frames, grates, lids and lintels for load class explicitly specified in the drawings.

For all drainage pipes and structures the Contractor shall obtain installation requirements from the corresponding manufacturer and submit copies to the Superintendent 28 days prior to works commencing. Installation shall be in accordance with the manufacturer's requirements.

7.2 TfNSW QA Specifications

The relevant TfNSW QA Specifications are listed below:

- R11 Stormwater Drainage

7.3 TfNSW R11 QA Specification

Unless explicitly specified as an amendment in the following section, the TfNSW specification shall remain applicable in its entirety as published by TfNSW.

7.3.1 Amendment – Annexure R11/A (Project Specific Requirements)

Annexure amended as below:

A.1 FASTENING DEVICE FOR GRATES

Clause	Details	Requirement
2.4.4	Grates to be provided with a fastening device which prevents opening without the use of a tool	Yes / No

7.3.2 Amendment – Annexure R11/L (*Minimum Frequency of Testing*)

No amendments to this annexure.

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
2.1	Precast concrete pipes:	AS 4058	As specified in Clause 2.1 and AS 4058
2.2	Fibre reinforced concrete pipes:	AS 4139	As specified in Clause 2.2 and AS 4139
3.1	Type BH Select Fill:		
	particle size distribution	TfNSW T201	- One per 50 m^3 or part thereof prior to placement
	plasticity	TfNSW T109	- One per 100 m^3 or part thereof prior to placement
3.1	Type SO Select Fill:		
	particle size distribution	TfNSW T201	- One per 100 m^3 or part thereof prior to placement
	plasticity	TfNSW T109	- One per 200 m^3 or part thereof prior to placement
4.9.2	Compaction: Surface of excavated open drains Foundations and trench bases Select Fill General fill Selected Material Zone	TfNSW T166	- In accordance with the requirements of Specification TfNSW Q

7.3.3 Amendment – Clause 4.1.1

The following modifications are required to Clause 4.1.1 Setting Out

- The removal of references to box culverts, open drains and catch drains.
 - (a) the locations, lengths and levels at outlets and inlets of pipes and box culvert structures;
 - (b) the locations and levels of gully pits, junction boxes, energy dissipators, and inlet and outlet structures;
 - (c) the locations and levels of the ends of wingwalls and headwalls; and
 - (d) the locations and levels of open drains.
- Unless shown otherwise on the Drawings, locate catch drains at a distance of not closer than 2.5 m from the top of the batter in cuttings, or the toe of batter in embankments.

7.3.4 Amendment – Clause 4.3.1

The following modifications are required to Clause 4.3.1 Excavation for Pipe Installation

- The removal of references to excavation under embankment conditions.

For pipes under embankments:

- (a) where “Embankment Condition” installation is specified, construct first the embankment to a height of at least 0.7 times the external diameter of the pipe above the top of the bed zone, and for a minimum lateral distance past the boundary of the trench of 2.5 times the external diameter of the pipe;
- (b) where “Trench Condition” installation is specified, construct first the embankment to the level of the underside of the Selected Material Zone;

7.3.5 Amendment – Clause 4.3.2

The following modifications are required to Clause 4.3.2 Excavation for Drainage Structures Other Than Pipes

- The removal of references to excavation for box culverts.

For drainage structures other than pipes, extend the excavation so that, for all points on the walls of the structure, the clear width between the structure wall and the face of the excavation is at least 300 mm.

~~When excavating for construction of box culverts and rock is encountered over part of the foundation, excavate the whole of the foundation area to a depth of 300 mm below the level of the bottom of the blinding layer and replace it with Type BH Select Fill, compacted to the requirements of Clause 4.9.2.~~

7.4 Durability Notes for Drainage Structures

The exposure classifications applicable to concrete elements are:

- Above-ground exterior environment = AS 5100.5 2017, classification B2.
- In contact with the ground = AS 5100.5 2017 or AS/NZS 4058:2007, classification B2.
- Elements below 1m below LAT (i.e. elements below -1.0m PKHD) are permanently submerged. Therefore, classification B2
- Elements between 1m below LAT and 1m above HAT (i.e. elements between +3.1m PKHD and -1.0m PKHD) that are subject to splash are in the tidal/splash zone. Therefore, classification C2
- Elements above HAT (HAT is at +2.1m PKHD) that exposed to airborne salt but not subject to splash are classification C1

For precast concrete pipes, the requirements of AS/NZS 4058:2007 shall apply. The sampling scheme and routine testing stipulated in appendices A and F of AS 4058:2007 is a mandatory requirement for all pipes manufactured. The acceptance criteria for the test covered by AS/NZS 4058:2007 appendix F is that the water absorption shall not exceed 6.0%.

7.5 Drainage Structures

- Structures have been designed for operational loads (100t MAFI trailers and reach stacker) acting on completed structures. The Contractor is responsible for the design and provision of any temporary bracing, propping, etc. required during construction. Structures shall be maintained in a stable condition and no part shall be overstressed.
- All structures located beyond the temporary concrete safety barrier shall be designed to accommodate Class D loading conditions.
- Pits and headwall shown on the drawings provide indication on footprint and size only. The concrete specifications shall be per the Construction Specifications unless noted otherwise. It is the pre-caster's responsibility to provide pits and headwall which meet the aforementioned specifications.
- All cast in-situ drainage structures (except pipes) shall be placed on minimum 50 mm thick concrete blinding slab.
- For location and level of pits and headwall refer to drainage longitudinal sections and schedules.
- All grates and frames are to be in accordance with AS3996 unless noted otherwise. Unless stated otherwise, Class D grates and frames to be fabricated from mild steel and hot dip galvanised. Orientation of covers to suit traffic direction if located within traffic lane or shoulder.
- Grate support to be constructed level to ensure that the grate does not rock after installation.

- All galvanising to be in accordance with AS/NZS 2312 and AS/NZS 4680. Galvanising to threaded fasteners to be in accordance with AS1214. Minimum galvanising 600 G/sqm other than on fasteners.
- All welds to comply with AS/NZS 1554. Fillet welds to be not less than 6 mm unless noted otherwise.
- Benching of pits is not required, unless noted otherwise.
- All cut steel reinforcement surfaces to be treated with Megapoxy PM (or equivalent) applied in accordance with manufacturer's instructions.
- All pits can be precast unless detailed otherwise.
- All concrete shall be in accordance with TfNSW QA Specification R53 unless noted otherwise. This includes a concrete grade of N25.
- Inadequate foundation material for drainage pits and Ocean Protect Water quality device shall be removed, and foundation must be in accordance with TfNSW QA Specifications R11 Clause 4.7.2.
- Inadequate foundation material for pipes shall be removed or improved in accordance with TfNSW QA Specifications R11.
- The foundations for the drainage lines that will be founded in in-situ material are to be inspected by the geotechnical representative. This will be administered through hold points on TfNSW QA Specification R11.

HOLD POINT

Foundations for drainage structures to be inspected and certified by a suitably qualified Geotechnical Engineer engaged by the Contractor. Geotechnical engineer to review and sign-off on the ITP provided by the Contractor and Contractor to submit certification to the Superintendent.

- For pits deeper than 600 mm, galvanised step irons are to be fitted.
- For details of access to pits greater than 1200 mm deep, refer to the TfNSW model on drawing DR-DRG-1318. These pits shall be fitted with galvanised step irons. Step irons to be fabricated and located in accordance with the TfNSW model on drawing DR-DRG-1318. Step irons to be mounted to face direction of traffic where possible.
- Side walls of pits deeper than 1500 mm are to be reinforced with one layer of RL1218 mesh returned 300 into the base.
- All exposed edges of pits are to be rounded with a 20 mm radius.
- A minimum reinforcement cover of 50 mm is to be applied, unless shown in the Drawings otherwise.
- The pit depth must not exceed 3500 mm.
- All steel bars are to be grade 400Y (according to AS4671-2001).
- While using a mesh, laps shall be made so that the two outermost wires of one fabric overlap the two outermost wires of the sheet being lapped. All laps are to be 300 mm long.
- TfNSW standard details and model drawings are to be adopted unless stated otherwise. Where TfNSW standard details are used, they must be used in conjunction with section 7.4. Note also concrete strengths specified on drainage drawings override concrete strengths specified on TfNSW model drawings.
- For all setout points quoted for drainage structures, refer to the TfNSW model drawings unless noted otherwise.
- Provision, installation and maintenance of DrainSafe units to be in accordance with manufacturer.

7.6 Water Quality Devices

- Provision, installation and maintenance of water quality devices (Ocean Protect or approved equivalent) to be in accordance with manufacturer.

7.6.1 *Ocean Protect – OceanGuard*

OceanGuard devices are to have Plan ID as L – see below.

PLAN ID	MAXIMUM PIT PLAN DIMENSIONS
S	450mm x 450mm
M	600mm x 600mm
L	900mm x 900mm
XL	1200mm x 1200mm

OceanGuard devices are to have Depth ID as 3 – see below.

DEPTH ID	BAG DEPTH	OVERALL DEPTH
1	170	270
2	300	450
3	600	700

- Modifications to the General Notes are per below.

GENERAL NOTES

1. THE MINIMUM CLEARANCE DEPENDS ON THE CONFIGURATION (SEE NOTE 2) ~~AND THE LOCAL COUNCIL REQUIREMENTS.~~
2. CLEARANCE FOR ANY PIT WITHOUT AN INLET PIPE (ONLY USED FOR SURFACE FLOW) CAN BE AS LOW AS 50mm. FOR OTHER PITS, THE RECOMMENDED CLEARANCE SHOULD BE GREATER OR EQUAL TO THE PIPE OBVERT SO AS NOT TO INHIBIT HYDRAULIC CAPACITY.
3. OCEAN PROTECT PROVIDES TWO FILTRATION BAG TYPES:- 200 MICRON BAGS FOR HIGHER WATER QUALITY FILTERING AND A COARSE BAG FOR TARGETING GROSS POLLUTANTS.
4. DRAWINGS NOT TO SCALE.

7.6.2 *Ocean Protect – OceanSave 1500-060*

OceanSave OS-1500-060 to have site specific requirements detailed below.

SITE SPECIFIC DATA REQUIREMENTS			
TOTAL FLOWRATE THROUGH INLET [L/S]			[89]
PIPE DATA:	I.L.	MATERIAL	DIAMETER
INLET PIPE	[2.91]	[RCP CLASS 4]	[375]
OUTLET PIPE	[2.91]	[RCP CLASS 4]	[375]

7.7 Existing Drainage Pits and Pipes

The existing stormwater drainage pit and pipe layout shown on the Drawings is indicative only. Where a new connection or extension is to be made to any existing pit or pipe, all locations, orientations and reduced levels at the proposed connection point shall be verified on site before commencing any work.

Details of existing stormwater drainage have been compiled based on a combination of new survey data obtained provided by the Principal.

Existing drainage system on local roads to be maintained and current connections to be reinstated where applicable.

7.8 Drainage Pipes

- All drainage pipes are to be precast reinforced concrete pipes to AS/NZS 4058 and rubber ring jointed spigot and socket type unless noted otherwise.
- Concrete pipe classes have been determined for operational traffic loading only (100t MAFI trailers and reach stacker).
- All new concrete drainage pipes proposed to be class 4 minimum.
- Pipe lengths provided in longitudinal drainage schedules are calculated from pit reference point to pit reference point.
- Contractor is responsible for determining minimum cover during construction, to suit construction methodology utilised and to ensure that pipe remains integral throughout construction.
- Concrete pipe installation to be Type HS3 support in accordance with the TfNSW model on drawing DR-DRG-1315 unless noted otherwise. Pipe classes assume Type HS3 support and a 0.3 x O.D. positive projection to AS/NZS 3725 and TfNSW Specification R11 unless noted otherwise.

HOLD POINT

Foundations for drainage pipes to be inspected and certified by a suitably qualified Geotechnical Engineer engaged by the Contractor. Geotechnical engineer to review and sign-off on the inspection record provided by the Contractor and Contractor to submit certification to the Superintendent.

- Connection between pipes and structures to be undertaken in accordance with TfNSW QA Specification R11 and TfNSW model drawings unless noted otherwise.

7.9 Standards and Codes

Unless specified otherwise, the standards, specifications, codes, test methods etc. applicable to drainage are:

TfNSW Specifications

TfNSW G2	General Requirements
TfNSW G38	Soil and Water Management
TfNSW Q	Quality Management System
TfNSW B80	Concrete Work for Bridges
TfNSW B115	Precast Concrete Members (Not Pretensioned)
TfNSW R15	Kerbs and Channels (Gutters)
TfNSW R16	Precast Reinforced Concrete Box Culverts
TfNSW R44	Earthworks
TfNSW R53	Concrete for General Works
TfNSW R55	Rock Filled Gabions and Mattresses
TfNSW R63	Geotextiles (Separation and Filtration)
TfNSW R83	Concrete Pavement Base
TfNSW R116	Heavy Duty Dense Graded Asphalt
TfNSW R119	Open Graded Asphalt
TfNSW R178	Vegetation
TfNSW 3051	Granular Pavement Base and Subbase Materials
TfNSW 3204	Preformed Joint Fillers for Concrete Road Pavements and Structures
TfNSW 3552	Subsurface Drainage Pipe (Corrugated Perforated and Non-perforated Plastic)
TfNSW 3553	Seamless Tubular Filter Fabric

TfNSW Test Methods

TfNSW T107	Fine Particle Size Distribution of Road Construction Materials
TfNSW T109	Plastic Limit and Plasticity Index of Road Construction Materials
TfNSW T119	Field Density of Road Construction Materials (Sand Replacement Method)
TfNSW T166	Relative Compaction of Road Construction Materials
TfNSW T173	Field Wet Density of Road Construction Materials (Nuclear Gauge in Direct Transmission Method)
TfNSW T201	Particle Distribution of Aggregates (by Washing)

Australian Standards

AS 1012.20	Methods of testing concrete
AS 1597.2	Precast reinforced concrete box culverts – Part 2: Large culverts (exceeding 1200 mm span or 1200 mm height and up to and including 4200 mm span and 4200 mm height)
AS 1646	Elastomeric seals for waterworks purposes
AS 1657	Fixed platforms, walkways, stairways and ladders - Design, construction and installation
AS 3600	Concrete structures
AS 3725	Design for installation of buried concrete pipes
AS 3735	Concrete structures retaining liquids
AS 3996	Access covers and grates
AS/NZS 4058	Precast concrete pipes (pressure and non-pressure)
AS 4139	Fibre-reinforced concrete pipes and fittings
AS/NZS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS 5100	Bridge design
AS/NZS ISO 9001	Quality management systems – Requirements

Other Documents

WSA 05 – 2008 Conduit Inspection Reporting Code of Australia

7.10 Summary of Hold/witness points

All hold and witness points for stormwater are outlined in Table 7.1.

Table 7.1 Hold/witness Point Schedule

PROCESS HELD	SECTION REFERENCE	HOLD POINT OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Supply of precast concrete members subject to traffic and/or earth pressure loading, and water retaining structures with capacity greater than 25,000 litres.	7.3	HOLD	At least 7 days prior to the date of delivery, submit the documents specified in TfNSW Specification R11 Clause 2.4.1 & TfNSW Specification Annexure R11/C Table C1	The Superintendent will consider the documents and may audit the Quality Records prior to authorising the release of the Hold Point.
Incorporation into the Works of any supplied manufactured drainage product.	7.3	HOLD	According to TfNSW Specification R11 Clause 2.6 & TfNSW Specification Annexure R11/C Table C1, provide a certificate of conformity, at least 7 days prior to incorporation into the Works.	The Superintendent may inspect the Quality Records prior to authorising the release of the Hold Point
Construction of each drainage system.	7.3	HOLD	According to TfNSW Specification R11 Clause 4.1.1 & TfNSW Specification Annexure R11/C Table C1, provide notification that set out of drainage system has been completed, and details of any design changes in locations and levels which are proposed by the Contractor.	The Superintendent will inspect the set out, including any proposed changes and, if necessary, amend the design to suit the actual site conditions prior to authorising the release of the Hold Point.
Replacement of inadequate foundation material	7.3	HOLD	According to TfNSW Specification R11 Clause 4.3.3 & TfNSW Specification Annexure R11/C Table C1, notification that inadequate foundation material has been excavated to the extent directed.	The Superintendent will inspect the excavation and may direct further excavation prior to authorising the release of the Hold Point.

PROCESS HELD	SECTION REFERENCE	HOLD POINT OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Construction of drainage structures (excluding pipes and box culverts)	7.3	WITNESS	According to TfNSW Specification R11 Clause 4.7.2 & TfNSW Specification Annexure R11/C Table C1, the Superintendent shall witness the construction of drainage structures other than pipes and box culverts.	Notify the Superintendent at least 7 days prior to the date of commencement of the work.
Moving heavy construction plant or vehicles over pipe or box culvert structures	7.3	HOLD	According to TfNSW Specification R11 Clause 4.10 & TfNSW Specification Annexure R11/C Table C1, submission of a certificate and verification of protective measures, at least 7 days prior to heavy construction plant vehicle movement	The Superintendent may examine the submitted documents, prior to authorising the release of the Hold Point.
Drainage laying	7.5 7.8	HOLD	Certificate and verification of foundation from a certified and suitably qualified Geotechnical Engineer engaged by the Contractor, submitted at least 7 days before placement.	The Geotechnical engineer will inspect and certify foundations for drainage pipes and structures, amendments may be required onsite to suit site conditions. The Geotechnical engineer will review and sign-off on the ITP provided by the Contractor. Contractor to submit certification to the Superintendent prior to the Superintendent authorising the release of the Hold Point.

Table 7.2 Schedule of Identified Records

Clause	Description of the Identified Record
2.4.1	Product drawings and methods for manufacture, testing and installation of precast drainage structures other than pipes and box culverts
2.6	Certificate of conformity, stating that the supplied manufactured product conform to the requirements of this Specification
5.2	Report on CCTV inspections of drainage structures

8 Potable Water Services

8.1 General Requirements

8.1.1 General

As part of this project the Contractor shall complete the services installation including potable and fire water services for the Port Kembla B104 extension, NSW.

The work programme shall be arranged in consultation with the Principal and the installation shall be completed according to the agreed programme. The Contractor shall programme the works to minimise interruption to supply to existing site facilities. Where the temporary shutdown of supply is unavoidable to execute the works, make prior arrangements with the Principal to access the origin of supply. Provide a minimum of two weeks of notice for all required shutdowns. The Contractor's planning shall include submission of documents to the Superintendent outlining where water supply will temporarily be lost (and for what duration) for approval.

HOLD POINT

Submission of documents outlining where water supply will temporarily be lost.

Existing services shown on drawings have been documented based on existing records. The accuracy of location and size etc shall be verified by the Contractor prior to commencement of works.

8.2 Project Requirements and Description of Works

8.2.1 Existing Services

Obtain full information regarding all existing services, including, but not limited to, water, gas, sewer, stormwater, electrical and telephone - wherever new piping is to be installed.

Pay any and all costs involved in making good any service damage while excavating, installing or backfilling for any service noted herein. Investigate for exact location, depth and size of all existing services prior to any installation being carried out.

Existing services shall be maintained and operational until new works are installed. Allow tracing services as necessary to determine if services shown or found are 'live' and performing connection to new services with the minimum of downtime. All disconnections and shutdowns shall be approved by the Superintendent prior to work being commenced.

HOLD POINT

Application for approval of disconnection and/or shutdown of existing services.

Where existing branch lines are located and are not shown on the drawings or 'As Constructed' drawing (available at request from the Superintendent) allow to trace and make connection to new services or cap off as appropriate.

8.2.2 Staging or Sequencing of Works

Allow to stage works as directed by the Superintendent and/or project manager. Allow for submission of plumbing approvals to match any separable portion handovers so as not to impede the certificate of classification process.

Existing services shall be maintained and kept operational until new works are installed. Allow for all temporary services to maintain continuity of services throughout the project as necessary.

HOLD POINT

Submission of pre-start/site establishment visual check and checklist.

Approved materials shall be checked on delivery.

HOLD POINT

Submission of visual check of approved materials, including quantity and condition, on delivery. Checklist completed.

8.2.3 Description and Extent of Work

The scope of work includes the supply, installation, testing, commissioning, maintenance, and defects liability service of materials, labour, and equipment for the complete hydraulic services installation as documented.

The Contractor will be responsible for coordinating the services trades and installers, managing the services commissioning programming, and ensuring the systems are operational.

The Contractor must provide all necessary plant, labour, materials, and supervision to complete the work in accordance with the Specifications, Drawings, and Contract requirements.

All minor and incidental work needed to fulfill the Specifications and Drawings is included in the scope of work. Unless explicitly excluded, all equipment for the installation must be supplied and installed, regardless of whether the words 'supply and install' are mentioned.

8.3 Design Methodology

8.3.1 General

A new potable water connection will be tapped off from a 375 mm Ductile Iron Cement Lined pipe along Tom Thumb Road.

HOLD POINT

Submission of inspection of existing water main, to AS3500 standards – checklist completed

A 250 mm HDPE connection will be made to the 375mm water main, and the new branch will be extended from the existing pipe.

HOLD POINT

Submission of inspection and dimensional check of deconstructed main (assembly by appropriately licensed plumber), to AS3500 standards – checklist completed by the Superintendent

The 250 mm HDPE pipe will be connected to this pipe and extended to service the new B104 Extension area, providing water for peak water and fire demand in the new extension area. The flow and pressure readings at the new connection point for the potable water supply are 28 l/s at 250 kPa.

HOLD POINT

Visual and dimensional check of system connection, including drilling.

The new water service being installed on Morton Way must maintain a 3.5 m clearance from the existing high voltage electrical pit and then reduced to 2.4 m at the booster plinth, as shown in the Drawings. The 250 mm HDPE pipe should be buried at a depth of 1.6 m along Morton Way up to the water meter assembly to allow for future inground utility reticulations.

The new water network will provide water supply to five existing ship water service valve outlets, one new ship water service valve, and one new hose tap within a power and water titan bollard and water supplies to six existing Fore Hose Reels each with a new dedicated backflow. The current water supply will need to be disconnected from the GrainCorp Leasehold network. This will involve disconnecting and capping the pipework. The disconnection is planned to take place at the potable and fire water valve platform on the B104 wharf, where the NSW Ports potable water network on B104 can be isolated.

The potable water branch on the B104 Access Bridge will remain in place to continue supplying potable water to the GrainCorp conveyor. Potable water will be distributed to the new wash down tap and multiple ships' water supply points.

The layout of the pipework and details of the pipe run through the deck are depicted in the Drawings. Coordination of potable water services with existing and new services has been finalised, with a combined services layout and section details provided for specific areas.

The Contractor shall inspect the existing water main at the proposed connection point and propose their work methodology for making the connection of the new service to the existing main, visual and dimensional checks to AS3500 Standards.

HOLD POINT

Submission of Contractor's work methodology for making the connection of the new service to the existing main, 28 days prior to commencement of this work.

8.3.2 Standards and Codes

The Codes and Standards applicable to only a portion of the work specified in this section are referenced in the relevant parts or clauses. The latest editions of the Codes and Standards used are listed below:

8.3.2.1 Australian Standards

- National Construction Code 2022 (Referred throughout this specification as NCC) including all relevant Australian Standards called in the NCC
- National Construction Code (NCC) Part 3 – Plumbing Code of Australia (PCA)
- AS/NZS 3500.1 2021 – Plumbing and Drainage Part 1 – Water Services

8.3.2.2 Other Standards / Guidelines

- Local Water Authority – Sydney Water
- Environmental Protection Authority – NSW
- Occupation / Workplace Health and Safety Legislation

The standards in this section are applicable throughout the project as a minimum. Where items of equipment are required the relevant Australian Standard to the equipment will apply. If clarification required, seek clarification at the time of tender. Where Australian Standards and Codes do not exist, the appropriate British Standard or Code shall apply.

8.4 Painting, Protection and Identification

8.4.1 General Requirements

- Select appropriate painting and finishes based on environmental conditions, ensuring all black steel surfaces and those prone to corrosion are primed with two coats of primer. Follow risk assessments and regulatory requirements, providing necessary labelling and signage.
Protect all work items during dispatch and installation, delivering fabricated pipe and steelwork prime-coated.
- Concealed pipe work should also be prime-coated and avoid mixing paints from different manufacturers. Repair damaged factory finishes with identical ones, finish visible joints before further treatment, and adhere to relevant Australian Standards for finishes such as galvanizing, electroplating, and powder coating.

8.4.2 Submissions

- Provide the following submissions or samples:

- Proposed Labelling Systems.
- Schedule of statutory, maintenance and operating signage.
- Valve Identification

HOLD POINT

Submission of details regarding painting, protection and identification.

8.4.3 Identification and Labelling

- All systems and equipment, piping, control panels, gauges, valves, and fittings, must be labelled for easy identification. Special maintenance procedures or hazardous equipment should have permanent labels that comply with regulations and are easily visible. Labels should match installation documentation schedules and follow AS 1318 guidelines for hazardous materials. Equipment and service labels should use appropriate symbols and include emergency and operating instructions. Labels should be permanent and can be engraved on metal, stencilled, or painted, with adhesive labels not suitable for outdoor use.
- Refer to the labelling requirements specified in the table below:

8.4.4 Labelling Requirements

ITEMS	REQUIREMENTS
Pipework (Hyd)	Labelling and lettering to AS 1345 and AS1318
Valves	Labels shall be colour coded laminated labels indicating service, function and normal position, and attached to hand wheels or spindles using a vandal resistant permanent chain/ring
All equipment such as chillers, pumps, gauges and fittings to that they are readily identifiable	<p>Label in accordance with the specification abbreviations, symbols and acronyms scheduled or otherwise approved.</p> <p>Locate labels so that they are easily seen from normal access adjacent to the item being marked. Do not install labels on components normally removed or replaced.</p> <p>Major equipment nameplates: 40 mm.</p> <p>Minor equipment nameplates: 20 mm.</p> <p>Danger, warning and caution notices: 10 mm for heading, 5 mm for test.</p> <p>Warning notices: 7 mm.</p> <p>Minor lettering: 3 mm.</p> <p>Lettering Style: Helvetica Medium.</p> <p>Fixing: Use mechanical fixings. Do not penetrate isolation vapour barriers.</p> <p>Equipment requiring special maintenance procedures or presenting occupational health and safety hazards: provide permanent labels complying with statutory requirements.</p> <p>Equipment requiring consumables including replacement belts, oils, filters and strainers: provide labels indicating consumable component details and quantities and corrective maintenance trigger point such as filter pressure drop.</p>

8.5 Testing, Commissioning and Maintenance

8.5.1 Tests

Include the following in testing of installation:

- Backflow prevention devices
- Water meters
- Tapware operating satisfactorily.
- Provide a water pressure test of 1500 kPa for a period of two hours. Disconnect any equipment connected to the service not rated to the test pressure before testing commences

8.5.1.1 Hydrostatic Tests:

- All cold-water piping shall be hydrostatically tested to a head of one and a half times the working head. Hydraulic (testing) pumps shall be disconnected immediately after pressurisation and all test heads shall be maintained until the Contractor has satisfied themselves as to the soundness of the pipe work and equipment.
- In no case, shall the period of test be less than 30 minutes.
- Before applying specified test head, all air shall be expelled from the piping being tested. If necessary, supply and install approved air relief valves for this purpose.
- Equipment is not to be connected to the respective services while hydrostatic tests are being carried out.
- Provide a suitable pump and gauge and do all necessary work for carrying out the tests.
- All testing of cold-water piping is to be carried out before finishing trades have commenced their work.
- At completion of testing, all cold-water lines shall be kept always charged full of water.

8.5.1.2 Fixtures:

- Fixtures shall be filled to spill level with water after installation and visually checked for leaks.

8.5.1.3 Test of Completion:

- Upon completion, the Hydraulic Works Package shall be tested under normal working conditions and as directed by the Contractor; such tests shall continue until the Contractor is satisfied that the terms of this specification have been compiled with and that the Hydraulic Works Package is capable of meeting all requirements.

HOLD POINT

Submission of pressure test when water is required prior to disinfection, including swabbing of main and pre-disinfection testing i.e. odour, clarity and turbidity test.

HOLD POINT

Submission of dual water flow test - Flow test of drinking water system. Lock and tag meter ball valve.

- All defects disclosed during the tests shall be remedied immediately and, if required by the Contractor fresh tests shall be carried out.
- The duration of the tests will be decided by the Contractor. The maximum duration of any one test will not exceed eight hours.

8.5.1.4 Essential Services:

- Upon completion of the works, provide Essential Services Certification to the requirements of the National Construction Code for the following:
 - Fire mains and pumps.
 - Fire hydrants.
 - Fire hose reels.
 - Fire extinguishers (where applicable).
- A certificate of compliance for each essential service installed under their contract as per requirements of the NCC is to be obtained and submitted upon completion of the works.

HOLD POINT

Submission of Essential Services Certification.

HOLD POINT

Submission of visual and dimensional check to DTS or Engineers certification.

8.5.2 *Pre-commissioning Tests*

Prior to commissioning the systems, it is essential to carry out several important steps. These include purging cold water regularly during construction to prevent stagnation, cleaning and flushing all water systems thoroughly, pressure and leak testing all pipework, valves, and fittings, providing manufacturers' test certificates for all proprietary items, overhauling backflow preventers, checking and recording backflow prevention devices, adjusting period controls and activating them, monitoring water meters, and checking the operation of all instruments and equipment under full working conditions. Maintaining detailed logs of settings and readings throughout the commissioning period is crucial for proper documentation and compliance.

HOLD POINT

Submission and manufacturers' test certificates.

8.5.3 *Commissioning*

The commissioning process involves testing the installation in four stages, starting with individual component functionality and progressing to system operation and inter-system interfaces. This includes performance testing (such as pressure tests and Denso Petrolatum (Wax) Tape or similar Spark Tests), calibration, and ensuring correct operation under various conditions (such as disinfection). The process also involves rectifying any defects or deficiencies until the installation meets the required performance standards and can provide the necessary service.

HOLD POINT

Submission of test reports for the above inspections regarding the commissioning.

8.6 Potable Cold-Water Systems

8.6.1 *General*

- Locate valves within accessible locations. Valves located in ground shall be provided with recycled plastic path box and non-trafficable lid set into concrete surround, with a pipe riser around the valve stem.
- Provide unions at wall or floor surfaces and at fixtures and appliances to allow removal and replacement without the need to adjust connections.

- To all changes of direction on rubber ring jointed pipelines below ground, install concrete thrust blocks to restrain the internal operating pressures of the pipeline under all conditions. Concrete mass shall be poured around and behind fittings and bear against virgin soil material. A minimum of 0.75 cubic metres of concrete shall be used at each position.
- Supply and install an approved BFPD (Backflow Prevention Device) in the domestic cold-water supply as required by the Water Authority and as specified in the “Materials” section. Maintenance instructions in as-built Manuals to be supplied at end of project establishing an authorised maintenance programme including registration and certification of all installed devices. Provide isolation valves upstream and downstream of valve and line strainer at inlet to BFPD. Flush piping before installing device and test device after installation and prior to operation in service
- Provide and install hose taps with anti-vandal heads. Each tap shall consist of a 20 mm diameter stainless steel riser with a back plated elbow and a 20mm diameter stainless steel finish hose tap. The tap shall be 450 mm above the floor unless otherwise directed.

8.6.2 Supply Authority Metering

A new authority water meter assembly to be installed as per documented.

8.6.3 Backflow Prevention

Provide approved BFPDs in the potable water supply and fire water as required by the Authority.

HOLD POINT

Submission of completed visual and dimensional checklist of backflow equipment and fittings.

Provide isolation valves upstream and downstream of valve and line strainer at inlet to BFPD.

- Flush piping before installing device and test device after installation and prior to operation in service

8.6.4 Flushing & Cleaning

- Immediately after the satisfactory completion of the sectional/first fix and the whole system/final fix hydraulic pressure tests the Contractor and its hydraulics subcontractor shall flush out, remove all foreign matter and clean all the systems.
- Water systems shall be flushed out with clean water. Whenever possible the flushing medium shall be fed into the system at high points and flushed out at low points on the system via suitably sized valve.
- The flushing and cleaning medium shall be fed into the system at the highest pressure that the system will safely withstand and be carried out for a sufficient period of time to ensure that all foreign matter is removed.
- The flushing shall be witnessed by the Contractor for the duration of the flushing of each service and shall be recorded by the Contractor and its hydraulics subcontractor and verified completed by the Contractor. A copy of the completion of flushing is to be provided to Superintendent.

8.6.5 Piping, Valves and Fittings

8.6.5.1 General

- Supply piping in clean, full standard, straight lengths, free from any defects, mill scale, rust, burns, dents and kinks and protected against mechanical damage.
- Refer to the Piping Schedule for pipe systems, design pressures and temperatures and permitted pipe materials and joining methods.
- Refer to the Piping Systems test criteria and procedures schedule for pipe testing requirements.

8.6.5.2 Dimensions on Site

The Contractor will be responsible for taking all dimensions on site. The dimensions must be checked before work is commenced or prefabricated. All levels and dimensions of existing services must be confirmed before commencing work. The invert levels shown on the Drawings are recommended only and must be checked by the Contractor on site before excavation or installation of pipe work to ensure connection to supply sources and fall to pipe work etc. is correct.

HOLD POINT

Submission of visual and dimensional check of water services to AS3500 standards.

8.6.5.3 Fixture and Fixture Points

Install and supply all materials, backing plate and noggins necessary to make all fixtures and fixture outlet points rigid (i.e. sanitary fixtures and tap fittings etc.). All fixtures shall be connected via a service pipe and union type fitting. Nut and olive connection is not acceptable. Direct connection of pipe work to the fixture will not be accepted.

HOLD POINT

Submission of visual and dimensional check of fixtures to AS3500 standards prior to installation.

8.6.5.4 Setting Out

Set out and identify all trenches, pits, pipelines and plant equipment positions.

Gain approval from the Principal for the proposed location of the works prior to commencement of any excavation.

Larger scale drawings are to be used in preference to small scale where no dimensions are shown.

— Trenches:

- Interpret all levels and grades to determine correct falls to street connections. Plumbing Subcontractor to advise if grades cannot be met so that the Contractor can determine revised locations or grades for the works.
- The set out of piping, pits and covers shall be arranged in conjunction with other trades so as to be readily accessible for operating, servicing, maintaining and repairing of it.
- Under no circumstance shall the Authorities and/or the Contractor conceal any drainage pipes etc. before inspection and approval by the Superintendent.
- Piping, pits, etc. which are installed in unsuitable locations shall be removed and relocated as directed by the Superintendent. All expenses caused by this action shall be made good without extra charge.

HOLD POINT

Submission of visual and dimensional check of trenches to AS3500 standards.

— Core Holes:

- Arrange for approval from the Superintendent to drill any proposed core holes or openings and pay all cost involved where required on the new structure.
- Core holes within "in situ" slabs shall be formed using "Gatic" preformed units installed in accordance with the manufacturer's instructions.
- Do not cut any holes, openings, and chases or otherwise interfere with the work of other trades without the specific approval of the Principal. Any damage done to other trades shall be made good without extra charge.

— Accessibility:

- The set out of piping, valves and equipment shall be arranged in conjunction with other trades to be readily accessible for operating, servicing, maintaining and repairing of it.

- In no circumstances, shall the Authorities and/or the Contractor conceal any pipes, valves, etc. before inspection and approval.
- Piping, valves, etc. which are installed in unsuitable locations shall be removed and relocated as directed by the Superintendent. All expense caused by this action shall be made good without extra charge.
- If neither the specification nor plans contain any mention of minor parts, which in the opinion of the Contractor are reasonably and obviously necessary for the satisfactory completion of the Hydraulic Works Package, such parts are to be provided without extra charge.

8.6.5.5 General Piping Installation Requirements

The arrangement of all piping shall be generally as shown on the Drawings.

General piping installation requirements are as follows:

- All screwed joints shall be made with the best quality pipe joint compound, carefully placed on the threads of the pipe and not through the fittings.
 - After cutting, all piping, burrs and sharp edges shall be reamed out.
 - Care should be taken when erecting piping; any marked, dented or otherwise damaged piping shall be replaced in a satisfactory manner.
 - Piping shall be installed as direct as possible between connecting points and parallel to walls.
 - Connections between pipe, fittings, hangers and equipment of dissimilar metals shall be avoided where possible. Where dissimilar metals are used, the risk of galvanic corrosion that can occur when different metals contact each other in the presence of moisture shall be minimised. If these connections are unavoidable, use insulating materials like plastic gaskets to separate the metals, apply protective coatings to shield surfaces from moisture, and select metals that are close in the galvanic series to reduce corrosion risk. Consider using sacrificial anodes to protect more valuable metals, design for proper drainage to prevent water accumulation, conduct regular inspections for signs of corrosion, and monitor environmental conditions to potentially apply corrosion inhibitors.
- Piping shall be carefully installed to provide for proper alignment and expansion, guided and supported in such a manner so that piping will not sag, buckle or cause water hammer.
 - Provide unions or flanges at connections to each piece of equipment, etc. for easy dismantling and at such other points to facilitate installation.
 - All fittings and connections at pumps, tanks or other major equipment, 65 mm and over shall be assembled with flanged joints.
 - All unnecessary lengths of male threads located in exposed pipe work within exposed areas shall be trimmed to the minimum necessary lengths.
 - They shall allow for all necessary trimming and machining of threads to obtain the requirements of this clause.
 - Provide special (and approved) threaded sections where necessary.
 - Remove all unnecessary hemp or other jointing materials from joints.

HOLD POINT

Submission of visual and dimensional check of pipe laying/installation to AS3500 standards.

8.6.5.6 Support and Fixing of Pipework

- Pipes shall be adequately supported and secured as detailed in the Drawings
- Pipes shall not be fixed to, supported by, or welded to other pipes.

- Pipe work must be free to move without causing stresses in the pipe work or pipe joints. Where provision has been made for movement in mains, the branch lines shall be unrestrained and annealed for a minimum of 1500 mm from the main.
- Vertical pipes passing through floors shall be supported at maximum 2400 mm centres.
- Support horizontal potable water pipes at maximum 3000 mm centres. Where fire water pipes require horizontal support alone, without potable water, spacing of supports may be extended to 4000 mm centres.
- Support all pipes in accordance with the manufacturer's instructions and complying with the catalogue regarding spans and loads.

8.6.5.7 Capping Off

Throughout the installation of all piping, special care shall be continuously exercised to protect all openings to prevent the admission of dirt, stones or other foreign substances that would subsequently obstruct the system.

8.6.5.8 Below Ground - HDPE

A new potable water connection will be tapped off from a 375 mm Ductile Iron Cement Lined pipe along Tom Thumb Road.

A 250 mm HDPE connection will be made to the 375 mm water main with a valve pit at the connection point and will be extended along Morton Way to service the new B104 extension area, providing water for peak water and fire demand in the new extension area.

- The new water service being installed must maintain a 3.5 m clearance from the existing high voltage electrical pit.
- The 250 mm HDPE pipe should be buried at a depth of 1.6 m along up to the water meter assembly to allow for future inground utility reticulations. All pipes and fittings must carry an Australian Standards approval, and watermark approval numbers.
- All high-density polyethylene (HDPE) pipe work and fitting joints shall be butt-welded or fused, utilising approved butt fusion welding equipment under factory-controlled conditions. Pipework used for potable water applications shall be PE100, SDR11, PN12 at a minimum as per Clause 2.5.3 of AS 3500. Pressure rating shall be increased where required to suit the application or as nominated in the Drawings, such as the 250 SDR 41 pipe nominated for the new potable water connection.
- All site welds may be either butt or fusion, utilising approved butt fusion welding equipment or electro fusion sleeves installed strictly in accordance with the manufacturer's direction. No other jointing methods are to be used.
- All persons carrying out the jointing procedure shall complete the installation course and be accredited by the manufacturer prior to commencing works.
- Confirmation of accreditation numbers of all personnel intending to install the HDPE system shall be provided to the Superintendent prior to commencement of works.
- Lay piping in accordance with manufacturers' instructions.
- Lay piping to generally follow final ground surface contours but not to vary within:
 - a A tolerance of 20 mm in a vertical plane over a distance of 6 m.
 - b A tolerance of 50 mm in a horizontal straight alignment within a distance of 12 m.
- Bed all pipework on a minimum of 75mm underlay in accordance with AS 3500.
- Use long radius bends unless space restriction precludes.
- Temporarily cap off pipework at the end of each day's work.

- Standardise jointing methods for all pipework.
- Install approved thrust blocks to all UPVC type ring jointed and ductile iron cement lined piping systems, and all HDPE pipe lengths which incorporate non electrofusion connections along its length, with due allowance for:
 - a Approval of shop drawings indicating location and size of all thrust/anchor blocks with calculations in regard to piping size, water pressure and soil bearing pressure.

Preparation of the works programme to include the required time period necessary before subjecting thrust/anchor blocks to water pressure loading. **HOLD POINT**

Submission of shop drawings indicating location and size of all thrust/anchor blocks with calculations in regard to piping size, water pressure and soil bearing pressure.

- Identify all buried pipework.
 - a Use 150 mm wide poly-vinyl chloride utility service warning tape placed 150 mm above the top of the service.
 - b Provide a continuous length metallic coil, colour coded to international standards with identification of the service, e.g. BLUE – Potable Water service.

8.6.5.9 Above Ground - Stainless Steel

Stainless steel pipework used for high pressure water services shall be Stainless Steel Grade 316L Schedule 10S, or approved equivalent. Fittings to be “Allmach” or approved equivalent. Jointing method to be stainless steel compatible press fit.

Pipes

- Stainless Steel Grade 316L Schedule 10S with 2B finish (cold-rolled, annealed and pickled)

Joints

- Use stainless steel of the same grade and wall thickness as the pipe.
- Weld Joints: full penetration welded. Comply with AS 4041–1998 Welding Requirements and AS/NZS 3992:1998. Provide details of qualified welding procedure to be carried out by qualified welding personnel with appropriate AS 1796–1993 certificate.
- Flanged Joints: to AS 2129–2000 and AS 2528–1982. Use flange jointing material similar to Bestobell J2100 preformed proprietary type at least 0.8 mm thick.
- Screwed joints: to AS 1722.1–1975. Screw threads to be sealed with degreased PTFE tape or an approved thread sealing compound, hemp and paste similar to ‘HAWKINS’.
- Schedule 10S Grade 316L press fit joints: Allmach supplied only. Press fittings are to be manufactured by an Allmach registered supplier. Design and install in accordance with Allmach Pressfit Piping System Stainless Steel Catalogue & Installation Manual.
- Allmach Schedule 10S press fit joints or rolled groove couplings for connections over 50 mm to all equipment to permit their removal without cutting pipework or breaking any structure.
- In stainless steel pipe systems use only stainless-steel nuts, bolts and washers of same grade as piping.
- Connections up to and including 50mm to be ground joint, steel socket welded unions to AS 1074–1989.

Bends

- Centreline radius not less than one and a half times the diameter of the pipe.
 - Victaulic Style 10 & 11 type.

- Branches from main pipelines to be welded swept tee type with a minimum centreline radius of not less than one and a half times the diameter of the pipe.

Reducers

- Use concentric reducers or Victaulic Style 50 type on all vertical lines.
- Use eccentric reducers or Victaulic Style 51 on all horizontal lines connections to items of equipment with the flat of the eccentric arranged on the top or bottom of the pipe to allow venting and drainage as required.

Valves

All valves used shall be in accordance with AS1628 and be “Reliance Manufacturing Company” (RMC) or approved equal.

All valves shall be of one type and of one manufacturer. All valves shall be placed in easily accessible positions for operation and repair. Valves in ducts shall be positioned at 600 mm from the finished floor level, unless noted otherwise on the Drawings.

Control valves to main branch lines and outlet positions shall be of the gate or ball valve pattern. Elsewhere the control valves shall be of the loose jumper pattern where required by code. All valves shall be tested to a pressure of 1700 kPa and marked by an approved Testing Authority.

Valves up to and including 50 mm shall be screwed. Valves above that size shall be flanged with Table E flanges. All valves shall be suitable for temperatures up to 90°C.

Spindles shall be nonrising type and must not project into the bore of the valve when the valve is in the fully open position. The bore must be clear and unobstructed when in this position.

8.6.5.10 Fire Hose Reel Connections (25 mm pipe)

Stainless steel pipework used for high pressure water services shall be Stainless Steel Grade 316L Schedule 40S, or approved equivalent. Fittings to be “Allmach” or approved equivalent. Jointing method to be stainless steel compatible press fit.

Pipes

- Stainless Steel Grade 316L Schedule 40S with 2B finish (cold-rolled, annealed and pickled)

Joints

- Use stainless steel of the same grade and wall thickness as the pipe.
- Weld Joints: Full penetration welded. Comply with AS 4041–1998 Welding Requirements and AS/NZS 3992:1998. Provide details of qualified welding procedure to be carried out by qualified welding personnel with appropriate AS 1796–1993 certificate.
- Flanged Joints: to AS 2129–2000 and AS 2528–1982. Use flange jointing material similar to Bestobell J2100 preformed proprietary type at least 0.8mm thick.
- Screwed joints: to AS 1722.1–1975. Screw threads to be sealed with degreased PTFE tape or an approved thread sealing compound, hemp and paste similar to ‘HAWKINS’.
- Schedule 40S Grade 316L press fit joints: Allmach supplied only. Press fittings are to be manufactured by an Allmach registered supplier. Design and install in accordance with Allmach Pressfit Piping System Stainless Steel Catalogue & Installation Manual.
- In stainless steel pipe systems use only stainless-steel nuts, bolts and washers of same grade as piping.
- Connections up to and including 50 mm to be ground joint, steel socket welded unions to AS 1074–1989.

Bends

- Centreline radius not less than one and a half times the diameter of the pipe.
 - Victaulic Style 10 & 11 type.
 - Branches from main pipelines to be welded swept tee type with a minimum centreline radius of not less than one and a half times the diameter of the pipe.

Reducers

- Use concentric reducers or Victaulic Style 50 type on all vertical lines.
 - Use eccentric reducers or Victaulic Style 51 on all horizontal lines connections to items of equipment with the flat of the eccentric arranged on the top or bottom of the pipe to allow venting and drainage as required.

Valves

All valves used shall be in accordance with AS1628 and be “Reliance Manufacturing Company” (RMC) or approved equal.

All valves shall be of one type and of one manufacturer. All valves shall be placed in easily accessible positions for operation and repair. Valves in ducts shall be positioned at 600 mm from the finished floor level, unless noted otherwise on the Drawings.

Control valves to main branch lines and outlet positions shall be of the gate or ball valve pattern. Elsewhere the control valves shall be of the loose jumper pattern where required by code. All valves shall be tested to a pressure of 1700 kPa and marked by an approved Testing Authority.

Valves up to and including 50 mm shall be screwed. Valves above that size shall be flanged with Table E flanges. All valves shall be suitable for temperatures up to 90°C.

Spindles shall be nonrising type and must not project into the bore of the valve when the valve is in the fully open position. The bore must be clear and unobstructed when in this position.

Pipes Below Water Level

To protect pipe surfaces below water level, wrap Denso Petrolatum (Wax) tape system or similar around all pipes and fixings. Wrapping shall be completed in dry conditions only and all wraps shall be spark tested to verify complete coverage of the pipe.

HOLD POINT

Submission of Denso Petrolatum (Wax) tape or similar spark testing results.

8.7 Excavation

8.7.1 General

- Excavate the ground in the form of trenches to enable the various pipelines to be constructed in the locations shown on the Drawings.
- Clear trenches of sharp projections and cut back roots to at least 600 mm clear of services and other obstructions including stumps and boulders, which interfere with services or bedding.
- Size trench excavation to:
 - Provide minimum clearance space of 75 mm between piping and trench face, and increase space as required to achieve compaction requirements. Allow correct bedding depth for piping.
 - Allow an overall depth to achieve the minimum backfill cover of 600 mm in areas of normal usage or 750 mm where passing under areas of vehicular traffic. Construct at greater depths where specified in the Drawings.

- Excavate at uniform grades and in straight lines.
- Provide tunnelling in lieu of trenches where required by the Principal.
- Complete all forms and pay all fees where necessary.
- Allow the supply, erection and withdrawal of all shoring in the cost of excavation.
- Withdraw all shoring and timbering in the correct manner as the work proceeds.
- Erect shoring and timbering of sufficient strength and quality where necessary for safe and efficient completion of work.
- Keep adequate dewatering equipment on site and maintain excavation free of water at all times.
- Carry out work in a careful, secure and tidy manner taking all precautions against damage whether arising from bad workmanship, breakage of machinery or plant, inefficient shoring, flooding or any other cause whatsoever.
- Provide, erect and maintain warning signs, temporary fences, barriers and night-lights adjacent to any work such as trenches and excavation or stack of materials which could be a danger to persons or traffic of any kind.
- Remove unwanted materials, fill in and make good with approved filling any extended excavation areas which exceed documented requirements as a consequence of injudicious working, slips, falls, blasting or any other cause.
- Obey all directions given, with regard to the provisions of lighting and barriers.
- Obtain permission from the Principal prior to any excavation and before placement of barricades.
- No permitted use of explosives.
- Allow all in-ground pipework to be inspected prior to backfilling with provision of a minimum of 48 hours' notice prior to any inspection required.

WITNESS POINT

Inspection of in-ground pipework.

HOLD POINT

Submission of main pipe survey prior to backfilling.

- Remove all surplus materials, broken concrete and rubble.

8.7.2 Backfilling of Trenches

- Obtain inspection and approval of pipework installation prior to backfilling. Prior to backfilling provide underground marking tape: To AS/NZS 2648.1
- Backfill trench bed, side, and haunch zones with select fill in accordance with AS 3725:2007 Section 9.2. Overlay zone to be backfilled with ordinary fill in accordance with AS 3725:2007 Clause 4.4:
 - Pipe overlay to be 75 mm minimum in accordance with AS 3500.
- Ensure all conditions, such as moisture content within the soil and correct grade or quality of soil for backfilling, are correct prior to compaction.
- Select backfill materials for trench widths greater than 450 mm to comply with: No stones greater than 25 mm occurring within 150 mm of the service, well graded, inorganic, particle size distribution for bed, haunch and side zones to comply with AS 3725 Tables 6 and 7. Under roadway, paved areas – coarse sand, controlled low strength material or fine crushed rock with grading limits in accordance with Table 5 of AS 3725. In reactive clay – in sites classified M, H or E to AS 2870.1, use an impervious material if trenches fall toward footings. In topsoil areas – complete with at least 50 mm topsoil.

- Select backfill materials for trench widths less than 450 mm to comply with: Under roadways and paved areas – stabilised sand using a 7% by weight cement/sand mix, poured into the service trench to match the level of the road sub grade. Not under roadways and paved areas – sand or coarse sands in accordance with AS 3725 in 150 mm maximum layers throughout depth of trench and to match the level of the surface sub grade prior final surface finish.
- Water, vibratory compact and test to the correct compaction pressure rating in accordance with test method to AS 1289.5.1.1. This is applicable for trenches located in areas for normal usage - as directed.
- Reinstate surface areas to match existing surrounding area and comply with:
 - Lawn areas – 50 mm of loam and re-sow the lawn over the trench and other disturbed areas.
 - Concrete surfaces – reinstate concrete surfaces to the original level and where necessary, provide steel reinforcement keyed to the adjacent concrete, laid to prevent the reinstated concrete from subsiding and cracking.

HOLD POINT

Submission of restoration and post connection visual inspection against photographs.

8.7.3 Use of Concrete

Provide 20 MPa concrete not less than 100 mm thick with exposed surfaces cement rendered as follows:

- Around pipes and fittings wherever required by appropriate authority. Around pipes and fittings pass under footing beams to the invert of the footing beam.
- Under and around bases of inclined junction and bends.
- Under roadways and footpaths / stabilised sand 10 MPa only.
- Where regulation cover cannot be provided over drains, surround pipes with 150 mm of 20 MPa concrete.
- Provide 150mm thick pads under all vertical bends and on the outside of all changes in direction.

8.7.4 Warning Tapes

- All buried water and fire services shall be identified with a 150 mm wide polyvinyl chloride utility service warning tape placed 150 mm above the top of the service.
- The PVC strip shall be a continuous length coil and colour coded to international standards, in addition to naming the service. e.g. BLUE - water supply.
- The warning tape shall be equal in all respects to VINICOVER as distributed by VINIDEX TUBEMAKERS PTY. LTD.

8.8 Materials, Equipment and Components

Materials, equipment, and components must be new, of high quality, and suitable for their intended purpose, with a reasonable service life. Avoid providing outdated or soon-to-be-discontinued products without approval. While identification of proprietary items does not imply exclusive preference, it signifies a deemed-to-comply item.

Manufacturers should offer equipment from established sources with comprehensive rating and test data. Consistency in using the same manufacturer or source for all materials is crucial, ensuring uniform type, size, quality, and appearance. Safety measures such as protective devices, safety guards, electrical grounding, and lifting eyes for heavy equipment are essential. Follow manufacturer's instructions for transport, storage, handling, and use of items, and provide permanent labels with manufacturer details. Notify of any deviations from manufacturer's recommendations and comply with

product certification schemes. Identification of a proprietary item does not necessarily imply exclusive preference for the item identified but indicates a deemed to comply item.

8.9 Summary of Hold/witness Points

All Hold/Witness and Surveillance points during construction of potable water line are outlined in Table 8.1.

Table 8.1 – Hold/Witness Point Schedule

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD POINT
Pre-start/Site establish	8.2.2	HOLD	Pre-start/Site establishment visual check & checklist completed, at least 2 weeks prior to site establishment	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Construction following delivery	8.2.2	HOLD	Visual check of approved materials, including quantity and condition, on delivery. Checklist completed and submitted at least 24 hours' following delivery	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Water supply shutdown	8.1.1, 8.2.1	HOLD	Submission of documents outlining where water supply will temporarily be lost, at least 2 weeks prior to water supply shutdown.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Installation of connection of new service and cut-in	8.3.1	HOLD	Plans for installation of connection of new service and cut-in, at least 28 days prior to commencement	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Installation of connection of new service and cut-in	8.3.1	HOLD	Visual inspection of main to AS3500 Standards. Checklist completed, at least 2 weeks prior to installation	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD POINT
Excavation and pipe laying	8.4.2	HOLD	Submission of details regarding painting, protection and identification, at least 1 week prior to pipe laying	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Pipe laying	8.3.1	HOLD	Visual and dimensional check of removal and deconstruction of existing water connection and water meter assembly by appropriately licensed plumber to AS3500 Standards, at least 24 hours' following tap-in	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Pipe laying and covering	8.6.5.4, 8.6.5.5	HOLD	Visual and dimensional check of excavation and pipe laying to AS3500 Standards. Checklist completed.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Backfilling	8.7.1	HOLD	Survey of pipe location, at least 48 hours' prior to backfill	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Installation of water meter assembly including RPZD, installation by an appropriate licensed plumber	8.6.3	HOLD	Visual and dimensional check of backflow equipment and fittings, at least 1 week prior to installation	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Installation of surface fittings	8.6.5.3	HOLD	Visual and dimension check of fixtures to AS3500 Standards. Checklist completed	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD POINT
Commissioning	8.3.1	HOLD	Visual and dimensional check of connection to system to AS3500 Standards, at least 24 hours' following connection	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Commissioning	8.3.1	HOLD	Visual and dimensional check of potable water drilling connections to AS3500 Standards. Checklist completed and submitted at least 24 hours' following connection	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Commissioning	8.6.5.2	HOLD	Visual and dimensional check of installation of water services to AS3500 Standards. Checklist completed and submitted at least 24 hours' following installation.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Commissioning	8.5.1.3	HOLD	Flow test of drinking water system. Lock and tag meter ball valve, within 2 weeks of test completion	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Commissioning	8.5.1.4	HOLD	Visual and dimensional check to DTS or Engineers certification	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Works approval	8.5.1.4	HOLD	Submission of Essential Services Certification.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD POINT
Acceptance	8.5.1.3	HOLD	Submission of pressure test when water is required prior to disinfection, including swabbing of main and pre-disinfection testing i.e. odour, clarity and turbidity test., at least 2 weeks before acceptance	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Acceptance	8.5.3	HOLD	Pressure test, Compaction test to AS3500 Standards, at least 2 weeks prior to acceptance	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Acceptance	8.5.3	HOLD	Disinfection testing to AS3500 Standards, at least 2 weeks prior to acceptance	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Acceptance	8.5.3	HOLD	Denso Petrolatum (Wax) Tape or similar Spark Test in accordance with AS3894.1, within 2 weeks of test completion	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Acceptance	8.6.5	HOLD	Submission of shop drawings indicating location and size of all thrust/anchor blocks	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point
Acceptance	8.7.2	HOLD	Visual inspection against photographs of restoration and post connection. Allow 2 weeks for clearance letter from Superintendent.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point

9 Fire Protection Services

9.1 General Requirements

9.1.1 General

The Contractor shall complete the fire protection services installation including fire hydrant, fire hose reels and pipework for the Port Kembla B104 extension, NSW.

The work programme shall be arranged in consultation with the Superintendent and the installation shall be completed according to the agreed programme. The Contractor shall programme the works to minimise interruption to supply to existing site facilities. Where the temporary shutdown of supply is unavoidable to execute the works, make prior arrangements with the Superintendent to access the origin of supply.

The Contractor shall provide a minimum of two (2) weeks' notice for all required shutdowns. The Contractor's planning shall include submission of documents to the Superintendent for approval outlining where water supply will temporarily be lost (and for what duration).

Existing services shown on Drawings have been documented based on existing records. The accuracy of location and size etc shall be verified by the Contractor prior to commencement of works and the Contractor shall provide as-built mark ups of the contract drawings showing any changes to the existing services locations.

HOLD POINT

Submission of water shutdown plan, two weeks prior to any shutdown.

9.2 Project Requirements and Description of Works

The Contractor shall be responsible for the following:

9.2.1 Existing Services

Obtain full information regarding all existing services, including, but not limited to, water, gas, sewer, stormwater, electrical and telephone - wherever new piping is to be installed.

Pay any costs involved in making good any service damage while excavating, installing or backfilling for any service noted herein. Investigate for exact location, depth and size of all existing services prior to any installation being carried out.

Existing services shall be maintained and operational until new works are installed. All disconnections and shutdowns shall be approved prior to work being commenced.

HOLD POINT

Application for approval of disconnection and/or shutdown of existing services.

Where existing branch lines are located and are not shown on the Drawings or 'As Constructed' drawing (available at request from the Contractor) allow to trace and make connection to new services or cap off as appropriate.

9.2.2 Staging or Sequencing of Works

Allow staging and sequencing of works as described in the Project Specification, Drawings or as directed by the Superintendent.

Existing services shall be maintained and kept operational until new works are installed. Allow for all temporary services to maintain continuity of services throughout the project as necessary.

9.2.3 Description and Extent of Work

The scope of work includes the supply, installation, testing, commissioning, maintenance, and defects liability service of materials, labour, and equipment for the complete fire protection services installation as documented.

The Contractor will be responsible for coordinating all the services trades and installers, managing the services commissioning programming, and ensuring the systems are operational.

The Contractor must provide all necessary plant, labour, materials, and supervision to complete the work in accordance with the Specifications, Drawings, and Contract requirements.

All minor and incidental work needed to fulfill the Specifications and Drawings is included in the scope of work. Unless explicitly excluded, all equipment for the installation must be supplied and installed, regardless of whether the words 'supply and install' are mentioned.

The work shall include, but will not be restricted to, the following principal items:

- Demolition of existing fire hydrants and mains pipework on B104
- Existing fire hose reels to be retained and connected to new potable water mains pipework
- Disconnection and capping of existing GrainCorp fire mains supply pipework to B104
- Installation of new Fire Hydrant
- Installation of new Fire Hydrant Booster
- Installation of new Fire Main to new and existing Wharf

9.3 Design Criteria Fire Services

Design criteria presented herein form the basis for the design of the works and for any alternative proposals submitted.

9.3.1 General

Table 9.1 General Design Criteria

ITEM	DESIGN CRITERIA
Portable Hose Reels	NCC and AS2441 as applicable
Fire Hydrant System	<p>NCC, AS2419.1-2021 as applicable</p> <p>Open Yard protection providing coverage to all areas of B104 by the use of 60m long hoses for external attack/feed fire hydrants.</p> <p>Yard area - $>3,000 \text{ m}^2 \leq 9,000 \text{ m}^2$</p> <p>2 off hydrants operating simultaneously at 10 L/s each @ 150 kPa (Feed hydrant performance)</p> <p>2 off hydrants operating at 10 L/s each @ 700 kPa (Attack hydrant performance boosted by fire brigade)</p>

9.4 Standards and Codes

Australian standards and codes current at the date of tendering are applicable in respect of all materials and workmanship. Specific codes forming part of this specification, but not limited to, include:

- NCC (BCA):2022 National Construction Code – Building Code of Australia,
- AS2419.1-2021 Fire Hydrant Installations
- AS 2441 Installation of fire hose reels
- AS/NZS 3500.1 2021 – Plumbing and Drainage Part 1 – Water Services

All work shall comply with the requirements of the appropriate supply authorities having jurisdiction, occupational health and safety regulations, local service and installation rules and council requirements.

Drawings must be read in conjunction with the total contract package including the Drawings and Specifications of all consultants.

The Contractor shall be responsible reviewing and confirming coordination with all other disciplines and structures prior to installation. Where conflicts arise, these are to be brought to the Superintendent's attention as soon as possible. Prior to any installation, the Contractor shall have arranged any inspections and obtained any approvals required to avoid delays in the programme. Any claims for additional costs or delays due to the lack of effective co-ordination by the various trades will be rejected.

HOLD POINT

Submission of coordination clash as soon as possible.

Should a part of the work be proposed to be done quicker, better or more effectively by substitution of materials or methods other than those specified, the details of such substitutions or alternatives shall be included in the tender, including a comprehensive report including any performance and life cycle analysis in support of the proposals.

It is the Contractor's responsibility to ensure that all equipment orders are made in a timely fashion to suit the project construction programme. The proposing of alternatives as a result of the Contractor's failure to do so will not be accepted as a means for alternative submissions.

Where the words 'equal or approved' are used in this technical specification, permission may be requested to use a substitute for what is specified, provided it and the relevant manufacturer of the item certify in writing that the substitute is of equal, or better quality and effectiveness to that specified. Submit for approval full details to allow verification that the alternative products comply with the Contract Documents. Provide a certificate for each alternate product confirming that the proposed alternative product complies with the Contract Documents. Include all compliance and non-compliance items related to project brief, Specifications and Contract Drawings.

HOLD POINT

Submission of details regarding substitutions, including certification that the product complies with the Contract Documents, 28 days before commencement.

State if use of proposed alternatives will necessitate alteration to other parts of the works and include consequential costs. Allow for additional work resulting from the utilisation of an approved alternative product, including additional or revised statutory approvals, changes to adjacent work, re-submission of shop drawings associated with the proposed alternative.

HOLD POINT

Submission of changes to additional or revised statutory approvals, adjacent work and/or re-submission of shop drawings, 28 days before commencement.

9.5 Painting, Protection and Identification

9.5.1 General Requirements

- Select appropriate painting and finishes based on environmental conditions, ensuring all black steel surfaces and those prone to corrosion are primed with two coats of primer. Follow risk assessments and regulatory requirements, providing necessary labelling and signage.
- Protect all work items during dispatch and installation, delivering fabricated pipe and steelwork prime-coated.
- Concealed pipe work should also be prime-coated and avoid mixing paints from different manufacturers. Repair damaged factory finishes with identical ones, finish visible joints before further treatment, and adhere to relevant Australian Standards for finishes such as galvanizing, electroplating, and powder coating.

9.5.2 Submissions

Provide the following submissions or samples:

- Proposed Labelling Systems.
- Schedule of statutory, maintenance and operating signage.
- Valve Identification
- Painting & protection of pipework

HOLD POINT

Submission of proposed labelling system, schedule of statutory, maintenance and operating signage, valve identification and details regarding painting & protection of pipework, 28 days before commencement.

9.5.3 Identification and Labelling

All systems and equipment, piping, control panels, gauges, valves, and fittings, must be labelled for easy identification. Special maintenance procedures or hazardous equipment should have permanent labels that comply with regulations and are easily visible. Labels should match installation documentation schedules and follow AS 1318 guidelines for hazardous materials. Equipment and service labels should use appropriate symbols and include emergency and operating instructions. Labels should be permanent and can be engraved on metal, stencilled, or painted, with adhesive labels not suitable for outdoor use.

WITNESS POINT

Inspection of labels.

9.6 Tests

Comply with Australian Standards for testing and commissioning comprising the following:

9.6.1 AS1851: Maintenance Of Fire Protection Systems Commissioning

Operate the installation to prove the performance, capacities and ability to provide the required service.

Undertake commissioning in 4 stages:

- 1 Individual component functionality testing including verification of defects free installation
- 2 Major items of plant and equipment and components.
- 3 Systems and sub-systems.

4 Inter-system operation and interfaces.

Commissioning to include:

- Performance of individual plant items and components.
- Operating sequences, interlocks and safeties.
- Final controls calibration.
- System operation under all operating modes and under all conditions of load.
- Inter-system operation and correct interfacing connections under all operating conditions and under simulated fire conditions.
- Noise and vibration tests.
- Environmental audit as required by Authorities.
- Rectification and correction of any defects and deficiencies.
- Continue commissioning until achievement of correct performance and operation.

HOLD POINT

Submission of test reports for the above inspections, no later than 28 days after testing.

9.6.2 AS3500: National Plumbing and Drainage Code

The Contractor shall conduct inspections of the existing fire water systems and propose their work methodology for all of the following works, with visual and dimensional checks to AS3500 Standards.

HOLD POINT

Submission of Contractor's work methodology for making the connection of the new service to the existing main, 28 days prior to commencement of this work.

HOLD POINT

Submission of visual checklist on mains line in accordance with AS3500, prior to connection.

HOLD POINT

Submission of visual checklist on demolished fire hydrants and mains pipework in accordance with AS3500.

HOLD POINT

Submission of visual checklist on retained fires hose reels and connection to new pipework in accordance with AS3500.

HOLD POINT

Submission of visual checklist on disconnection from existing fire mains supply pipework in accordance with AS3500.

HOLD POINT

Submission of visual and dimension checklist on surface fittings in accordance with AS3500.

HOLD POINT

Submission of pressure test to AS3500 Standards. Swabbing of main and pre-disinfection testing i.e. odour, clarity and turbidity test.

HOLD POINT

Submission of pressure tests and compaction tests to AS3500 Standards.

HOLD POINT

Submission of disinfection documentation to AS3500 Standards

9.7 Fire Hydrant Systems

9.7.1 *Hydrant Millcock*

- Provide connections compatible with equipment used by Fire Authority/NSW Ports.
- Spindle type to match existing on site.
- Include brass cap chained to valve body.
- Locate at correct height above finished ground/floor access level.
- Maintain clearances to hand-wheels and connections.

9.7.2 *Fire Authority Booster*

- Locate in appropriately sized cabinet.
- Incorporate nominated booster inlets and outlets appropriate to the installation.
- Include block plan and notice of working pressure appropriate to system design.
- Incorporate brass caps on booster inlets outlets, chained to valve body.

9.7.3 *Fire Booster Cabinet*

- Mount on concrete plinth base.
- Locate appropriately for visibility and access.
- Construct of sheet metal complete with rigid steel inner frame, stiffeners and supports mounted on legs butted to concrete plinth.
- Provide clean, neat, non-sharp sheet metal edges free from burrs and indentations.
- Include paved or hardstand area at entry to enclosure for Fire Authority use.
- Incorporate appropriate number of access doors with minimum of three (3) hinge supports.
- Secure doors with minimum of two (2) point locking arrangement with approved locking device complying with Fire Authority requirements.
- Paint in standard manufacturers baked enamel finish or powder coated to an approved nominated colour.
- Provide signage to required size in an approved colour contrasting to cabinet background colour.

9.7.4 *Piping and Fittings – Hydrant*

- Comply with piping manufacturing Codes:
 - a AS 1074 for steel piping, medium weight grade as a minimum. Light wall tubing not permitted.
 - b AS 1432 for copper piping, Grade ‘B’ as a minimum.
 - c AS/NZS 2280 for ductile iron piping.
 - d AS/NZS 1477 for UPVC pipes.

- e ASTM A312M for Stainless Steel pipes.
- f AS 5200.053 for Stainless Steel tubes.
- Comply with pipe fitting manufacturing Codes:
 - a BS1640 and BS 1740 BS EN 10241
 - b AS 3688.
 - c ASME B16.9
 - d ASME B16.28
 - e ASME B36.19M
 - f AS 5200.053.
- Comply with AS/NZS 4791/4792 for hot dipped galvanising.
- Comply with the Drawings showing the indicative sizes of piping and the manner in which the system is to be installed.
- Comply with the nominated system requirements:

Table 9.2 Nominated system requirements

PIPEWORK LOCATION	PIPING MATERIAL	FITTING TYPE	DESIGN WORKING PRESSURE KPA
Underground	PE100PN16	Electrofusion	Refer Design Criteria for specific Working Pressures
	Stainless Steel Grade 316L Schedule 10S with 2B finish (cold-rolled, annealed and pickled)	Flanges double wrapped with Denso Petrolatum (Wax) Tape or similar	
Above ground	Stainless Steel Grade 316L Schedule 10S with 2B finish (cold-rolled, annealed and pickled)	Groove type fit	

- Not utilise on site welding.
- Use long radius bends unless restricted by space. Mitre joints not permitted.
- Install correctly aligned and uniformly graded.
- Provide free from loose scale, burrs and swarf after fabrication.
- Suitably clean prior installation, with open ends temporarily sealed with proprietary covers of pressed steel or plastic.

9.7.5 Pipework Installation – Above Ground

- Independently support for fire system exclusive use.
- Do not use dissimilar metals.
- Use corrosion resistant supports for the environment where located.
- Eliminate vibration from structure to piping and vice versa.
- Standardise jointing methods for all pipework.

- Schedule 10S Grade 316L groove type fit joints: Victaulic supplied only. Groove type fittings are to be manufactured by a Victaulic registered supplier. Design and install in accordance with Vic-Press Schedule 10S System Products Field Installation Handbook.
- Provide support within 1000 mm either side of a rolled groove type fitting.
- Not use explosive type fixings.

9.7.6 Pipework Installation – In Ground

- Lay piping in accordance with manufacturers' instructions.
- Lay piping to generally follow final ground surface contours but not to vary within:
 - a A tolerance of 20 mm in a vertical plane over a distance of 6 m.
 - b A tolerance of 50 mm in a horizontal straight alignment within a distance of 12 m.
- Bed all pipework on a minimum of 150 mm of approved coarse river sand. Sand is to adhere to 100% Standard Maximum Dry Density in accordance with AS 1289.0, Test E3.1 or E3.3.
- Use long radius bends unless space restriction precludes. In cases where space is restricted, obtain permission from the Superintendent prior to use bends with a shorter radius.
- Temporarily cap off pipework at the end of each day's work.
- Standardise jointing methods for all pipework.
- Install approved thrust blocks to all UPVC type ring jointed and ductile iron cement lined piping systems, and all HDPE pipe lengths which incorporate non electrofusion connections along its length, with due allowance for:
 - a Approval of shop drawings indicating location and size of all thrust/anchor blocks with calculations in regard to piping size, water pressure and soil bearing pressure.
 - b Preparation of the works programme to include the required time period necessary before subjecting thrust/anchor blocks to water pressure loading.
- Identify all buried pipework.
 - a Use 150 mm wide poly-vinyl chloride utility service warning tape placed 150 mm above the top of the service.
 - b Provide a continuous length metallic coil, colour coded to international standards with identification of the service, e.g. RED – fire hydrant service.

9.7.7 PE Pipework and Fittings

- All pipes and fittings must carry an Australian Standards approval, and watermark approval numbers.
- All high-density polyethylene (HDPE) pipe work and fitting joints shall be butt-welded or fused, utilising approved butt fusion welding equipment under factory-controlled conditions.
- All site welds may be either butt or fusion, utilising approved butt fusion welding equipment or electro fusion sleeves installed strictly in accordance with the manufacturer's direction by competent personnel. No other jointing methods are to be used.
- Pipework used for pressure applications shall be PE100, SDR11, PN16 at a minimum. Pressure rating shall be increased where required to suit the application or as nominated within the Drawings.
- All persons carrying out the jointing procedure shall complete the installation course and be accredited by the manufacturer prior to commencing works.

- Confirmation of accreditation numbers of all personnel intending to install the HDPE system shall be provided to the Superintendent prior to commencement of works.

HOLD POINT

Submission of accreditation numbers of all personnel intending to install the HDPE system.

9.7.8 *Excavation of Trenches*

- Excavate the ground in the form of trenches to enable the various pipelines to be constructed in the locations shown on the Drawings.
- Clear trenches of sharp projections and cut back roots to at least 600 mm clear of services and other obstructions including stumps and boulders, which interfere with services or bedding.
- Size trench excavation to provide the minimum requirements in accordance with the relevant Australian Standards for the service in question including:
 - a Minimum clear space between piping and trench face.
 - b Allow correct bedding.
- Allow an overall depth to achieve the minimum cover requirements including but not limited to:
 - a Service in question.
 - b Surface treatment.
 - c Subject to pedestrian or vehicular traffic.
 - d Subject to construction traffic
- Excavate at uniform grades and in straight lines.
- Provide tunnelling in lieu of trenches where required by any Authority or where directed by the Superintendent.
- Bench (or provide shoring) for all excavation deeper than 1.5 m in depth, or where ground stability could compromise the trench excavation profile.
- Allow the supply, erection and withdrawal of all shoring in the cost of excavation.
- Withdraw all shoring and timbering in the correct manner as the work proceeds.
- Erect shoring and timbering of sufficient strength and quality where necessary for safe and efficient completion of work.
- Keep adequate dewatering equipment on site and maintain excavation free of water at all times.
- Carry out work in a careful, secure and tidy manner taking all precautions against damage whether arising from bad workmanship, breakage of machinery or plant, inefficient shoring, flooding or any other cause whatsoever.
- Provide, erect and maintain warning signs, temporary fences, barriers and night-lights adjacent to any work such as trenches and excavation or stack of materials which could be a danger to persons or traffic of any kind.
- Remove unwanted materials, fill in and make good with approved filling any extended excavation areas which exceed documented requirements as a consequence of injudicious working, slips, falls, blasting or any other cause.
- Obey all directions given, with regard to the provisions of lighting and barriers.
- Where relevant, obtain permission from the Superintendent prior to any excavation and before placement of barricades.
- Not permit use of explosives.

- Allow all in-ground pipework to be inspected prior to backfilling with provision of a minimum of 48 hours' notice prior to any inspection required.
- Remove all surplus materials, broken concrete and rubble.

WITNESS POINT

Inspection of in-ground pipework.

9.7.9 Bedding, Pipe Side Support and Overlay

- For the purposes of this section, “bedding” includes:
 - Bedding**; layer below the underside of the pipe (collar) and trench base.
 - Side support**; layer between the underside and top of pipe (or collar).
 - Overlay**; layer above the top (collar) of pipe to underside of backfill zone.
- Materials to be in accordance with the AS/NZS 3500 (part relevant to service), and other relevant Australian Standards and Local Authority requirements. Materials shall be of same type for bedding, side support, and overlay zones.
- Minimum depths/widths to be in accordance with the AS/NZS 3500 (part relevant to service), and other relevant Australian Standards and Local Authority requirements.
- Where backfill material may infiltrate the bedding material (such as sand backfill above gravel bedding), allow all costs to install geofabric textile placed on top of the “overlay” material prior to backfilling.

9.7.10 Backfilling of Trenches

- For the purposes of this section, “backfilling” is defined as the material reinstated above the “bedding” (overlay layer).
- Notify the superintendent of the intent to complete backfilling

HOLD POINT

At least 24 hours' notice given to the Superintendent for the intent to conduct backfilling.

- Obtain inspection and approval of pipework installation prior to backfilling by the Superintendent. Prior to backfilling provide underground marking tape: To AS/NZS 2648.1

WITNESS POINT

Inspection of pipework installation prior to backfilling.

- Backfill materials and reinstatement/compaction methods shall at minimum be in accordance with AS/NZS 3500 (part relevant to service).
- At minimum, backfill materials shall be compacted to restore the trench to the normal surrounding ground surface level and reduce the likelihood of subsidence.
- At minimum, backfill material shall be free from rock, hard matter, and organic material, and broken up so that it does not contain soil lumps larger than 75mm.
- In reactive clay – in sites classified M, H or E to AS 2870.1, use an impervious material if trenches fall toward footings.

9.7.11 Piping Valves, Strainers and Gauges

- Isolating Valves – Above Ground:
 - Outside screw and yoke (OS&Y) type where required by Code.

- b Incorporate indicator (where not OS&Y type) to identify open or closed status on sizes 100 mm and greater.
 - c Incorporate visible coloured open or closed position flag indicator for butterfly type.
 - d Monitor where identified on Drawings.
- Non Return (Check) Valves:
- a Hinged rubber faced clapper.
 - b Allow installation in horizontal or vertical position.
 - c Protect with petrolatum tape wrapping or with approved manufacturers coating where installed in ground.
- Strainers:
- a Y type.
 - b Screwed bronze body on all lines up to and including 50mm and flanged cast iron body above 50 mm.
 - c Easily remove cable perforated stainless steel or brass strainer basket.
 - d Select mesh for 15 kPa maximum pressure drop.
 - e Fit ball valve and drain line to waste for strainer over 50mm.
 - f Fit isolation valve and drain line to waste for strainer over 50mm.
 - g SPIRAX or approved equal.
- Pressure Gauges:
- a Install to monitor pressure at pump inlet, pump outlet, town's main inlet, fire authority booster and elsewhere as nominated.
 - b Face diameter of 100 mm minimum.
 - c Display pressure in 'kPa' at 50 kPa intervals.
 - d Fit with a valve cock to piping inlet.
 - e Identify with permanent label displaying gauge function.

9.7.12 Signage

- Signage is to be provided in accordance with the Principal's user requirements, which are as follows:
 - Signage noting hydrants and freshwater on the wharf.
 - Signage noting the asset numbers for light poles, hydrants, etc.
 - Signage noting the direction of buried pipework.

9.8 Acceptance

Not later than 28 days after System installation, the Contractor shall provide to the Superintendent a complete and detailed submission which includes all quality records, photographs and proof of satisfactory System installation including final sign off and acceptance by the Contractor and System guarantees in accordance with the ITP.

HOLD POINT

Submission of System installation documentation including System guarantee, no later than 28 days after System installation.

9.9 Summary of Hold/witness Points

All hold and witness points during construction of fire protection services are outlined in Table 9.3, and all required tests are outlined in 9.6.

Table 9.3 Hold/witness Point Schedule

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD / WITNESS POINT
Water shutdown	9.1.1, 9.2.1	HOLD	Submission of water shutdown plan, with at least 2 weeks notice prior to any shutdown	Acceptance by Superintendent prior to authorising the release of the hold point
Continuation of works	9.4	HOLD	Submission of coordination clash as soon as possible.	Acceptance by Superintendent prior to authorising the release of the hold point
Materials procurement	9.4	HOLD	Submission of substitutions and/or changes to approvals, at least 28 days before commencement	Acceptance by Superintendent prior to authorising the release of the hold point
Materials procurement	9.5.2	HOLD	Submission of proposed labelling system, schedule of statutory, maintenance and operating signage, valve identification and details regarding painting & protection of pipework, 28 days before commencement	Acceptance by Superintendent prior to authorising the release of the hold point
Excavation and pipe laying	9.7.8, 9.7.9, 9.7.10	WITNESS	Visual and dimensional check to AS3500 Standards. Checklist completed.	The Superintendent will inspect the trenches and in-ground pipework, prior to authorising the release of the Witness Point.
Installation of HDPE system	9.7.7	HOLD	Submission of accreditation numbers of all personnel intending to install the HDPE system, at least 2 weeks before installation	Acceptance by Superintendent prior to authorising the release of the hold point

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD / WITNESS POINT
Backfilling	9.7.10	HOLD	Adequate notice prior to backfilling, at least 24 hours	Acceptance by Superintendent prior to authorising the release of the hold point
Installation of labels	9.5.3	WITNESS	Superintendent to inspect labels prior to installation.	The Superintendent will inspect the labels, prior to authorising the release of the Witness Point.
Before water is required prior to disinfection	9.6.2	HOLD	Pressure test to AS3500 Standards. Swabbing of main and pre-disinfection testing i.e. odour, clarity and turbidity test. Checklist completed and submitted at least 2 weeks prior to commissioning	Acceptance by Superintendent prior to authorising the release of the hold point
Commissioning	9.6.1	HOLD	Submission of test reports no later than 28 days after testing	Acceptance by Superintendent prior to authorising the release of the hold point
Commissioning	9.6.2	HOLD	Visual and dimension check of surface fittings to AS3500 Standards. Checklist completed and submitted at least 2 weeks prior to commissioning	Acceptance by Superintendent prior to authorising the release of the hold point
Commissioning	9.6.2	HOLD	Pressure test, Compaction test to AS3500 Standards. Checklist completed and submitted at least 2 weeks prior to commissioning	Acceptance by Superintendent prior to authorising the release of the hold point
Commissioning	9.6.2	HOLD	Disinfection to AS3500 Standards. Checklist completed and submitted at least 2 weeks prior to commissioning	Acceptance by Superintendent prior to authorising the release of the hold point

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD / WITNESS POINT
Commissioning	9.6.2	HOLD	Pre-connection inspection to mains to be conducted to AS3500 Standards. Checklist completed and submitted at least 2 weeks prior to commissioning.	Acceptance by Superintendent prior to authorising the release of the hold point
Commissioning	9.6.2	HOLD	Visual and dimensional check of existing fire hydrants and mains pipework demolition to AS3500 Standards. Checklist completed and submitted at least 2 weeks prior to commissioning.	Acceptance by Superintendent prior to authorising the release of the hold point
Commissioning	9.6.2	HOLD	Visual and dimensional check of retained existing fire hose reels and connection to new pipework to AS3500 Standards. Checklist completed. Checklist completed and submitted at least 2 weeks prior to commissioning.	Acceptance by Superintendent prior to authorising the release of the hold point
Commissioning	9.6.2	HOLD	Visual and dimensional check of disconnection of existing fire mains supply pipework to AS3500 Standards. Checklist completed. Checklist completed and submitted at least 2 weeks prior to commissioning.	Acceptance by Superintendent prior to authorising the release of the hold point

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD / WITNESS POINT
Commissioning	9.7.4	HOLD	Visual and dimensional check of new Fire Hydrants to AS2419.1-2021 Fire Hydrant Installations. Checklist completed and submitted at least 2 weeks prior to commissioning.	Acceptance by Superintendent prior to authorising the release of the hold point
Commissioning	9.6.1	HOLD	All inspection test reports. Checklist completed and submitted at least 2 weeks prior to commissioning.	Acceptance by Superintendent prior to authorising the release of the hold point
Acceptance	9.8	HOLD	Submission of System installation documentation including System guarantee, no later than 28 days after System installation.	Acceptance by Superintendent prior to authorising the release of the hold point

10 Electrical Services

10.1 General

As part of this project the Contractor shall complete the electrical services installation for the Port Kembla B104 extension, NSW.

The work programme shall be arranged in consultation with the Superintendent and the installation shall be completed according to the agreed programme. The Contractor shall programme the works to minimise interruption to supply to existing site facilities. Where the temporary shutdown of supply is unavoidable to execute the works, make prior arrangements with the Superintendent to access the origin of supply. Provide a minimum of two weeks notice for all required shutdowns. The Contractor's planning shall include submission of documents to the Superintendent, outlining where power will temporarily be lost (and for what duration) for approval.

Existing services shown on Drawings have been documented based on existing records. The accuracy of location and size etc shall be verified by the Contractor prior to commencement of works. Any discrepancy is to be raised in writing to the Superintendent. Drawings must be read in conjunction with the total contract package including the Drawings and Specifications of all consultants.

10.1.1 Standards and Codes

Australian standards and codes current at the date of tendering are applicable in respect of all materials and workmanship. specific codes forming part of this specification but not limited to include:

- NCC (BCA):2022 National Construction Code – Building Code of Australia,
- AS/NZS 3000:2018 Electrical Installations,
- AS/NZS 3008:2017 Electrical Installations – Selection of cables,
- AS/NZS 61439:2016 Low voltage switchgear and control gear assemblies.

All work shall comply with the requirements of the appropriate supply authorities having jurisdiction, occupational health and safety regulations, local service and installation rules and council requirements.

10.1.2 Interfaces

The Contractor shall be responsible for reviewing and confirming coordination with all other disciplines and structures prior to installation. Where conflicts arise, these are to be brought to the Superintendent's attention as soon as possible. Prior to any installation, the Contractor shall have arranged any inspections and obtained any approvals required to avoid delays in the programme. Any claims for additional costs or delays due to the lack of effective co-ordination by the various trades will be rejected.

HOLD POINT

Submission of conflicts between other disciplines.

10.2 Description and Extent of Work

The scope of work comprises supply, installation, testing, commissioning, maintenance and defects liability service of materials labour and equipment for the complete electrical services installation documented.

The Contractor shall have overall coordination responsibility for the services trades and installers and shall coordinate and manage the services commissioning programming for the services trades and installers.

The Contractor shall supply all plant, labour, materials and supervision to carry out the work (in accordance with the specification, Drawings and the Contract) to form complete and operational systems.

The work shall include all necessary minor and incidental work required to implement the intent and meaning of this specification and the associated drawings. Whether or not the words 'supply and install' appear in this specification or on the drawing, unless clearly excluded, all items of equipment for the complete installation are required and shall be supplied and installed.

The work shall include, but will not be restricted to, the following principal items:

- a Modifications of existing electrical boards:
 - B104 distribution board
 - Grain Berth 415V Switchboard
- b The Contractor and its Electrical subcontractor to verify on site that the existing distribution board and main switchboard are in good physical condition and complies with the latest AS3000 requirements prior to modifications/new installations. The Contractor is to provide to the Principal a condition report of the existing electrical services that will be impacted with these modifications.
- c Confirm existing electrical infrastructure is still suitable for upgrade works and that the information provided to WSP for the scope of the design works is still relevant. Verify existing max demand, fault levels, and voltage drop to the boards.
- d Cable support systems and cable reticulation. All trenching works and coordination of below ground services for all disciplines/buried services.
- e General power outlets and power to other services.
- f Circuit protection devices, including discrimination study to ensure cascading between existing circuit protection devices is achieved. Contractor to determine final circuit protection settings and submit for approval.
- g Confirm all procured electrical loads of equipment requiring supply and verify cable rating/selections based on:
 - i the available voltage drop,
 - ii installed cable lengths,
 - iii selected cable manufacturer data,
 - iv installation conditions and external influences,
 - v short-circuit fault levels,
 - vi ratings of protection equipment.
- h Final sub-circuit cabling.
- i Any other Calculations necessary to realise the works under contract.
- j All equipment provided shall be suitable for marine grade.
- k Earthing and bonding system.
- l Removal of demolition items.
- m Labelling of all outlets and equipment as required.
- n Testing and commissioning including certification of the new installation and modification works to the relevant Australian standards and the BCA / NCC.
- o Workshop drawings.
- p Submission of all samples requested by the Superintendent for approval.
- q As installed drawings and O&M manuals.

10.3 Required submissions

- Provide the following in good time to allow review without impediment to the programme, including possible amendment and resubmission:
 - a Documents showing approval of the Authorities whose requirements may apply to the work (for example, requirements for occupancy permits).
 - b Factory test results where applicable.
 - c All product data, performance test and commissioning results required by this Specification.

HOLD POINT

Submission of authority approvals, factory tests and other tests required in this specification.

- d Shop drawings for fabrication and installation of all equipment and items supplied. See section 10.4 for requirements
- e Manufacturer's product data for equipment, materials, components, and systems including:
 - i Technical specifications and drawings.
 - ii Size, arrangement, operating and maintenance clearances.
 - iii Operating weight.
 - iv Type test reports.
 - v Design verification documentation.
 - vi Performance and rating curves or tables marked with each selection showing for both duty point and for part load conditions the capacity; the energy consumption and power factor; and the sound power level.
 - vii Motor power requirements (both full load and starting).
 - viii Recommendations for installation and maintenance.
 - ix Evidence of compliance with specified product certification schemes.

HOLD POINT

Submission of shop drawings and manufacturer's product data for equipment, materials, components and systems.

- f Inspection, test and commissioning plans for every section of the works, and in line with the construction program.

HOLD POINT

Submission of inspection, test and commissioning plans.

- g Client handover/training proposals.
 - h Record and installation drawings.
 - i Operating and Maintenance manuals.
 - j Maintenance/service records during the defects liability period.
- Give notice before commencing work affected by the submissions, unless the submissions have been reviewed with no exception taken.
 - Do not commence production of equipment, materials, components of equipment, components or systems until submission has been reviewed with no exception taken.
 - Maintain and submit monthly a schedule of shop drawings and submissions to identify all proposed drawings and submissions designated in the following categories:
 - a Reviewed
 - b Submitted, awaiting review (with submission date and revision number).
 - c Not yet submitted.
 - Submit electronically (PDF or alternative agreed format).

- Identify the project, trade, supplier/manufacturer, applicable product name, product number, included product options, and relevant specification references.
- Where selected equipment or systems do not fully comply with this Specification and associated documents, a schedule of items which are different from the tender specification shall be submitted for review and acceptance.
- Where such deviations require any changes to the structure, building works or services, these shall be provided by the Contractor without variation to the Contract. Apart from deviations listed, it will be taken that the materials and equipment proposed meets with all other specified requirements. Review of equipment and materials is undertaken on this basis, and that non-complying equipment/materials may be rejected and require replacement at any time – even if already installed.
- Submit amended documents as appropriate, highlighting changes since the previous submission.

HOLD POINT

Submission of design changes.

10.3.1 Samples / Data Sheets

Submit data sheets with an approval register for the following items. Do not cause delays by making late submissions or submitting inadequate data sheets.

HOLD POINT

Submission of data sheets and samples.

- Each type of power outlet in applicable finish and colour
- Cable management and power distribution units
- Each typical label

Provide supporting documentation and include ancillary items such as fasteners and mounting brackets. Include service connection requirements and product certification. Data sheets must be made available for review at least 2 weeks prior to the installation. Minimum 7-days' notice shall be given to the Superintendent for review of data sheets. Do not commence work affected by proposed fixtures until the data sheets have been accepted. The data sheet approval register shall be retained on site, accessible at any time and shall contain a unique identification number, brief description, supplier and proposed location(s) for installation of each item

10.3.1.1 Timing

- Co-ordinate submissions of samples as listed in the Schedules. Do not cause delays by making late submissions or submitting inadequate samples.

10.3.1.2 Quantity

- Submit a sample of each designated item and 2 copies of supporting documentation. Include ancillary items such as fasteners and mounting brackets. Amend and resubmit samples which are not accepted.

10.3.1.3 Identification

- Identify the project, Contractor, their agents or supplier, manufacturer, applicable product, model number and options, as appropriate and include pertinent Specification references.
- Include service connection requirements and product certification.
- Identify non-compliances with project requirements, and characteristics that may be detrimental to successful performance of the completed work.

10.3.1.4 Sample acceptance and retention

- Do not commence work affected by samples until the samples have been accepted. Submit further samples as necessary.
- Keep approved samples in good condition on site, until Practical Completion.
- Incorporate in the works samples, which have been approved for incorporation. Do not incorporate other samples.
- Installed items shall match accepted samples throughout the works.

10.3.2 Alternative products

- Should the part of the work be proposed to be done quicker, better or more effectively by substitution of materials or methods other than those specified, the details of such substitutions or alternatives shall be included in the Tender, including a comprehensive report including any performance and life cycle analysis in support of the proposals.
- It is the Contractor's responsibility to ensure that all equipment orders are made in a timely fashion to suit the project construction programme. The proposing of alternatives as a result of the Contractor's failure to do so will not be accepted as a means for alternative submissions.
- Where the words 'equal or approved' are used in this Technical Specification, permission may be requested to use a substitute for what is specified, provided it and the relevant manufacturer of the item certify in writing that the substitute is of equal, or better quality and effectiveness to that specified.
- Submit for approval full details to allow checking that the alternative products comply with the Contract Documents. Provide a certificate for each alternate product verifying that the proposed alternative product complies with the contract documents. Include all compliance and non-compliance items related to Project Brief, Specifications and Contract Drawings. State if use of proposed alternatives will necessitate alteration to other parts of the works and include consequential costs.
- Allow for additional work resulting from the utilisation of an approved alternative product, including additional or revised statutory approvals, changes to adjacent work, re-submission of shop drawings and any costs incurred.
- Proposals for substitution must include details of:
 - a Changes to adjacent work, if any.
 - b Cost differences.
 - c Life cycle cost differences.
 - d Quality differences, Specification compliance and advantage to the Client.
 - e Lead time and program changes.
 - f Certificate of compliance with the applicable code or standard.
 - g Assumptions.
 - h Calculations.
 - i Design basis and performance parameters.
 - j Installation and maintenance requirements.
 - k Manufacturers' technical literature.
 - l Risk assessment.

HOLD POINT (Proposed Changes)

Submission of details, certificates, additional or revised statutory approvals, changes to adjacent work and/or resubmission of shop drawings relating to substitutions.

10.4 Shop drawing and construction drawing requirements

10.4.1 General

- The term shop drawings includes manufacturing and For Construction drawings and shall mean complete drawings showing all details of fabrication assembly, installation and fixing of the items concerned, and shall include any necessary explanatory notes or specifications.
- Prepare, and submit for review before commencing manufacture or installation, Construction Shop Drawings from which the subject works shall be built. Shop drawings shall be dimensioned, showing details of the fabrication, layout and installation of all plant and equipment, including relationship to building structure and other services. No factory or site work, other than manufacture of standard equipment or controls, shall proceed until such drawings have been reviewed and marked as satisfactory. Show all dimensions and note which are based on site measurement. Confirm dimensions on site prior to preparation of drawings. Allow for adjustments and fitting on site. Indicate whether site dimensions have been verified. Confirm site dimensions prior to fabrication. No extra charge or compensation will be considered for differences between actual dimensions and dimensions indicated on Contract Documents. Do not delay job progress.
- Co-ordinated penetration drawings shall be submitted in sufficient time for review. Any failure to submit requirements within sufficient time for revision of structural drawings, resulting in re-working of the structure or re-ordering of structural components shall be responsibility of Contractor and shall not constitute any claim for variation or delay. All penetration measures shall relate to grid lines, co-ordinates or relative levels.
- Prepare and submit drawings of penetrations and “built-in” components in the same form and manner as described for the processing of shop drawings. All penetration measures shall relate to grid lines, co-ordinates or relative levels.

10.4.2 *Shop drawing minimum requirements:*

- Provide drawings generally in accordance with the design drawings format (CAD /Revit) supplied. Each drawing shall be submitted on a Contractors Title Block. Provide the following information on the title block:
 - a Project identification/Contractor’s and Subcontractor’s Names/ Date of preparation of submission, and all revisions, if applicable
 - b Shop drawing number and title of item to which the shop drawing refers
 - c The name(s) of the contractors staff or approved representatives responsible for preparing the shop drawings
 - d Statement or stamp of approval by the Contractor, which shall signify that he has seen and examined the shop drawing as conforming to the Specification.
- Shop drawings shall be submitted in standard metric sheet sizes and included as noted on the following table. All shop drawings shall be dimensioned and submitted for review. Provide the following:
- Description:
 - a General:
 - i Design of connections not indicated on the Contract Documents.
 - ii Details of all interfaces with other services and utilities.
 - iii Location and identifier for all equipment.
 - iv Label and signage schedules.
 - v Plant room layout plans 1:50 scale, with sections and details at 1:20 scale.
 - vi Major equipment details.
 - vii Explanatory notes and specifications.
 - viii Site survey references, grid locations and set out.

- ix Methods of assembly, including junctions and trim to adjoining surfaces, fittings and accessories and methods of installation, including fixings, anchorages and sealants.
 - x Legend of Symbols.
 - xi Methods of assembly, including junctions and trim to adjoining surfaces, fittings and accessories and methods of installation, including fixings, anchorages and sealants.
 - xii Underground and above ground reticulation routes including conduits/pipes and pit details.
- Layouts (Scale 1:250):
- i Complete power and communications layout drawings for all areas, showing the actual locations and outlet types and the final circuiting arrangements.
 - ii Complete power and communications reticulation layouts for all areas including cable support systems, piping, cable tray, ladder and conduit routes with dimensioned set outs and sizing.
- Schematics:
- i Complete LV schematic diagrams of all systems incorporated in the installation including switchboards, and protection settings
 - ii Sub main and final sub circuit schedules indicating origin, destination, cable length, voltage drop calculations and cable sizing details for each individual circuit type.
 - iii Switchgear and control gear assembly circuit schedules including electrical service characteristics, controls and communications and discrimination settings
- Equipment:
- i Major equipment details
 - ii Explanatory notes and specifications.
 - iii Methods of assembly, including junctions and trim to adjoining surfaces, fittings and accessories and methods of installation, including fixings, anchorages and sealants.
 - iv Distribution Boards and switchboard control panel layouts, control diagrams, single line diagrams, equipment lists and schematics with terminal numbering.
- Structural Coordination:
- i Layout and details of services cast in concrete
 - ii Structural support details and methods of fixing to structure.
 - iii Construction loadings
 - iv Lifting point loads
 - v Details of required penetrations in structural elements.
 - vi Site survey references, grid locations and set out.
 - vii Details of items to be cast-in, built-in or fixed by others, including setting diagrams and templates.
 - viii Provision for movement of the work of the base structure.
 - ix Foundations, plinths, chases, ducts, pits and penetrations through structure.
- Submit computations with shop drawings to demonstrate the adequacy of the submitted design/detail. Computations shall be in a form acceptable to the Superintendent and Authorities having jurisdiction over the works.
- Allow a minimum of 5 working days for the shop drawing review appraisal.
- If amendments are required from the review, shop drawings are to be revised and resubmitted. This process shall continue until the shop drawings are deemed satisfactory. Review of shop drawings by the superintendent refers to general design intent only and does not relieve the Contractor of responsibility for contract requirements, or dimensional accuracy of the information presented in the shop drawings.
- Please note when shop drawings review comments states “satisfactory subject to comments”, resubmit the revised drawings with comments incorporated within a period of no longer than 2 weeks. However, this should not stop the installation works.

- Once a drawing is accepted as satisfactory, the contractor shall maintain a current, set of the final shop drawing on site for review at all times. The Contractor shall progressively 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. These drawings shall be used as the basis for the creation of as-built drawings.

10.4.3 Penetrations and building-in drawings

- Prepare and submit drawings of penetrations and “built-in” components in the same form and manner as described for the processing of shop drawings. All penetration measures shall relate to grid lines, co-ordinates or relative levels.
- Obtain and co-ordinate fully all penetration requirements, with particular attention to adjustments in penetration locations made necessary by crossing of ducts, pipes, conduits, etc.
- Submit co-ordinated penetration drawings in sufficient time for review. Any failure to submit requirements within sufficient time for revision of structural drawings, resulting in re-working of the structure or re-ordering of structural components shall be solely at the expense of the Contractor and shall not constitute any claim for variation or delay.
- The location of all sleeves, block outs and penetrations required for the works in accordance with dimensions and set out tolerances indicated on the drawings, including sealing of the penetrations form part of the works.
- Penetrations through fire rated, smoke rated, air tight, water tight or acoustic barriers must be sealed in accordance with the requirements of the Authority having jurisdiction.

10.5 Modifications on Existing Distribution Board

Modifications on existing B104 distribution board to suit the new layouts as required.

All electrical installations and any alterations to electrical installations shall, prior to being placed in service or use, be inspected as far as practicable and tested to verify that the installation meets the requirements of AS3000.

Supply and install new lighting and power circuits.

Circuits to be RCBO protected (30mA) where required for code compliance.

All new and modified circuits shall be individually protected in accordance with AS/NZS 3000.

In addition to distribution board circuit schedule, provide a A3 laminated copy of the power and lighting layout drawings at distribution board showing the connected circuits. Laminated drawings shall include the distribution board single line diagrams.

HOLD POINT

Submission of details, certificates, additional or revised statutory approvals, changes to adjacent work and/or resubmission of shop drawings relating to modifications on the Existing Distribution Board.

10.6 Modifications on Existing Main Switch Board

Modifications on the existing Grain Berth 415V Switchboard to provide power supply and cable connection to new ICCP (Impressed Current Cathodic Protection) system for the northern extension of Berth 104 shall be installed and coordinated by the Contractor. Refer to the layouts provided for further detail.

The Contractor shall ensure all electrical installations and any alterations to electrical installations shall, prior to being placed in service or use, be inspected as far as practicable and tested to verify that the installation meets the requirements of AS3000.

The Contractor shall supply and install 40A/100A circuit breaker to be located at 1T4 – Spare space on the existing Grain Berth 415V Switchboard for the ICCP requirement. The Electrical Contractor is to undertake discrimination analysis including implementation of protection setting as required on site.

The cable size recommended for the AC supply of TRU is 1x4C 10 mm² + E 4 mm² CU XLPE with an expected distance of approximated 50 m (Contractor to verify actual site conditions) from the Grain Berth 415V Switchboard to the TRU.

Electrical Contractor to verify the voltage drop and cable size complies with AS3000 prior to installation.

HOLD POINT

Submission of details, certificates, additional or revised statutory approvals, changes to adjacent work and/or resubmission of shop drawings relating to modifications on the Existing Main Switch Board.

10.7 Reticulation, Distribution, Cabling and Conduits

Supply, install, connect and terminate all required cabling and cable support systems to complete the electrical reticulation and distribution system. Provide equipotential bonding throughout. All electrical services shall be separately supported from their own dedicated support system, including containment.

Provision of all new final circuit wiring - lighting and power circuits, unless stated otherwise, shall be wired in single or multicore cables having copper conductors with PVC insulation and sheath. Cable selection shall be in accordance with AS/NZS 3000 and AS/NZS 3008.

Power and lighting cabling shall generally be reticulated from the supplying distribution board to the required location using a system of conduit on support brackets and underground conduits. Refer to the electrical layout drawing notes for cable support requirements in specific areas.

Conduits on the support brackets and the cantilever support brackets must be of C5-M (Marine) atmospheric corrosivity for corrosion protection. Marine grade aluminium or 316 stainless steel for the support brackets and heavy duty PVC conduits for above ground runs.

Electrical and communication cabling shall be separated from other services in accordance with AS/NZS 3000. A minimum of 100 mm separation is to be provided between low and high voltage conduits, 100 mm between low voltage and communications conduits, 100 mm between low voltage and water services and 450 mm between high voltage and communications conduits.

All cables shall be run concealed and installed in a workman like manner parallel to walls, floors and ceiling as applicable. Where impractical, obtain Superintendent approval before proceeding with alternative methods.

Seal all building penetrations using compliant methods to maintain the fire/smoke rating and security rating of the penetration wall/walls.

Surface conduits, where required, are to be coordinated with all other trades.

All below ground services and clearances are to be considered by the Contractor on-site prior to installation and in keeping with all standards and legislation.

The services shown on the Drawings are indicative. Contractor is to do their own verifications and on-site co-ordination prior to installation.

All plant, equipment, fastenings etc. are to be marine grade suitable as they are located around corrosive environments.

Junction boxes to be coordinated on-site, locations shown are indicative only.

Final size/dimensions for the pits are to be coordinated and confirmed by the Contractor prior to installation.

Contractor to coordinate all pit dimensions, spacing etc. with the supplier prior to installation

Contractor to ensure support is adequate to support loading of all new, existing and future equipment

Contractor to coordinate all cabling, connection points, pit locations, bending radius to ensure compliance.

Provide size and quantity of conduits as required and allow spare capacity. Coordinate all conduits with the Contractor and maintain all minimum cable segregations in accordance with AS/NZS 3000. Provide draw wires within conduits once works are completed for ease in future installation works.

All cables shall have high conductivity plain annealed copper conductors and shall be of the multi-stranded type.

Conductors shall be minimum 2.5 mm. Contractor to complete their own cable calculations at the actual measured lengths and validate sizes to ensure voltage drop allowances as per AS3000.

Phase rotation to be constant for total installation and demonstrated prior to practical completion.

10.7.1 *Underground services*

10.7.1.1 Cable pits

General: Draw-in pits: Sizes given are internal dimensions. All pipe penetration location and sizes to be followed as per the Drawings where shown.

HOLD POINT

Submission of cable pit pipe penetration locations and sizes.

All construction joints shall be scabbled before second stage of concrete pour and superswell 47b or approved equivalent waterstop provided. Side walls shall be reinforced with N12-200 both ways each face, and base slab shall be reinforced with N16-150 T&B both ways. The pit shall be founded on soil with a minimum allowable SLS bearing pressure of 600 kPa.

Proprietary Cable Pits: For pits with no dimension greater than 1000 mm, provide proprietary concrete or polymer moulded pits unless noted otherwise.

- **In Situ Construction:** For pits with any dimension greater than 1000 mm, construct walls and bottoms using core filled reinforced blockwork or 75 mm thick reinforced concrete. Incorporate a waterproofing agent in the render or concrete unless noted otherwise. Lifting anchors and related reinforcement not required.

Pit Covers:

- **General:** Provide pit covers to suit expected loads. Fit flush with the top of the pit and finished ground level.
- **Standard:** To AS 3996.
- **Maximum weight:** 40 kg for any section of the cover that is to be manually handled. Where excessive loads occur due to Class G pit classification ratings, maintenance via forklift and lift hooks on site are necessary.
- **Lifting handles:** Provide a means of lifting with lid lifters/handle for ease in access for manual or machine operated use, pending coordination with the supplier. Provide all means of lifters etc. to the Client as part of Practical completion where manual keys/handles etc. may be required. Permanent handles protruding from lids shall not be provisioned.
- **Lid Material:** Provide metal checker plate lids unless noted otherwise.
- **Recesses and Support Beams:** Refer to manufacturers detail.

Drainage:

- **General:** Provide drainage from the bottom of cable pits to absorption trenches filled with rubble.
- **Absorption trenches:** Minimum size 300 x 300 x 2000 mm.

10.7.1.2 Underground cable routes

Survey: Accurately record the routes of underground cables before backfilling.

Location Marking:

- The proposed LV electrical network is an expansion to the existing from Wharf MSB which is to supply:
 - Additional lighting as required for the Northern Wharf Extension and the Turnaround Area.
 - Single 10A 240V surge protected double switched outlet for the Turnaround Area CCTV camera.
 - Single 10A 240V single switched outlet at the Turnaround Area.
 - Additional cathodic protection for the Northern Wharf Extension and Southern Wharf Connection.
- The supply and installation of the LV, HV and communications conduit network will adopt location markings as stipulated and detailed in the Drawings.
- LV and HV conduits from Tom Thumb Rd are to tie into PK-LV-001 and PK-HV-001 respectively, adjacent to a future HV kiosk (by others). The communications conduit is to tie into PK-CO-001 as per the Principal's preferred alignment.
- Installation and location marking of buried LV electrical conduits as follows:
 - 3x150 mm and 2x100 mm LV electrical conduits from PK-LV-001 to PK-LV-002, initially in a shared trench with HV electrical conduits only, and then in a shared trench with communications and HV conduits.
 - 3x150 mm and 2x100 mm LV electrical conduits from PK-LV-002 to PK-LV-003 in a shared trench with a communications conduit.
 - 3x150 mm and 2x100 mm LV electrical conduits from PK-LV-003 to PK-LV-004 (adjacent to the HV cable bridge) in a shared trench with a communications conduit, parallel to the wharf access ramp. This trench follows the Principal's preferred alignment. It runs along an embankment batter and must be constructed with care to maintain slope stability, reinstate ground conditions to prevent erosion, and avoid impacts to the mooring dolphin performance.
 - 2x100 mm LV electrical conduits from PK-LV-002 to PK-LV-005, in a shared trench with a communications conduit.
 - LV electrical conduit from PK-LV-005 into the light pole in the Turnaround Area.
 - LV electrical conduit from PK-LV-005 into the northern mooring dolphin, supplying power to the capstan.
 - LV electrical conduit from PK-LV-005 into the power titan bollard.
 - 1x63 mm LV electrical conduit from PK-LV-005 to be capped within 2 m of the proposed CCTV pole location in the Turnaround Area with a timber stake or similar installed over the capped end indicating the position of the end of the conduit.
 - 3x100 mm future connection conduit stubbs from pit PK-LV-003 to be capped and protected, and to be marked with timber stake or similar over capped end indicating the position of the end of the conduit. The conduit stubbs to extend 200 mm minimum beyond the edge of the pit.
 - Minimum bending radius of LV conduits to be maintained at 600 mm
- Installation and location marking of buried High Voltage electrical conduits as follows:
 - 6x150 mm (ID) HV electrical conduits from pit PK-HV-001 to PK-HV-002, initially in a shared pit with LV, then with LV and communications, and finally alone.

- 3x150 mm future connection conduit stubbs from pit PK-HV-002 to be capped and protected, and to be marked with timber stake or similar over capped end indicating the position of the end of the conduit. The conduit stubbs to extend 200 mm minimum beyond the edge of the pit.
- Minimum bending radius of HV conduits to be maintained at 1400 mm.
 - The pit PK-HV-001 assumes no HV cable bending within the pit.
 - PK-HV-002 is designed to accommodate a minimum cable bending radius of 1400 mm.
- Installation and location marking of buried communications conduits as follows:
 - 1x100 mm communications conduit from PK-CO-001 to PK-CO-002 initially in a trench alone, then a shared trench with LV and HV conduits.
 - 1x100 mm communications conduit from PK-CO-002 to PK-CO-003 in a shared trench with LV conduits.
 - 1x100 mm communications conduit from PK-CO-003 to PK-CO-004 in a shared trench with LV conduits.
 - 1x100 mm communications conduit from PK-CO-002 to PK-CO-005 in a shared trench with LV conduits.
 - 1x63 mm communications conduit from PK-CO-005 to be capped within 2 m of the proposed CCTV pole location in the Turnaround Area with a timber stake or similar installed over the capped end indicating the position of the end of the conduit.
 - 1x100 mm future connection conduit stub from pit PK-CO-005 to be capped and protected, and to be marked with timber stake or similar over capped end indicating the position of the end of the conduit. The conduit stub to extend 200mm minimum beyond the edge of the pit.
 - 1x100 mm future connection conduit stub from pit PK-CO-003 to be capped and protected, and to be marked with timber stake or similar over capped end indicating the position of the end of the conduit. The conduit stub to extend 200 mm minimum beyond the edge of the pit.
 - Minimum conduit bends for communications to be provided as per AS/CA S009:2020\ 18.3.6.2
- Installation of pits at each primary change in direction of the buried conduits.
- Pit lids are to be Class B as all pits are located on vegetated verge.
- The Contractor must maintain the following minimum separation distances within shared trenches:
 - 100 mm between LV and HV conduits
 - 450 mm between communications and HV conduits
- All pits must include access rungs or ladders in accordance with AS 1657 and signage compliant with AS 1319.

Marker Tape:

- **Communications Marker tape:** Provide white marker tape complying AS/NZS 2648.1. Install marker tape at least 100 mm above conduits, just below the above white marker tape, or 50% of the depth of burial, whichever is shallower, below finished ground level. Where chased in rock, concrete or installed directly below slab, lay marker tape directly on top of wiring system.
- **LV/HV Marker tape:** Provide orange marker tape complying AS/NZS 2648.1. Install marker tape at least 300 mm above conduits, just below the above white marker tape, or 50% of the depth of burial, whichever is shallower, below finished ground level. Where chased in rock, concrete or installed directly below slab, lay marker tape directly on top of wiring system.
- **Polymeric cover:** If specified by documents, required by AS 3000 for the wiring system method of installation or for any direct lay cabling, provide a minimum 5 mm thick AS 4702 polymeric cable cover strip. Polymeric cover shall be wide enough to protect the entire wiring system, including any cable bedding.

Reinstatement:

- **Lawn Areas:** Provide 150 mm of loam and resew the lawn over the trench and other disturbed areas.
- **Paving and Roads:** Reinstate to match adjacent work, paved surfaces and assets disturbed or removed during excavation of trenching.
- **Concrete Surfaces:** Reinstate concrete surfaces to the original level. Provide steel reinforcement keyed to the adjacent concrete and laid to prevent the reinstated concrete from subsiding and cracking.

10.7.2 Suspended cable routes

- The conduit system is to be installed in accordance with the Drawings, which include recommended sizing and component specifications.
- All bracketry, conduit fixings, and accessories shall be installed per the Drawings and manufacturer/supplier installation requirements.
- Installation of suspended LV electrical and communications conduits sharing the same suspension structure as follows:
 - 3x150 mm and 2x100 mm LV electrical conduits and 1x100 mm communications conduit from PK-LV-004 to the existing wharf edge, utilising cantilever brackets attached to the edge of the existing cable bridge. Which will then transition to 2x600mm Cable tray.
 - The 2x600mm Cable trays for shared communications and power shall reticulate to the existing distribution board inside the MSB room, through MSB room penetrations. Separation of Communications and power cables shall be inline with AS3000 requirements.
 - The circuits for the wharf located TPU and Light pole shall reticulated along the provided cable tray before transitions into a junction box to be continued around the wharf within 1x150 mm and 2x100 mm LV electrical conduits, and 1x63 mm communications conduit.
- 6x50mm Core holes penetrations through the Wharf MSB Switch Room , as indicated on the Drawings, are provided cables to enter the Wharf MSB Switch Room from the supplied cable trays, then reticulate across the existing MSB tray for connection the Distribution board circuits.
- Installation of cantilever brackets on both the existing and new wharfs, below the kerb line is as follows:
 - The suspended LV and communication conduits will be mounted on the same CB254 Cantilever Bracket system used for fire hydrant piping detailed in Section 9.
 - The cantilever brackets are generally to be 1000 mm in length, with 1200 mm brackets to be used where necessary, such as fire hydrant clearance zones.
 - LV and communications conduits to be attached to the upper side of cantilever brackets.
 - Fire water services to be installed below the cantilever brackets.
 - A future 150 mm LV conduit run has been allowed for in the current conduit and support design.
- Junction boxes and cable inspection points along the wharf edge are to be installed as indicated in the Drawings. They are to be IP67 rated. Final dimensions and specifications are to comply with the Drawings.
- Gland plates: Provide removable gland plates fitted with gaskets to maintain the degree of protection. Gland plates shall be sized to ensure there is enough space for all cables. The manufacturer shall ensure they make themselves aware of how many and what size cables need to enter or leave through each gland plate and size the cable zone accordingly. Cable zones shall be sized to prevent overcrowding of cables and allow a neat, installation and termination of cables.

- Where cables transition to wharf-side assets, cable trays with removable lids are to be installed to provide protected and accessible routes.
-

10.8 Building penetrations

- Ensure that the penetration of services through walls, floors and roofs is undertaken in a manner consistent with maintaining fire ratings, smoke proof ratings, achieving acoustic performance and achieving weather-proofing, as necessary.

10.8.1 *Fire resisting building elements*

- Seal penetrations to comply with NCC using a system to AS 4072.1, Components for the protection of openings in fire-resistant separating elements – Services penetrations and control joints.
- Comply with Section 3 of AS/NZS 1668:1, Fire and Smoke control in Multi Compartment Buildings.
- AS4072.1 inter-alia Appendix B and AS1851 inter-alia Section 12 and 13 shall be complied with in as-built documentation to identify all fire and smoke containment compartment walls and barriers. To satisfy specific identification requirements to AS4072.1 Appendix B and AS1851, permanently fixed labelling, tagging and signage of all passive fire and smoke containment systems must be provided for on-site identification. Fire stopping barriers and penetrations shall comply in particular with reference to a service label affixed adjacent to each fire stop barrier and service penetration (or close proximity group) as detailed in Appendix B of AS4072.1 and AS1851. This as-built provision amongst other as-built documentation and manuals is essential as part of handing over process of the project.

10.8.2 *Non-fire resisting building elements*

- Seal penetrations around conduits and sleeves. Seal around cables within sleeves. If the building element is weatherproof, acoustic rated or subject to pressure, maintain the rating. Acoustically seal penetrations through plantroom walls and floors.

10.8.3 *Limitations*

- General: Do not penetrate, or chase the following without approval:
 - b Structural building elements including external walls, core walls, fire walls, floor slabs, beams, or columns.
 - c Acoustic barriers.
 - d Other building services.
 - e Membrane elements including damp-proof courses, waterproofing membranes, and roof coverings.
 - Membranes: If approval is given to penetrate membranes, provide a waterproof seal between the membrane and the penetrating compound.
-

10.9 Existing services

The works include contact with all utility companies prior to commencing work when required, to ascertain the precise location of all in ground and above ground services in the vicinity of any proposed excavation or building works. Ensure protection of the services, as necessary, during the progress of the work at all times.

In the case of work in close proximity to in ground services, particularly electrical cables or gas piping, hand digging may be necessary in order to determine the exact location of such services. Electronic tracing of in ground services may be required. Any damage to existing services shall be made good as part of the work of the Contract, at no additional cost to the Principal.

10.10 Demolition Works

Removal works of the capstan and the supporting infrastructure and cables back to the Wharf MSB. Contractor to ensure works occur at the after commissioning of the proposed Northern Mooring Dolphin as the capstan will be in use during construction. Existing lighting and existing cables, ladder or other associated electrical items not in use shall be removed and made good on site. Contractor to confirm on site and with client on items for removal that are not currently in use.

10.11 Earthing and Bonding

Earthing of the complete electrical installation shall be strictly in accordance with the requirements of AS/NZS 3000 and any special requirements of this specification and the local supply authority.

Earth wires shall be run for all luminaires, power outlets, isolators, conduits, metalware and as otherwise required by regulations.

Earth wires shall be sized in accordance with AS/NZS 3000.

10.12 Accessories, Outlets and Appliances

Circuit breakers are to be Schneider or equal and approved.

Supply and install all accessories, outlets, appliances and appliance connections complete with required fixings and fastenings.

All socket outlets shall have the circuit to which they are connected written in permanent marker under the cover. Outlet cover plates shall also be fitted with traffolyte labels (or approved equal) indicating the supplying distribution board and circuit breaker number.

10.13 Positioning of Equipment and Labelling

The layout of equipment shown on the Drawings is diagrammatic only, and exact positions shall be determined on site. Outlets shall be spaced accurately and symmetrically within areas.

All switches, fuses, relays, terminal strips, distribution boards, outlets, circuit breakers and compartments shall be comprehensively labelled to clearly indicate their function. All labels shall be traffolyte type (white background/black writing) approximately 2 cm x 1 cm and secured to the respective outlet fascia. Adhesive labels or free handwritten labelling are not acceptable.

10.14 Testing, Commissioning and Maintenance

The installation shall be tested to the satisfaction of the Superintendent and the statutory authorities prior to the acceptance of the installation and the commencement of the defect's liability period.

WITNESS POINT

Inspection of the entire installation and performance testing of electrical systems.

Superintendent to witness commissioning of electrical systems. The tests shall comprise a thorough inspection of the entire installation and the operational and performance test to confirm compliance with the specification and the Australian standards. Carry out all commissioning tests necessary to put the systems into commercial use and to approval before practical completion is granted. Each item of equipment shall be tested individually, and each complete system shall be tested as a whole.

Provide all necessary training to staff for effective and safe operation of all new and modified electrical requirements.

Maintain a logbook on site during installation and testing. Record details of all faults found, the cause of the problem, the solution affected and the time taken to repair. In addition, record details of tests undertaken. Keep the logbook on site and continuously update it throughout the defects liability period.

Routine maintenance and servicing of the installed work shall be carried out by the Contractor on a regular basis up to the point of handover to the Principal, whereupon the Principal will take over this responsibility. A logbook shall be kept on site by the Contractor for recording the maintenance visits and work executed. This shall include and not be limited to:

- Inspection and maintenance
- Rectifying faults
- Equipment adjustments
- Replacement of consumables

A formal letter shall be provided to the Superintendent detailing the testing and commissioning is complete to enable practical completion to be granted. Provide a certificate of compliance and testing to AS/NZS 3000 along with the results to the Superintendent at commissioning.

The Contractor shall:

- Commission the entire installation and allow for verification of system operation in the presence of the Superintendent.
- Perform all tests necessary to ensure the satisfactory operation of the installation before performing witness tests in the presence of the Superintendent and representatives.
- Co-ordinate with a nominated independent commissioning agent to commission/verify all installation works as required.
- Ensure that they are fully aware, understand and coordinate all their commissioning works.
- Provide all necessary instrumentation, equipment, materials and labour.
- Record all tests and system calibrations and retain a copy of these results on site in the Commissioning Records.
- Copies of all test records shall be submitted to the Consulting Engineer.

HOLD POINT

Submission of commissioning test reports and certificate of compliance according to AS/NZS 3000.

10.15 Practical completion requirements

Notwithstanding any other provisions of the Contract regarding the granting of Practical Completion, the following requirements, shall be completed and completion submissions made prior to the date of Practical Completion.

- a** Submissions required for application for Occupancy Permit.
- b** Submission of signed off testing and commissioning schedules including all controls, metering and interfaces
- c** Submission of Authority approvals including Statutory Authority approvals and Certification of Compliance with the NCC.
- d** Submission of Certification that works comply with the Contract Documents.
- e** Operating Instruction and Maintenance manual sections covering all Safety Services as required by regulations including Installation and commissioning Inspection and Test Plans ITPs
- f** Adequate training and instruction of the Superintendent's representatives in safe operation of the plant
- g** Official Equipment manufacturer's acceptance certification for the installation
- h** Completed Operating and Maintenance manuals and 'as built' drawings

- i The Defects Liability period may be extended in the event:
 - A Specific systems fail to achieve the desired outcomes after two attempts are made to rectify the drawback. These specific systems include those that are fire and life safety or business / mission critical to the Principal.
 - B If there have been more than three (3) attempts to rectify the defect, in which instance a further 12 months of monitoring will be required after the defect is rectified to monitor that the desired outcomes are achieved without further shortfalls.

HOLD POINT

Submission of the above certificates, reports and drawings.

10.16 Summary of Hold/witness Points

All hold and witness points during construction of electrical services are outlined in Table 10.1, and all required tests are outlined in Section 10.16.1.

Table 10.1 Hold/Witness Point Schedule

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Pre-start/Site establishment	10.3, 10.4	HOLD	Technical data, including calculations, certification of compliance, design drawings, risk assessments, samples etc, at least 28 days prior to site establishment	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Pre-start/Site establishment	10.3, 10.4	HOLD	Shop drawings, including amendments where appropriate, at least 28 days prior to site establishment	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Pre-start/Site establishment	10.3, 10.4	HOLD	Electrical service drawings, at least 28 days prior to site establishment	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Pre-start/Site establishment	10.3, 10.4	HOLD	Inspection, test and commissioning plans, at least 28 days prior to site establishment	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Pre-start/Site establishment	10.3, 10.4	HOLD	Design changes, at least 28 days prior to site establishment	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Pre-start/Site establishment	10.3	HOLD	Authority approvals, factory tests, at least 28 days prior to site establishment	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Pre-start/Site establishment	10.3, 10.15	HOLD	Submission requirements for occupancy permit, at least 28 days prior to site establishment	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Modifying existing electrical boards	10.5, 10.6, 10.14	HOLD	Submission of details, certificates, additional or revised statutory approvals, changes to adjacent work and/or resubmission of shop drawings relating to modifications on existing electrical boards, at least 2 weeks prior to work on the boards	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Installation of any items	10.1, 10.3, 10.4	HOLD	Conflicts between other disciplines.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Cable laying	10.3, 10.4	HOLD	Certificates and details regarding substitutions, including additional or revised statutory approvals, changes to adjacent work and/or re-submission of shop drawings.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Installation of cable pits	10.7.1	HOLD	Submission of cable pit pipe penetration locations and sizes, at least 2 weeks prior to installation.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Commissioning	10.14	WITNESS	Superintendent to witness testing and commissioning of electrical systems.	The Superintendent will inspect the electrical systems during testing, prior to authorising the release of the Witness Point.
Electrification	10.14, 10.15	HOLD	Commissioning test reports and certificate of compliance according to AS/NZS 3000.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Electrification	10.15	HOLD	As built drawings.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.

10.16.1 Works Testing

The Contractor shall make provision of comprehensive testing and commissioning including ITP's for every aspect of the installation and witnessing by all relevant Engineers, Contractor's Certifiers and relevant Authorities. The Contractor shall submit correctly and completely an executed ITPs including test results at Practical Completion.

- 1 Inspection test plans are to be prepared specifically for the project but may be based on or customised from generic ITPs. Submit ITPs at least 6 weeks prior to commencement of testing.
- 2 List acceptance criteria for each element and sub-element of the electrical installation in ITPs. Acceptance criteria to include:

- a Specification details and workshop drawings in regard to materials, construction methods, physical requirements, performance and operational requirements.
 - b Schedule of Technical Data in respect of make, model and performance details of equipment.
 - c Shop drawings.
 - d Control logic and diagrams.
 - e Authority inspection and testing requirements.
- 3 Format ITPs as follows:-
 - a A4 single sided.
 - b Machine printed.
 - c Each page identified with Inspection and Test organisation's name, project name, ITP record no., electrical services element or sub-element, signature of inspector, date of sign off, page no. of total pages.
 - d Tick boxes and comment column for record purposes.
 - e Copy of completed ITPs to be supplied electronically as a PDF.
 - f Copy of Installation Manuals to be supplied electronically as PDF.
- 4 All instrumentation used in the commissioning of the installation shall be managed in accordance with the requirements of AS 3912 or NEBB. Reference instruments are to be NATA certified. All commissioning results to include instrument calibration documentation.
- 5 Pre-completion tests: Tests carried out before completion tests.
 - a Prototype tests: Tests carried out on an item or assembly for development or to demonstrate suitability for the project.
 - b Type tests: Tests carried out on an item identical with a production item, before delivery to the site and witnessed by an approved independent testing authority.
 - c Production tests: Tests carried out on manufactured equipment, before delivery to the site.
 - d Factory Inspection Tests: Tests carried out at the Installers premises prior to Factory Acceptance Testing and delivery to site.
 - e Factory Acceptance Tests: Tests carried out at the Installers premises and Witnessed by the Engineer prior to delivery to site.
 - f Site tests: Tests carried out on site on static plant and systems before commissioning (e.g. inspection and testing of welding, electrical insulation resistance testing, etc).
- 6 Prior to energisation of any system with electrical connections, conduct the following tests:
 - a Tightness of screwed and bolted connections.
 - b Physical integrity.
 - c Correct phasing. Check phase rotation is consistent throughout the project and is the same as the supply.
 - d Motor rotation.
 - e Insulation resistance tests.
 - f Test operation of all trips, interlocks, motor driven devices, contactors and control circuits and devices by instigating or simulating inputs.
 - g Perform site tests on all cables in accordance with manufacturer recommendations

- 7 Site testing shall include but not be limited to the following:

 - a Testing of the earthing system
 - b Testing of the operation of circuit breakers, RCDs etc.
 - c Interface with other services
 - d Testing of polarity
- 8 The Contractor is to provide manufacturer's factory test records (type tests and witnessed tests) and site installation inspection and sign-off certifying that the completed installation comply with the manufacturer's installation guidelines and requirements.
- 9 Completion tests: Tests carried out before the date for practical completion on installations or systems which have been completed and commissioned, to demonstrate that the installations or systems, including components, controls and equipment, operate correctly, safely and efficiently, and meet performance and other requirements and are integrated with connecting systems.
- 10 Acceptance tests: Tests carried out before the date for Practical Completion on installations or systems which have been completed and commissioned. Witnessed by the Superintendent to demonstrate that the installations or systems, including components, controls and equipment, operate correctly, safely and efficiently, and meet performance and other requirements and are integrated with connecting systems.
- 11 Deferred tests: Acceptance tests carried out during the defects liability period (e.g. performance tests to suit seasonal climatic conditions and/or occupancy).

11 Lighting Services

11.1 General

This section of this Technical Specification includes floodlighting fixtures, Light Emitting Diodes (LEDs), LED drivers, mast standards and accessories. This specification section must be read in conjunction with the Lighting Drawings.

All materials, workmanship and testing shall be in accordance with the following documents, in their latest revisions, except that this Technical Specification will have priority over any duplicated requirements.

Marine grade plan BT, equipment, fixings etc. are to be provided by the Contractor throughout. The Contractor is to validate and coordinate all works prior to submission of workshop drawings and in keeping with all relevant standards and legislation. Where works are impacting existing main plant, the Contractor shall ensure all works meet current code and seek certified approval prior to installation where there may be risk associated with upgrade works.

Illumination of the new link between B104 and B105 is assumed to be provided by the existing high mast, no lighting upgrade works are to be undertaken in this area at the request of the Principal.

11.2 Standards and Codes

The Codes and Standards applicable to only a portion of the work specified in this section are referenced in the relevant parts or clauses. The latest editions of the Codes and Standards used are listed below:

11.2.1 Australian Standards

- AS/NZS 1680.5:2012 Interior and workplace lighting, Part 5: Outdoor workplace lighting

11.2.2 Other Standards / Guidelines

- Port Skills and Safety - SIP009 – Guidance on Lighting (UK Document).
 - Health and Safety Executive (HSE) – Lighting at Work guideline (UK Document).
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11.3 Materials

Lighting equipment shall be as specified in the lighting Drawings and guaranteed by the luminaire manufacturer/supplier. All equipment shall be installed as per the manufacturer's instructions and recommendations.

Supply and install all equipment required to construct the installation as documented on the Drawings.

All equipment, materials, fittings, fixings, coatings and sealants shall be installed strictly in accordance with the manufacturers and supplier's instructions.

The complete installation shall be handed over in a perfectly clean condition with all rust and dirt removed and paintwork and bright parts cleaned and polished, and with all labels and identification marks affixed. All plant is to be neatly installed. No rough edges shall remain.

All materials shall be the best of their respective kinds, qualities or grades as hereinafter specified, of the one make as far as is practical to simplify the provision of spare parts and shall comply with the requirements of the Superintendent, Inferior materials will be rejected and must be removed from the site whether such materials have already been incorporated in the installation. The Superintendent's decision on such matters shall be final and binding.

Where no specific kind or quality of material has been specified, including materials not shown on the Drawings or mentioned in the specification that are normally included as good trade practice, provide materials and equipment of the finest quality and most suited to the application concerned and available at the time.

All work shall be done in accordance with sound trade practice by competent, and where necessary registered, tradesmen experienced in the types of work concerned.

Metal sheet components must be corrosion-resistant unless otherwise indicated and should prevent warping and sagging. Where dissimilar metals are used, these shall be suitably coated to prevent galvanic reaction which could lead to corrosion.

Housings must be weather-tight and light-tight enclosures that have to be rigid to avoid warping or sagging in use.

Doors, frames, and other internal access must be working smoothly and free from light leakage under operating conditions.

Wiring within the lighting fixture shall be heat resistant with silicone braided sleeve, capable of withstanding working temperatures up to 105 °C.

HOLD POINT

Submission of luminaire datasheet with specific details, at least 2 weeks prior to procurement.

Wiring within lighting column/mast shall be rubber insulated to withstand the high ambient working temperatures encountered.

The luminaire body shall be from marine grade aluminium (LM6) or approved equivalent.

High mast lighting must allow for maintenance via elevated platform.

HOLD POINT

Submission of mast shop drawings, at least 2 weeks prior to procurement.

11.4 Durability

The ‘design life’ shall be the period over which an asset (or equipment or sub-component of equipment) must perform its intended function without replacement, refurbishment, or significant maintenance. This does not include prescribed regular maintenance or small sub-components (or replaceable sub-components such as fuses) but where multiple sub-component failure of the same type occurs significantly prior to the design life this shall be considered as non-compliant with the intent of the clause.

This clause shall be used for evaluation of the equipment offered and the Contractor may be requested to demonstrate that the intent of this clause is complied with.

External components shall have coatings that provide a minimum durability of 15 years allowing for the environment which they are installed; for example, coastal, marine, industrial, etc.

Surfaces shall be prepared, and paints or coatings applied in accordance with vendor recommendations or coatings specialist recommendations.

Where galvanised steel is used for the lighting masts, mounts and fixings, the galvanising treatment shall only be of the hot dip type. Items to be protected shall be completely fabricated with all possible penetrations pre-drilled or punched before the application of the protective finish. All mild steel, proprietary equipment, components exposed to the view of occupants and components likely to corrode shall be painted or otherwise protected in a manner approved by the Superintendent.

Equipment must have the following minimum design life:

Table 11.1 Lighting Equipment minimum design life

EQUIPMENT	DESIGN LIFE (YEARS)
Luminaires	20
Lighting Masts	30+

11.5 Lighting Masts

All new lighting masts shall be manufactured to AS/NZS 4676 and galvanized to AS/NZS 4680 HDG600 and then painted as per the requirements of Table 7.1 of AS/NZS 2312.1:2014 after 15 years or first sign of major degradation of finish.

Masts shall be supplied and installed as shown in the Drawings and in accordance with the manufacturer's instructions. Masts shall be installed vertically ($\pm 1^\circ$) after levelling and shall remain so until the end of the defect's liability period. The surrounding ground shall be reinstated to match undisturbed ground. Masts (are where applicable, luminaires) shall be subject to the following construction tolerances.

HOLD POINT

Submission of mast shop drawings, at least 2 weeks prior to procurement.

11.5.1 Tolerances

- Mast / Column Location: ± 1.0 m
- Luminaire height: ± 0.2 m

Masts shall be marked out on site by the Contractor. Excavations and installation of Masts is not permitted until approved by the Superintendent. A minimum of three working days' notice is required for the Superintendent to mark new mast locations.

WITNESS POINT

Inspection of mast marked locations.

All new lighting masts shall be erected with their inspection doors being comfortably and safely accessible for an operative of either handedness.

All new 'Tilt and/or hinged Masts' shall be erected in an orientation that allows for the unimpeded and safe lowering of the mast system.

Mast mounting accessories (mounting brackets, nuts, bolts etc.) shall be hot dip galvanised, unless otherwise specified.

11.5.2 Mast Installation

- Use web fabric slings (not chain or cable) to raise and set Masts/columns.
- Bolts to be tightened to manufacturers recommendations.
- All baseplate bolts to be wrapped in Denso Petrolatum (Wax) tape or similar to protect the threads.
- The mast type 'FLA' is to be located in a way that the mast can be safely lowered parallel with the shore to not block the turnaround area, but also provide access to the luminaires on the ground from the formed pavement. The mast lowering arrangement is to be orientated such that the adjacent titan power bollard does not foul the mechanism.

11.5.3 Cross Arms / Headframes

The luminaire cross arm assembly shall be designed so that these units jointly impose a ‘balanced’ load on the mast. Where the design requires asymmetrically positioning of luminaires, secured weights shall be added to counterbalance the weight distribution.

The cross arms shall have bespoke aiming plates to suit the designed fittings capable of providing 45° of aiming rotation left and right from centre, i.e. 90° of rotation in total.

Luminaires shall be further secured to the cross arm / headframe using a lanyard system.

11.5.4 Foundations

Mast foundations shall be constructed as per the structural design and associated specification section of this document.

11.6 Luminaires

Luminaires shall be as per the lighting Drawings and shall be manufacturer warranted for 10 years.

Luminaires shall have the following general attributes.

- 3000 K correlated colour temperature.
- 100,000 Hours of maintained lighting operation.
- IP65 or above.
- MF = 0.9 X Luminaire Light Loss Factor (LLF = 100,000 hours @B10 in a 25 Degrees ambient temperature (TA))
- Be equipped with surge protection equipment up to 10kV, 10kA level.
- ≤ 0.1% Upward Waste Light Ratio in the designed configuration.
- The floodlight shall have a track record for operation in the Australian environmental conditions.

Consideration of alternative submissions will necessitate the Contractor to demonstrate ‘equal’ or ‘improved’ lighting performance over the luminaires specified in all aspects of lighting performance and technical specification. This must include a whole or life cost analysis for the duration of the design life, final acceptance for use must be provided by the Superintendent.

HOLD POINT

Submission of details of alternative submissions.

Alternative luminaire submissions are required to provide the following information from an ISO 9002 certified laboratory.

Copies of the following test reports are to be provided to the Superintendent:

- L70/L80/L90 to B10 Specifications
- LM79 (LM-79-08). (From an ILAC Accredited Laboratory)
- LM80 (LM-80-80).
- TM21 (TM-21-11).
- Ingress Protection.
- IK Rating.
- Salt Spray Test

Luminaire Aiming Tolerances:

- Tilt above/below the horizontal plane: $\pm 2^\circ$
- Spin or Roll: $\pm 2^\circ$
- Orientation / Rotation: $\pm 5^\circ$

11.6.1 Luminaire Drivers

New luminaires shall be supplied with new electronic drivers/control gear, which is Digital Addressable Lighting Interface (DALI) compliant and shall be guaranteed by the manufacturer and/or supplier.

Remote drivers shall be \geq IP66 and must not be operated in an environment that exceeds 55° Celsius ambient temperature.

Luminaire mounted drivers shall be housed in a proprietary IP66+ enclosure supplied by the luminaire manufacturer.

11.6.2 Electrical Wiring within the Lighting Mast/Column

Refer to the electrical Design Drawings and the relevant section of the Technical Specification for detailed required.

The internal wiring of the lighting masts shall comply with the requirements of AS/NZS 3000. Any external sections of wiring from the cross arm to the luminaire cable entry shall be appropriate UV rated cables and be mechanically protected to limit direct UV exposure and prevent damage from birds.

11.6.3 Photo Electric (PE) Sensors (100 – 2,000 lux)

- The sensors shall be installed in a position designed to ensure accurate measurement of the ambient light levels. Care shall be taken to avoid direct light from luminaires or other sources striking the detector.
- The sensors shall be designed to measure ambient light levels in the range of 100 to 2,000 lux.

11.7 Summary of Hold/witness Points

All hold and witness points during construction of lighting services are outlined inTable 11.2, and all required tests are outlined inTable 11.3.

Table 11.2 Hold/Witness Point Schedule

PROCEESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Luminaire Procurement	11.3	HOLD	Submission of luminaire datasheet with specific details, at least 2 weeks prior to procurement	Review and approval of the supplied documentation by the Superintendent
Lighting Mast Procurement	11.3, 11.5	HOLD	Submission of mast shop drawings, at least 2 weeks prior to procurement.	Review and approval of the supplied documentation by the Superintendent.

Alternative Luminaires	11.6	HOLD	Provide all documentation listed in this specification with accompanying lighting design layout. Must include structural assessment.	Review and approval of the supplied documentation by the Superintendent.
Lighting mast installation	11.5.1	WITNESS	Inspection of mast marked locations to be witnessed on site prior to install.	The Superintendent will inspect the locations prior to installation

Table 11.3 Works Testing

ACTIVITY	TEST METHODS	MINIMUM FREQUENCY	ACCEPTANCE CRITERIA
Check of luminaire aiming.	Visual Inspection during the day.	Once at completion.	Approved by the Superintendent.
Post construction Lighting Survey	Sample recorded Illuminance measurements throughout the design area with a calibrated illuminance meter.	Once at completion.	Provision of a plan showing the recorded measurements alongside the design illuminance levels (at initial output, not maintained). For review by the Superintendent.

12 Piling

12.1 Scope

This section of the Specification covers the supply, delivery, handling and installation of piles. The Scope of Work covered by this Section includes, but is not limited to, the supply and installation of steel tubular piles to support the Berth B104 Extension and Mooring Dolphin.

12.2 Standards and Codes

The workmanship and materials provided under this Specification shall comply with the requirements of all Statutory Authorities having jurisdiction over all or part of the specified works, together with the relevant Standards listed below, unless specified otherwise.

12.2.1 *Applicable Standards*

- AS 2159 Piling - Design and Installation
- AS 1163 Structural Steel Hollow Sections
- AS 1365 Tolerances for Flat-Rolled Steel Products
- AS 3678 Structural Steel - Hot Rolled Plates, Floorplates and Slabs
- AS 3679 Structural Steel
- AS 3679.1 Hot Rolled Bars and Sections
- AS 3679.2 Welded Sections
- AS 4100 Steel Structures
- AS 1101 Graphical Symbols for General Engineering
- AS 1101.3 Welding and Non-Destructive Examination
- AS 1553 Parts 1-3 Covered Electrodes for Welding
- AS 1554 Parts 1 -6 Structural Steel Welding Code
- AS 1579 Arc Welded Steel Pipes and Fittings for Water and Wastewater
- AS 1674 Safety in Welding and Allied Processes
- AS 1796 Certification of Welders and Welding Supervisors
- AS 2214 Certification of Welding Supervisors - Structural Steel Welding
- AS Z5 Glossary of Metal Welding Terms and Definitions
- AS 1171 Methods for Magnetic Particle Testing of Ferromagnetic Products and Components
- AS 1391 Methods for Tensile Testing of Metals
- AS 1710 Non-Destructive Testing of Carbon and Low Alloy Steel Plate - Test Methods and Quality Classification
- AS 1815 Metallic Materials - Rockwell Hardness Test
- AS 1816 Metallic Materials - Brinell Hardness Test

- AS 2177 Non-destructive Testing - Radiography of Welded Butt Joints in Metals
- AS 2207 Non-destructive Testing - Ultrasonic Testing of Fusion Welded Joints in Carbon and Low alloy Steel
- AS1100 Technical Drawings
- AS1101 Graphic Symbols for general engineering
- AS/NZ 2312 Guide to Protection of structural steel against atmospheric corrosion by the use of protective coating
- AS 1627 Metal Finishing – Preparation and Pre-treatment of surfaces
- ISO 834 Quality Requirements for Welding
- ISO 14731 Welding Coordination – Tasks and Responsibilities
- ISO 10474 Steel and Steel Products – Inspection Documents
- ISO 9001 Quality Management Systems
- BS4360 Steel plate manufacture
- JIS A 5525 Tolerances for pile manufacture
- BS5228-2 (2009) Code of practice for noise and vibration control on construction and open sites
- Where conflict exists between different applicable codes, standards or regulations, the higher requirement shall apply. The Contractor shall not deviate from the provisions of the relevant standard without first obtaining approval in writing from the Superintendent.

12.3 Materials

12.3.1 *Materials for Pile Supply*

All materials forming part of the completed works shall be new and supplied by the Contractor in accordance with the steelwork requirements stipulated on the Drawings. Any materials rejected for failing to comply, shall be replaced at the Contractor's cost. Steel plate for the tubes, fabricated sections, backing rings and driving shoes shall conform to the requirements of AS/NZS 3678:2016.

The Contractor shall submit the Supplier's certified reports of physical properties and chemical analyses for all steel used in pile fabrication, in the form of self-explanatory, clearly set-out conformance reports in English language, demonstrating compliance with AS/NZS 3678:2016. All materials used in pile fabrication shall be capable of being traced to a mill certificate and quality documentation. Unidentified material shall not be used in the fabrication of pile sections supplied under this Contract.

All steel shall be free from excessive rust, pitting and other defects which either impair the structural capacity of the member or are likely to impair the quality of the protective coating system. Material that has been split or permanently damaged shall not be used.

Tubular piles shall be rolled or formed from steel with minimum guaranteed yield strength of 350 MPa. Steel composition and performance shall conform to the requirements of Australian Standard AS3678. The Contractor shall not vary the place of manufacture of the steel plate to be used in the pile fabrication stated in their Tender without the written approval of the Superintendent. All plate shall have clear and distinct manufacturer's markings identifying the material certificate and quality documentation for that plate.

An Inspection and Test Plan (ITP) for the supply of steel for pile fabrication shall be provided along with certificates and supporting quality documentation, no later than 28 days prior to procurement.

HOLD POINT**HP112**

Submission of Inspection and Test Plan (ITP) for the supply of steel materials for pile fabrication, 28 days prior to procurement.

12.3.2 *Welding Consumables*

Welding electrodes shall be suitable for Grade 350 steel. Welding electrodes (including filler wires) shall comply with the relevant requirements of Clause 2.3.1 of AS/NZS 1554.1:2014 and AS 4855:2007, as appropriate. Only electrodes of approved manufacture and type shall be used. Electrodes shall be stored and handled in accordance with Clause 2.3.2 of AS/NZS 1554.1:2014 and any special precautions recommended by the electrode manufacturer.

Welding consumables shall be stored in conditions appropriate to their use and in accordance with the governing standards and the manufacturer's instructions. In addition:

- Low hydrogen electrodes shall be kept in their sealed packets until the time of welding;
- Immediately after opening a new pack of electrodes they shall be transferred to a portable drying oven where they shall be kept at a temperature recommended by the electrode manufacturer. If they are not used within two hours of removal from the hot box, the electrodes shall be reheated; and
- Electrodes that have been exposed to the weather and especially to atmospheric moisture conditions shall be discarded.

Only fluxes of approved manufacture and type shall be used and must be of a grade compatible with the parent material. Flux used for submerged arc welding shall be stored in approved conditions. It shall be free of contamination from mill scale, moisture or other foreign matter. Other requirements relating to flux are detailed in Clause 2.3.3 of AS/NZS 1554.1:2014.

12.4 Steel Pile Fabrication and Supply

12.4.1 *Pile Sections*

The Contractor shall manufacture, supply and deliver of all pile sections as specified here and as shown on the drawings. Nominated pile tube diameters, thicknesses, configurations and levels are provided in the pile schedule on the Drawings.

Although indicative variability in founding levels has been provided in Table 12.1, this information shall not be relied upon for calculation of ordered pile length and the Contractor shall make their own assessment of the delivered pile lengths and order the length of piles to facilitate pile placement, driving, cut off and contingency for potential variations in driven toe level and, additional pile length as required by the Contractor based on their piling method and equipment (e.g. crane height, lifting holes, impact damage, etc.).

12.4.2 *Pile Fabrication*

12.4.2.1 Standards

The fabrication of all steelwork shall be carried out in accordance with the requirements of Australian Standard AS4100 or other international standard approved by the Superintendent.

12.4.2.2 Fabrication

Tubular piles shall be fabricated as seamless, seam welded or spirally welded. All tubular piles shall be supplied with the pile shoes welded in place. Where piles are formed with longitudinal welded seams the steel plate shall be rolled into cans not less than 3 m long that are butted together and spliced into lengths suitable for delivery to the site.

The ends of piles shall be cut accurately and square to the longitudinal axis of the pile and shall be prepared for welding at splice locations. All pile fabrication splices shall be undertaken with pre-qualified full penetration continuous butt welds complying with the requirements of AS1554. Longitudinal seam welds or spiral seam welds of lengths of steel tube forming a complete pile segment shall be evenly staggered.,

The pile shall be clearly, indelibly and uniquely marked such that all quality documentation relating to the fabrication of that pile can be traced back to its quality documentation and so to identify its location in the works (e.g. grid line location or other suitable identifier). The length and diameter of the pile shall also be clearly and indelibly marked on the outside of the shoe end of each pile and additionally on the inside at the top of each pile.

12.4.2.3 Welding

All welding shall be qualified complete penetration butt welds carried out in accordance with the Drawings and the requirements of AS1554 unless otherwise specified. Fabrication shall be in accordance with the requirements of AS1554. Trial welds shall be prepared and non-destructive tests shall be carried out in accordance with AS 1554 in order to demonstrate the soundness of the method proposed for the splicing of pile segments.

Welders shall be qualified in accordance with AS 1796 and shall only be assigned work for which they are qualified. Copies of certificates relating to the welders' tests shall be supplied to the Superintendent before the welding personnel take part in any work covered by this Contract. Welding supervisors shall be qualified in accordance with AS 2214. All welding shall be category "SP" (Structural Purpose) as defined in AS 1554 using E49 electrodes.

The finished surface profile of all welding shall be smooth and free from sharp edges or crevices that would be detrimental to the performance of the structure or to the protective treatment. All slag and weld splatter shall be thoroughly removed, and the weld surface shall be replaced, repaired and ground as directed by the Superintendent until a satisfactory surface finish has been achieved. Finished pile welds shall be as small as possible but not project above the surface of the pile by more than 4 mm.

12.4.2.4 Weld Inspection and Testing

All welds shall be 100% visually examined for surface porosity and cracks. Welds that are suspect shall be further examined using a water-soluble dye penetrant process. All defects shall be rectified by grooving and by re-making the affected length of weld. A deep-penetration reinforcing run may be accepted as an alternative to cutting out and re-welding subject to approval.

Twenty five percent of the completed weld lengths shall be ultrasonic tested in accordance with AS 2207 as a spot check on weld quality. The frequency of testing shall be increased as directed should any of the welds tested fail to reach the specified standard of acceptance. Copies of results of all weld tests shall be provided to the Superintendent.

12.4.2.5 Superintendent's Inspection

During fabrication, the Contractor and its subcontractors shall permit the Superintendent or their representatives free access to the works at all times for the purpose of carrying out inspection and additional testing, and shall afford all necessary facilities for the carrying out of such inspections. The Contractor shall make available all relevant records and shall allow access to the manufacturing plant and workshops for inspection of the piles during and after manufacture.

Pile sections shall be laid out and fabricated as necessary so that all parts are accessible for inspection before transportation to the site. Any inspection by the Superintendent shall not prevent the possible rejection of any work or materials in which defects have been found at any time prior to the completion of the Contract. All piles shall be subject to final approval on site prior to unloading.

12.4.2.6 Fabrication Location

The Contractor may elect to fabricate off site part pile lengths or cans, transport them to the Site and then fabricate them into full length piles in a fabrication yard set up within the Site. A specific available site has been made available by the

Principal as indicated in the Construction Site Plan in the Drawings. If piles are to be spliced on site, a separate specific ITP shall be provided for that purpose.

Notwithstanding, the Contractor shall be responsible for delivery of full length piles to the nominated storage yard shown in the Drawings.

HOLD POINT

Submission of Inspection and Test Plan (ITP) for the on-site fabrication and supply of steel piles and shop drawings, 28 days prior to commencement of fabrication.

12.4.3 Tolerances and Imperfections

Steel plate shall generally satisfy the tolerance limits of AS 1365. Steel tubes shall satisfy the tolerance requirements set out below.

The complete tube pile sections after welding shall not deviate from straightness by more than 1/1000 of their length measured from a straight line joining the head and toe of the pile. The maximum deviation from straightness shall not exceed 15 mm for any lengths greater than 15 m.

For machined butt joints in compression, the clearance between the surfaces shall not exceed 0.25 mm for at least 60% of the bearing surface. Over the remainder of the surface, the measurable gap between the surfaces shall not exceed 1 mm.

The diameter of any section of a tubular pile shall not vary by more than $\pm 1\%$ from the specified diameter. The outside circumference shall not vary by more than ± 25 mm from the nominal circumference. The face on the ends of the tubes shall not be out of square by more than 3 mm.

All tubular pile sections shall be joined to match as near as practicable. The maximum allowable mismatch of the end to be butt-welded shall not exceed 3 mm at any location on the joined surface notwithstanding the specified tolerances.

Imperfections of the following type shall be cause for rejection of tubular steel piles. This shall not be construed as limiting the Superintendent's right to reject tube for imperfections other than as given below:

- The tube pile shall contain no visible dents. The length of tube pile in which any dent occurs shall be cut out and the ends spliced together. Working the dent to restore the cross section will not be permitted.
- Laminations extending into the face of the bevel of the tube and having a transverse dimensions exceeding 5 mm shall be cause for rejection.

12.4.3.1 Submission of Quality Procedures

Piles shall be manufactured under a strict factory quality assurance/control plan accredited with ISO 9001 certification.

The Contractor shall arrange for steel in the pile tubes to be inspected, tested and marked under the supervision of an internationally accredited authority acceptable to the Superintendent or by a qualified responsible metallurgist. The Contractor shall maintain full records of materials, welding and testing, and these shall be submitted to in a form acceptable to the Superintendent from time to time as requested and at the completion of the works.

The Contractor shall arrange for copies of mill and test certificates to be forwarded to the Superintendent, with such schedules or other documentation that permits identification of the steel so tested and marked. Certificates shall clearly indicate code compliance and yield strength of steel used in the piling.

A steelwork fabrication Inspection and Test Plan (ITP) for steel pile fabrication shall be provided along with the shop drawings, qualifications, certificates and supporting quality documentation no later than 28 days prior to commencement of fabrication.

HOLD POINT

Submission of Inspection and Test Plan (ITP) for the fabrication and supply of steel piles and shop drawings, 28 days prior to commencement of fabrication.

12.4.4 Contractor Submission and Acceptance

- No later than 28 days before delivery of piles to site, the Contractor shall provide a Compliance Form from the pile manufacturer showing that the delivered piles comply with all corresponding quality data for materials, manufacture, straightness, length, diameter and mismatch tolerances and coatings as per the specification. Each pile is to be checked off on delivery to site as having a corresponding Compliance Form as above and marked when survey certification is checked off and is completed.
- All supplied piles shall be clearly marked to allow cross-matching to the quality documentation to each pile.

HOLD POINT

Submission of all quality data for materials and components including a Compliance Form to specified codes and standards. No later than 28 days before delivery to site.

Piles to be Witnessed as checked off on arrival to site and cross-checked to corresponding Compliance Form

12.4.5 Storage, Handling and Delivery

Before, during and after fabrication, and during transit, all pile segments shall be handled, stacked and stored with the utmost care so that they are not damaged, bent or twisted. Before delivery to site, piles stored in the Contractor's yard or elsewhere shall be stacked clear of the ground on suitable supports to prevent distortion or damage to the piles.

The fabricated tube piles shall be delivered to the nominated storage yard within the Site. All piles shall be stored above the ground on adequate supports. The minimum clearance from ground level to the underside of the pile shall be 100 mm

The piles shall be stacked in incremental lengths and in groups of the same length. The piles shall be stacked one pile high in a safe and secure manner. They shall be separated with a minimum 600 mm between piles and shall be stacked clear of the ground.

All chocks and wedges shall be secured to bearers in a manner to prevent sliding or rolling of the sections and to ensure stability of the stacks during further stacking, when the stack is completed and when sections are being removed.

Adequate load spreaders shall be provided to spread loads over the ground to ensure that stacks remain true and stable.

The Contractor shall submit the proposed stacking arrangement to the Superintendent and obtain approval 28 days before delivery to the Site.

HOLD POINT

Submission of proposed stacking arrangement.

12.4.6 Defects and Damage

If any defects or damage are found on delivery before or during unloading and after completion of handling of the piles, the Superintendent shall, at its absolute discretion, decide whether piles will be rejected, repaired on Site or the damaged portions returned to a workshop. The full cost of repairs or replacement of sections damaged in transit or at the shop shall be borne by the Contractor.

12.5 Pile Installation

12.5.1 Pile Installation and Acceptance

- No later than 28 days before the commencement of pile installation, the Contractor shall supply an Inspection and Test Plan (ITP) covering all aspects of pile installation and acceptance including all aspects of this specification and applicable Codes and Standards.
- All supplied piles shall be clearly marked to allow cross-matching to the quality documentation to each pile.

HOLD POINT

Submission of ITP for Pile Installation and Acceptance. No later than 28 days before the commencement of pile installation.

12.5.2 *Pile Pitching – Identification, Set Out and Location*

- No pile shall be pitched for driving until the pile has been checked for its identity, proper location, size, tolerance, straightness and integrity and pile markings have been applied.

HOLD POINT

Identification of pile size, tolerance, straightness, integrity and pile marking – prior to pitching.

12.5.3 *Ground Conditions*

The Contractor shall satisfy themselves as to the character of the materials to be penetrated and shall assume all responsibility and risk involved therein. No warranty expressed or implied is given for data contained in the Technical Information made available to the Contractor with the Contract Documents. Borehole data indicated are only represented as accurate for the exact location where the boreholes were made.

12.5.4 *Piling Set Out and Location*

- Permanent datum level points, base lines and grid lines shall be established and maintained during completion of the works. The set out shall include suitable identifiable sight lines, pins or markers indicating the position of each pile. The setting out of each pile shall be agreed with the Superintendent prior to commencing work on a pile and adequate notice for checking shall be given. Piles shall be adequately held and supported so as to achieve its installation tolerance at the end of driving.
- Prior to driving and after pile pitching, the plan location and verticality of each pile shall be provided to ensure compliance with the pile installation tolerance. Adequate notice shall be provided to the Superintendent to allow Witnessing of compliance. This survey shall be prepared and certified by a qualified Surveyor.

HOLD POINT

Before driving, submission of survey of plan location of each pile showing the pile being within tolerance.

Within 24hrs of pile installation and cut-off operations, a complete survey of the level and plan location of each pile shall be provided. This survey shall be prepared and certified by a qualified Surveyor.

HOLD POINT

Submission of level and plan location survey of each pile after pile driving, within 24hrs of pile installation

12.5.5 *Sequence of Piling*

At least 28 days prior to commencement of pile driving, the Contractor shall submit to the Superintendent for approval the proposed sequence for driving the piles. No piling operations shall be commenced until such approval has been given.

HOLD POINT

Submission of pile driving proposal.

12.5.6 *Piling Plant and Work Method*

The Contractor shall be responsible for assessing the pile installation and marine plant necessary to install the piles to the penetrations, position tolerance and ultimate geotechnical capacities (axial compression and tension and lateral capacity) necessary to fulfill the requirements of the design.

It is the responsibility of the piling Contractor to undertake driveability assessment based on proposed hammer and driving system to be used on site and considering other factors such as pile splices, driving interruptions, etc. this is to ensure that the proposed pile termination depths and required capacities can be achieved without damaging the piles with

the equipment proposed to be used on site. If the pile installation and marine plant proposed in the tender proves to be inadequate for achieving the piling accomplishment rate required by the Contractor's Programme, the number and or capacity of the installation equipment shall be increased at the Piling Subcontractor's cost.

Pile installation equipment shall be in good condition and shall at all times be maintained and operated by suitably experienced operatives at the efficiency and capability stated by the manufacturer. A pile driving hammer(s) shall be provided of sufficient capacity to meet all the criteria above and as stated on the Drawings. Piles shall be driven by approved proprietary hydraulic pile driving hammers or drop hammers, or an alternative type as approved. Approval shall be obtained prior to mobilisation of the required hammers.

Full details of the proposed piling plant and detailed method statements for carrying out the works shall be submitted at least 28 days before the proposed date of commencement of piling. Such details shall include where applicable a full description of the piling frame, hammer, helmet and packing, methods of handling, pitching and supporting the piles before and during driving, the support system for the piling plant, the proposed driving procedure, calculations and analysis carried out to determine the proposed pile sets to achieve the required minimum ultimate geotechnical capacity , the methods of bracing piles after driving is completed and other relevant information.

The calculations and analysis shall be carried out by a Chartered geotechnical Engineer with a minimum of 10 years' experience in the design and installation of driven pile foundations and shall be provided to the Superintendent. This shall include the design and certification of stable piling platforms.

HOLD POINT

Submission of pile installation method statement details regarding piling plant, detailed method statements and piling calculations 28 days before commencement of pile driving.

Piling equipment and methods adopted shall be such that damage does not occur to the steel pile casings, driving shoes or adjacent piles. Where pile tubes cannot be driven to the required levels as shown without damage, the Contractor shall propose alternate methods of advancing the pile, which shall be approved by the Superintendent. If these levels cannot be achieved, bored rock sockets and concrete toe plugs will be required. Such methods may include a larger pile driving hammer or excavating inside the pile or employing other techniques, such as auguring or jetting, which shall be approved by the Superintendent, to advance the piles to the required level.

Any proposed changes in the plant and methods of working shall be approved prior to implementation of the proposed work methods.

12.5.7 Disturbances and Damage

Piling work shall be carried out in such a manner and at such times as to minimise noise and disturbance. Care must be taken to ensure that there are no adverse impacts on surrounding structures and services due to construction vibrations. Vibration monitoring is required during pile driving in close proximity to the existing wharf for both risk management and construction control. Monitoring activity is recommended to comprise fixing of vibration monitoring devices (geophones) to the deck of the existing Wharf structure (including above the nearest piles and edge of the wharf deck) closest to the pile driving being carried out. Vibrations shall not exceed the following limits during pile installation activities:

- Peak particle velocity (PPV) of 25 mm/s for continuous vibration (e.g. vibratory driving)
- Peak particle velocity of 50 mm/s for transient vibration (e.g. impact/percussive driving)

Note that these thresholds assume that the existing wharf structure is in good condition. The current structural condition/integrity of the existing wharf is a factor in PPV thresholds and if the existing wharf is in poor condition, then lower thresholds should be adopted.

The existing masonry structures at the northern and southern end of the wharf are also to be protected against damage, the vibration level at their location is limited to:

- PPV 7.5 mm/s for continuous vibration (e.g. vibratory driving)

- PPV 15 mm/s for transient vibration (e.g. impact/percussive driving).

If during the execution of the works any damage is or is likely to be caused to mains, services or adjacent structures, proposals for repair or avoidance of such damage shall be prepared and submitted for comment by the Superintendent.

HOLD POINT

Submission of vibration monitoring methodology, repair or avoidance proposals where damage is likely to be caused, 28 days before commencement of pile driving.

When pile-driving plant is moved between pile driving operations, care shall be taken to avoid displacing or damaging previously driven piles.

The piling methodology shall ensure that damage does not occur to completed piling works. Any pile displaced or damaged shall be withdrawn and replaced with a sound pile or otherwise made good.

12.5.8 Pile Toe Levels

Piles shall be driven to levels that achieve the geotechnical ultimate capacities as stated on the drawings, determined from testing in accordance with Section 12.7.2.

Pile toe levels nominated on the Drawings are estimates based on the borehole data and previous piling records. Actual toe levels shall be determined by pile testing to ensure that the required pile ultimate geotechnical capacity is achieved. The Contractor shall make their own assessment of the required pile lengths and order the required length of piles to accommodate variations in driven toe level. The pile lengths ordered and supplied by the Contractor shall include a contingency length to accommodate variations in driven length.

12.5.9 Obstructions

Ground obstructions may be encountered during the execution of the works, whether foreseeable or not. Thus a contingency construction methodology shall be prepared with details of proposed methods for overcoming obstructions.

The Contractor shall also be responsible for assessing any difficulties likely to be encountered at the Site including piling over water, piling from land-based plant and obstructions to driving or any other construction risks. The Contractor shall be deemed to be aware of geotechnical data provided as Technical Information to Tenderers and to have visited the site and made themselves aware of site conditions.

The following clearance activities must also be completed before commencement of piling:

- Do not allow piling to start until clearance activities are completed and location has been verified clear of services and seabed objects.
- BYDA and other service plans must be available and current at time of piling.
- Inspect the site for evidence of unidentified services (e.g. undersea cables, sewer and stormwater outfalls).
- Underground/undersea services must be marked on the ground and communicated to workers.
- Never make assumptions regarding the location of services, if in doubt don't break ground.

HOLD POINT

Submission of methodology for overcoming ground obstructions, 28 days before commencement of pile driving.

12.5.10 Driving Piles

Piles shall be accurately pitched and driven in the position and to the lines shown on the Drawings within the specified tolerances.

At all stages during driving, piles shall be adequately supported and restrained without damage to the piles or any coatings or preservative treatment, by means of leaders, trestles, temporary supports or other guide arrangements to maintain position and alignment and prevent damage or buckling. Where necessary, extension leaders shall be fitted.

Helmets or anvil blocks shall be used for preventing damage to pile heads. Strengthening shall be provided to the heads of piles if required to resist driving stresses. Other than for time to carry out splicing in the leaders, driving shall be carried out continuously until the target or required set and/or depth of pile is reached.

Each driven pile shall be marked and numbered at 1 m intervals from the toe of the pile. The marking shall be a of a size and extent to be clearly legible for the purpose of noting initial pile penetration after pile pitching. To facilitate monitoring of blow counts, piles shall be additionally marked with markings at 100 mm intervals in that part of the driving length where the pile toe is expected to be within 5 metres of the estimated final toe level. All numbers, markings and graduations shall be accurately and legibly applied to the pile using a template and shall be positioned on the pile so that they are visible and legible from the shoreline / pile driving plant, whichever is closer.

The final set of each pile shall be recorded either as the penetration in millimetres per 10 blows or as the number of blows to produce a penetration of 25 mm, as may be agreed with the Superintendent during the works. The Contractor shall employ a suitably qualified geotechnical engineer to witness and agree the final set of each pile until such time as alternative arrangements have been agreed with the Superintendent. The final set on each pile shall be taken in the presence of the Superintendent, unless otherwise agreed. Pile acceptance at completion of driving is specified in Section 12.7.

WITNESS POINT

Final set on each pile.

Unforeseen changes in pile driving characteristics shall be notified immediately to the Superintendent. Adequate notice of pile driving operations shall be provided to the Superintendent and facilities provided to enable checking of pile driving resistances.

Generally pile driving shall cease when driving resistance is consistently harder than 100 blows per 100 mm to avoid buckling the end of the pile.

After driving, the pile shall be monitored for loosening and movement due to oscillation and vibration. If the piles are loosening in the ground due to the above, adequate measures shall be taken to ensure that pile capacity is achieved. The Contractor shall determine what bracing is required to ensure that the piles that have been driven are not disturbed or loosened prior to installation of the wharf deck, capping beam and/or bulkhead pile anchors. If piles are disturbed or loosened prior to installation of the wharf deck, it shall be the Contractor's responsibility to develop and carry out remedial works to the satisfaction of the Superintendent at no cost to the Principal.

Should any pile be damaged during driving the Contractor shall undertake remedial measures approved by the Superintendent. Any such remedial measures shall be at the Contractor's expense.

The use of jetting or augering as an aid to obtaining the required minimum pile capacity may be permitted subject to the preparation and submission of a detailed work method statement and acceptance by the Superintendent. Methods involving the return of soil and water along the outside surface of the pile (open circuit drilling) are not acceptable. The use of jetting or (undersize) augering may be permitted if the size of piling hammer required to obtain sufficient capacity would be such that damage could be caused to the pile during driving.

Where jetting or augering is permitted, it shall be carried out under rigorous supervision and control by a suitably qualified geotechnical engineer and in such a manner so as not to cause detriment to the surrounding ground or any part of the works.

HOLD POINT

Submission of work method statement for jetting or auguring, 28 days prior to commencement of pile driving.

12.5.11 Extensions to Pile Toes

To achieve the required geotechnical bearing capacity, concrete socket may be required to be used at the pile toe. Where a concrete pile toe socket is specified on the Drawings or as directed by the Superintendent, the Contractor shall extend the toe to the nominated level by means of the following:

- Materials to be removed from inside the pile using either air/water lift or augering.
- The use of drilling methods or other methods of excavating inside the piles and forming the toe socket, which could potentially cause belling of the socket, and hence be an obstruction to subsequent piling, will not be permitted.
- A positive head of water inside the pile shall be maintained at all times and in the event that there is evidence of caving of the excavated socket bentonite slurry or other support methods shall be employed. To exclude the water affected concrete from the design socket length in the steel tube, additional concrete of 0.5m to 1m inside steel tube shall be poured in addition to the specified plug length on the drawing.
- On completion of socket excavation all material shall be removed from the sides and base of the excavation to ensure the full cross-sectional area of the extension is free of debris and slush and shall comprise of natural exposed rock over at least 90% of the pile socket base area and side walls. Clay smear shall be removed from the sidewalls in the rock socket and driven pile using a scouring tool brush or other approved method.
- The material from pile excavation shall be inspected by the Contractor's Geotechnical Engineer in order to assess the strength of the rock, effectiveness of the pile socket cleaning methods and confirm that the minimum rock embedment length has been achieved, prior to placement of reinforcement steel and casing concrete. If the socket is not poured with concrete on the day of drilling, socket shall be checked and recleaned before commencement of the concrete pouring.

WITNESS POINT

Extensions to Pile Toes – Inspection of socket cleanliness

- Once the pile and excavation have been cleaned, a reinforced concrete toe extension is to be cast as shown on the Drawings. Concrete is to be placed under water using submerged tremie methods in accordance with this specification.

12.5.12 Driving Tolerances

Piles shall be driven as accurately as possible to the vertical and the permitted deviation of the pile centre from the centre point shown on the Drawings or setting out plan shall not exceed the tolerances specified below. Should it be necessary to offset a pile to avoid clashing with existing structures the Superintendent's written approval to proceed shall be obtained.

Forcible corrections of excessive deviation shall not be made to piles. A tolerance of 25 mm horizontally from true position will be allowed on the position of vertical piles as pitched before driving commences.

All piles shall be driven to the following tolerances:

- Plan position at design cutoff level within 150 mm, except as otherwise noted on the Drawings.
- Within 2% of vertical or design rake.

Should any pile be driven to exceed the specified vertical tolerances the Contractor shall take at their own expense such remedial measures as are approved or directed by the Superintendent.

After agreement on pile set and accuracy, the pile can be cut off. The pile cut off tolerance shall be:

- ± 5 mm flatness and
- ± 5 mm in target level when measured at intended pile top cut off level/location.

Pile surveys and records shall be in accordance with Section 12.5.4

12.5.13 Re-Driven Piles

Remedial measures may include withdrawing and re-driving of piles, which are outside the permissible tolerances. No pile may be re-driven after withdrawal unless it has been inspected and approved for re-use. The Contractor shall be responsible for all costs associated with re-driving or repairing piles including the cost of replacement piles.

When extraction of piles is undertaken it shall be carried out using efficient extraction equipment of adequate capacity. The extraction equipment shall be correctly positioned over the pile to minimise damage to the pile head and to prevent major disturbance of the supporting ground. Pile heads damaged during extraction, and pile toes found to have been damaged during initial driving are to be trimmed with a clean-cut perpendicular to the pile axis prior to re-driving.

In carrying out such work, any resulting holes due to withdrawal of the pile or of measures for removing the pile shall be packed with approved non-plastic material prior to re-driving. Should any pile be damaged during driving it shall be withdrawn at once and replaced by a sound pile at no additional cost to the Principal.

Levels and measurements shall be taken to determine any movement of the ground or any pile resulting from adjacent pile driving. Piles that have risen as a result of driving adjacent piles, shall be re-driven to prove the original set and or acceptance criteria.

12.6 Records

The Contractor shall provide complete records of all data covering the installation of each pile, which shall include but not be limited to the following:

- The date and time of pile driving.
- The sequence of driving
- Position of the pile
- Pile number and details of the pile.
- Type and size of hammer and for drop or single acting hammer, details of release mechanism,
- The length of the drop or stroke; for diesel hammer the length of stroke and the blows per minute, for double acting hammer the number of blows per minute, and for hydraulic hammers the recommended average energy per blow.
- Deviations from specified tolerances of toe of pile with hammer in place before driving and of toe of pile on completion of driving.
- Size and length of the completed pile.
- RL of existing surface and tide level.
- RL of toe of pile with hammer in place before driving.
- RL of toe of pile on completion of driving.
- Driving progression; i.e. log of pile depth, blow counts per 500 mm of penetration for the whole of penetration, until the last 3 m of driving, then at 100 mm intervals, interruptions or breaks in driving).
- The set and temporary compression for each of the last ten blows.
- Dolly and packing, type and condition before and after driving.
- Weight of helmet/dolly
- Pile hammer details, including weight, energy, etc.

- Details, dates and time of any re-driving or re-strike testing, including type and size of hammer and for drop or single acting hammer, details of release mechanism, the length of the drop or stroke; for diesel hammer the length of stroke and the blows per minute, for double hammer the number of blows per minute.
- Pile lengthening.
- Pile toe extension.
- In particular, the Contractor shall monitor the installation of piles in a manner appropriate to their Method Statement to indicate the nature and consistency of the ground penetrated and to ensure that damage to the pile does not occur.
- The Contractor shall correlate this information with the boreholes and piling records and shall notify the Superintendent immediately if any anomalies are apparent. An approved recording and reporting sequence shall be established prior to the commencement of the piling.

A signed copy of these records shall be submitted to the Superintendent within 24 hrs after installation of the piles.

HOLD POINT

Submission of piling records within 24 hrs after installation.

12.7 Pile Testing Acceptance and Completion

12.7.1 *Testing*

A pile testing programme shall be conducted to ensure the required minimum ultimate geotechnical pile capacities as described in this Specification are being achieved. This programme shall comprise dynamic pile testing and signal matching (e.g. CAPWAP) of piles as specified on the Drawings.

This shall be supplemented by determination of pile resistance by driving formula, (e.g. Hiley), on all driven piles. Tested piles shall be spaced throughout the works as shown on the Drawings.

Dynamic pile testing shall utilise a Pile Driving Analyser (PDA) such as that manufactured by Pile Dynamics.

Initial dynamic pile testing shall be conducted on the first piles driven in the northern wharf extension, northern access bridge, and southern extension. Thereafter testing shall be spread to be representative of full piling area. Dynamic pile testing shall as a minimum include:

- 1 no. vertical landside pile $\varnothing 1016$ mm at the mooring dolphin
- 3 no. vertical piles $\varnothing 1016$ mm at northern wharf extension
- 1 no. vertical pile $\varnothing 914$ mm at northern access bridge
- 1 no. vertical pile $\varnothing 914$ mm at northern wharf extension
- 2 no. vertical piles $\varnothing 1016$ mm at southern extension

Pile test results shall ignore the contribution to pile ultimate resistance from any material that would be present above the final dredged level during testing.

Additional dynamic testing may need to be undertaken if driving conditions vary significantly. The need for additional tests shall be as determined by the Superintendent.

Piles shall be PDA/CAPWAP tested to verify geotechnical capacity. PDA and Pile Driving Monitor (PDM) shall be conducted concurrently to establish correlation for driving impact energy and pile capacity. A minimum of 10% of piles are to be PDA tested. Should the pile load testing and analysis indicate inconsistency across the site, a greater level of pile testing will be needed (up to 20% of total number of piles).

The Contractor shall constantly monitor and record the last 3 m of anticipated driving. The data collected for all the pile tests shall be analysed using CAPWAP software or an equivalent.

An experienced independent testing company shall be engaged by the Contractor to conduct the dynamic testing. The proposed testing company, the equipment they propose to use and the curriculum vitae of staff who undertake the testing shall be submitted to the Superintendent for approval four weeks prior to any dynamic testing. The staff proposed to carry out the dynamic pile testing shall have experience in this specialist field.

HOLD POINT

Submission of proposed testing company, their proposed equipment and curriculum vitae of staff, 28 days prior to commencement of pile driving.

- No pile shall be tested until the pile tester has been approved and the piles to be tested agreed.
- No pile shall be built over with permanent works until written approval has been given of acceptance of the pile or group of piles into the works

HOLD POINT

Approval of pile tester and confirmation of piles to be tested.

Within one working day of each test a summary of the field results obtained during testing including the static resistance mobilised, the permanent set per blow during the test blows, an assessment of pile integrity and pile stresses during testing, shall be submitted for comment by the Superintendent.

HOLD POINT

Submission of daily field results within one working day.

Within two working days the results of any CAPWAP analyses completed shall be submitted for comment. The CAPWAP analyses shall be accompanied by a report indicating all assumptions and interpretation used in determining pile capacities.

HOLD POINT

Submission of CAPWAP analysis, within two working days.

Results of PDA testing shall be submitted for comment. The Contractor shall propose from the results the acceptance criteria for ‘set’ for piles not subject to PDA testing or describe what other provisions shall be incorporated into the works. These proposals shall be submitted to the Superintendent for approval.

HOLD POINT

Submission of PDA testing.

12.7.2 Criteria for Acceptance

All piles shall achieve the minimum required embedment as specified on the Drawings.

The achieved design geotechnical capacity for each pile shall be greater than the ultimate compression or tension loads as specified for the pile on the Drawings.

The design geotechnical capacity shall be calculated as the design ultimate geotechnical strength (calculated by either a pile driving formula or from dynamic testing results) multiplied by the geotechnical strength reduction factor of 0.75 for both compression and tension loads, as noted on the Drawings.

As such, the required minimum ultimate geotechnical pile capacity shall be calculated as the ultimate compression or tension loads divided by the geotechnical strength reduction factor. For example, the maximum pile axial load is for the seaward piles at the northern wharf extension. The ultimate compression load in the northern extension is 7400 kN for these piles which corresponds to a required design ultimate geotechnical capacity of 9870 kN.

The Dynamic Pile Test results will take precedence over estimates of pile capacity based on Hiley or other equivalent pile driving formulae. CAPWAP results shall take precedence over field estimates of capacity.

Any pile that is dynamically tested and found not to meet the ultimate geotechnical capacity requirement or found to be damaged shall be rejected.

If it is considered that a rejected pile is representative of other untested piles the latter piles may also be rejected, subjected to additional dynamic testing and/or further driving. It will be considered that a pile is representative of other untested piles if these piles have similar driving records, recorded sets, temporary compressions and driving energy at the end of driving.

Tested piles shall be accepted if results of CAPWAP pile tests show the piles to have ultimate geotechnical capacities, equal to or greater than the minimum ultimate geotechnical capacities calculated as above. Results shall be submitted for review to determine if they meet acceptance criteria for “set” and “penetration” nominated on the Drawings.

HOLD POINT

Submission of CAPWAP results and comparison to acceptance criteria, within two working days.

Piles not dynamically tested shall be accepted if pile-driving formulae based on driving energy and correlated to other PDA tests, indicate a pile capacity equal to or greater than the required minimum ultimate geotechnical capacity for that pile.

Piles shall not be subject to stresses higher than 90% of the yielding strength of the material during driving operations.

If a pile or group of piles fails to meet the specified acceptance criteria, proposals for remedial actions shall be submitted for comment.

HOLD POINT

Submission of remedial actions, if a pile or group of piles fails to meet specified acceptance criteria, within 2 days of each test result.

12.7.3 Cutting Off Piles

- No pile shall be cut off until it has been confirmed the pile has adequate capacity.

HOLD POINT

Confirmation of pile capacity, 24 hours in advance of planned cut off.

Pile cut off tolerance shall be in accordance with Section 12.5.12.

HOLD POINT

Measurement and confirmation of pile cut-off tolerances are achieved. Depending on the damage and cold working of the top of the pile during driving, the minimum length of the pile to be removed will be nominated. Under no circumstances will this be less than 300 mm, and will be dependent on the driving record and performance of the helmet. Pile segments shorter than 1500 mm shall not be reused in the permanent works

12.7.4 Electrical Continuity

Electrical continuity between all steel piles to allow for cathodic protection shall be provided as shown on the Drawings. These steel bars shall be protected from any damage during the deck beam construction.

No later than one day before concrete is poured in any section, the Contractor shall test inter-pile connections to ensure that continuity has been achieved in that portion of the work to the satisfaction of the Superintendent.

HOLD POINT

Testing of the inter-pile connections to ensure that continuity has been achieved in that portion of the work to the satisfaction of the Superintendent.

The Contractor shall enlist the services of a competent cathodic protection technician for testing the electrical continuity of the bonding systems. The Contractor shall supply all necessary testing equipment in good working condition.

12.7.5 Pile Acceptance

Not later than 28 days after pile installation, the Contractor shall provide to the Superintendent a complete and detailed submission which includes all quality records, photographs and proof of satisfactory pile installation including final sign off and acceptance by the Contractor and Superintendent in accordance with the ITP.

HOLD POINT

Submission of pile installation documentation including quality and test data, no later than 28 days after System installation.

12.8 Protective Coating System for Piles

12.8.1 General

This section sets out the general requirements for the coating methodology of the new steel piles. It describes the standards to which the materials and work must conform, and the procedures to be followed for the application of the coatings, both off and on site.

The corrosion protection of piles shall comply with coating quality level PC2 in Section 9 of AS/NZS 5131 and for all painted piles, the treatment grade shall be to P2: Thorough Treatment. The design requires the paint system to be applied from pile cut-off level to LAT -0.5 m (RL -0.5) and including for level variability.

It is anticipated that piles will be coated in the fabrication shop prior driving, however some site application may be required to address variability in pile founding levels – indicative variability in Levels is shown in Table 12.1.

Table 12.1 Indicative variability in founding levels

LOCATION	INDICATIVE LEVEL VARIABILITY (m)
Northern Extension	+/- 0.65
Northern Access Bridge	+/- 0.9
Southern Extension	+/- 1.1

The Contractor shall allow for the possibility of piles being founded higher than the toe levels given on the Drawings due to driving conditions and tolerances and should extend the length of protective treatment to suit. The Contractor shall also allow for the possibility of piles being driven below the toe levels defined on the Drawings and extend the protective coating at the top of each pile to suit. In both cases field application of the coating (or surface tolerant equivalent) shall be allowed for.

The extents of the coating application on the piles being coated in the fabrication shop shall be limited to the length between the required pile cut-off level and RL -0.5 (plus the variable level) – Refer Table 12.1.

The coating Inspection and Test Plan, methodology, and sample daily inspection reports / quality control (QC) forms, as outlined in accordance with Section 16.2, shall be submitted to the Superintendent 28 days prior to the pre-start meeting.

HOLD POINT

Submission of proposed ITP methodology, and sample daily inspection reports / quality control (QC) forms 28 days prior to pre-start meeting.

12.8.2 Coating Type

Protective coatings for the steel piling (from deck soffit to at least 0.5 below LAT and including for level variability), will meet the minimum requirements as follows:

- Organic paint system in accordance with table C1 of AS/NZS 2312.1, such as EUH2 or PES3 (glass flake reinforced systems) OR:
- Wrapping tape system, includes site application of a coating Mastic primer, petrolatum tape (2 layers) and HDPE sheath (Denso SeaShield 2000 FD or similar)

Where piles meet ground above the nominated -0.5m PKHD at the revetment, wrapping shall extend a minimum of 300 mm into the revetment fill below the rock. Pile head embedded in concrete is to be protected with a single wrap of Denso Seashield tape or equivalent approved centred on the concrete soffit prior to placing concrete as shown on the Drawings.

Any other steel components installed within the tidal/splash zone that cannot be wrapped will be provided with a protective coating meeting the requirements of Table C1, AS/NZS 2312.1, (seawater splash paint system) unless otherwise specified by components manufacturers.

The extents of field coating application zones are anticipated to extend from:

- 1 The bottom of the full shop applied coating to RL -0.5 (minus the variable level).
- 2 The top of the full shop applied coating to the cut-off level (plus the variable level).

12.9 Organic paint system

The coating system shall consist of two coats of either the PES3 system (Ultra high build polyester with a total nominal DFT 3000 µm), the EUH2 system (Ultra high build epoxy with a total nominal DFT 3000 µm) or an equivalent system suitable for seawater immersion as per table C1 of AS/NZS 2312.1:2014.

All paints shall be supplied by the same coating manufacturer, whose QA systems shall have current certification by the Australian Paint Approval Scheme (APAS). The composition and performance of coating materials shall comply with the relevant product standard specified in the AS/NZS 3750 series.

12.9.1 Surface Preparation

The surface preparation of all new steel piles requiring protective coating application shall be carried out in accordance with Section 16.3.

12.9.2 Application of Coating

Areas designated for full shop coating shall receive the specified nominal DFT as per Section 12.9.

Areas where field coating application is anticipated shall receive a light coating (minimum dry film thickness) to act as a holding coat to give temporary protection. The minimum dry film thickness of coating system needs to be confirmed with the paint manufacturer and provided to the Superintendent 28 days before procurement of the paint system.

HOLD POINT

Confirmation of the minimum dry film thickness of paint system with the paint manufacturer 28 days before procurement.

Particular care shall be taken to ensure that an adequate film thickness is achieved on all welds, corners, and edges. Brush application shall not be used, except for areas inaccessible to spray application, and for small areas of patch painting at the site, brush application may be used, provided such application is to a blast-cleaned surface. The appropriate curing

and drying times recommended by the paint manufacturer shall be allowed to elapse before the application of additional coats or cover coats.

12.9.3 *Holiday Testing*

Continuity or Holiday testing shall be carried out on the final coat to be immersed, in accordance with AS 3894.1 or AS 3894.2. Testing shall be carried out at the voltages specified therein. Any defective areas shall be marked, and their location recorded for later repair.

12.9.4 *Shop Repair of Defects*

Before application of any further coat of material, all damage to previous coats shall be repaired. "Damage" shall include localised areas of site welding and physical damage due to handling. Sagging, dimpling and curtaining not exceeding 5% of the total surface area coated shall not be considered as a defect requiring repair, where the coating thickness above the sag remains more than the specified minimum. Areas with an inadequate coating thickness, shall be thoroughly cleaned and where necessary additional coats applied until the specified thickness for each layer or area is achieved. Where the specified maximum thickness has been exceeded on painted surfaces, the coating shall be removed and reapplied so that the DFT is within the specified thickness range.

12.9.5 *Site Repair of Damaged Surfaces*

All pile coatings shall be thoroughly inspected by a coating inspector employed by the Contractor. The piles shall be inspected after delivery on site and prior to driving. The pile shall be inspected again at least 14 days prior to handover to capture any post-installation coating damage.

All areas of damage shall be identified and documented for site repair. Surfaces to be repaired on site, shall be thoroughly cleaned in accordance with AS 1627.1 by washing with water to remove soluble contaminants (e.g. salt); solvent or detergent solution to remove organic material (e.g. oil or amine bloom); and after degreasing, hand sanding or lightly brush blasting if required by the coating manufacturer. After cleaning, the full system shall be reinstated with each primer or build repair coat overlapping onto adjacent sound coating by between 25 mm and 50 mm.

The Contractor shall include a HOLD POINT in their Inspection and Test Plan for the pile installation.

HOLD POINT

Submission of inspection records on delivery and 14 days prior to handover. Repair records provided no later than 28 days after completion of the site repairs.

12.9.6 *Health and Safety*

The safety requirements for the preparation and application of a corrosion protection system on steelwork shall be in accordance with Clause 9.2.2 and 9.9.2 of AS/NZS 5131, and the current Health and Safety at Work Act and Regulations. The manufacturer's Material Safety Data Sheets for all materials including thinners and solvents shall be available to be reviewed by the Superintendent.

WITNESS POINT

Submission of manufacturer's Material Safety Data Sheets, 28 days before coating procurement.

12.10 Marine Petrolatum Tape with HDPE Jacket

If the Contractor selects the Denso SeaShield 2000FD jacketed petrolatum tape system, then the following specification items apply.

12.10.1 Guarantee

The coating system guarantee shall be 15 years. This guarantee shall be provided by the Contractor and shall be endorsed by the manufacturer and supplier. In the guarantee the material supplier shall confirm that it is satisfied that the application methods used have met with the required standards in order to provide the respective service life guarantees. At the end of the specified guarantee period the coating shall be deemed to meet with the guarantee if the coating is in a good condition and less than 1% of the coating surface is suffering from deterioration.

12.10.2 Installation Subcontractor

All surface preparation, system installation and inspection shall be carried out by specialists who shall produce evidence of satisfactory experience in this particular field. Only applicators approved by the Superintendent shall be employed for the works. The installation of this protective System is specialised work and only independent coating installers who can submit evidence of a suitable history of successful completion of similar work will be approved. The Superintendent shall have the sole authority to approve or reject the nominated independent system installer.

The Contractor shall provide to the Superintendent a submission including details of: the nominated independent system installer, associated work method statements, data sheets, installation manuals of product and an Inspection and Test Plans for the installation of the system. This submission shall be provided no less than 28 days prior to procurement of the system.

HOLD POINT

Submission of nominated independent system installer and associated Inspection and Test Plan, work method statements, installation manuals of product and Inspection and Test plans for the installation of the system no less than 28 days prior to procurement of the system.

12.10.3 Surface Preparation for Jacketed Tape System

The pile surface shall be cleaned of loose rust, any original coatings (excluding pre-applied coatings on new piles), marine growth etc by scraping, chipping, high pressure water blasting or ship hull scrubbers, in accordance with the manufacturer's instructions. The prepared surface shall be free of all possible contaminants immediately prior to system installation and a HOLD Point for the System installation Contractor ITP shall be included at this point.

HOLD POINT

Pile is cleaned and prepared to System installation specification requirements. To be accepted by System installation Contractor

12.10.3.1 Component and Installation

The specified coating system shall comprise four main components, primer, petrolatum tape membrane, outer mechanical protection jacket and fastening system all installed in accordance with the manufacturer's specifications.

A Denso SeaShield System 2000FD or approved equivalent outer protection jacket will be installed alongside the CP bond bar system which includes a bonded bar connection to the surface of the pile. The Contractor shall follow the Denso prescribed method statements for all installation activities including the Anode Bracket IFU or Anode Bracket Wrapping process.

12.10.3.2 Primer

A blend of saturated petrolatum-based compounds, inert mineral fillers, and water displacing wetting and passivating agents and wide spectrum biocides.

12.10.3.3 Sealant/Mastic

To protect complex surfaces and configurations such as brackets, flanges, valves etc., apply Denso Mastic by filling and packing to achieve a uniform contour to which tape can be applied without bridging or voids. Use Denso Mastic to fill in cavities at the pile/pile cap interfaces

12.10.3.4 Petrolatum Tape Membrane

Marine grade non-woven stitch bonded synthetic fibre fabric tape impregnated and coated with neutral specially formulated petrolatum-based compounds and inert fillers with additional inhibitors, thermal extenders, wide spectrum biocides and water displacing agents.

12.10.3.5 Outer Protection Jacket

The outer protection jacket shall be Denso SeaShield System 2000FD or approved equivalent. The jacket system shall cover the full circumference of the pile, ensuring no exposed petrolatum tape.

12.10.3.6 Fasteners

The jacket shall be secured using the M12 x 90 316 SS bolts, nuts & washers into the exposed empty holes and tightened up so that the bars are compressed, and the nut has reached the end of the thread or cannot be tightened further. or approved equivalent.

The jacketed petrolatum tape system shall be installed in accordance with the manufacturer's specification.

12.10.4 Pile Coating Length

The jacketed tape system shall be installed to the full external circumference of the pile, from the soffit of the concrete deck and beam to the minimum level of -0.5mPKHD and including for pile driving variability. Double layer of Denso Marine Piling Tape followed double layer of SA PVC overwrap Tape shall be installed at pile concrete interface as per suppliers recommendations. Tape to extend 50mm min and 100mm past soffit of the pile capital as shown on the drawing.

Where piles meet ground above the nominated -0.5m PKHD at the revetment, wrapping shall extend a minimum of 300mm into the revetment fill below the rock.

Prior to the installation of deck formwork and/or pouring of the concrete slab/beams the exterior of the pile shall be coated with primer and tape membrane.

12.10.5 Acceptance

Not later than 28 days after System installation, the Contractor shall provide to the Superintendent a complete and detailed submission which includes all quality records, photographs and proof of satisfactory System installation including final sign off and acceptance by the Contractor and System guarantee in accordance with the ITP.

HOLD POINT

Submission of System installation documentation including System guarantee, no later than 28 days after System installation.

12.11 Summary of Hold/witness Points

Hold points and witness points shall be observed in accordance with the following Table 12.2.

Table 12.2 Hold/witness Point Schedule

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD POINT
Procurement of steel pile materials	12.3.1	HOLD	Submission of Inspection and Test Plan (ITP) for the supply of steel materials, at least 28 days prior to procurement.	Acceptance by Superintendent prior to authorising the release of the hold point
Commencement of fabrication	12.4.2.6, 12.4.3.1	HOLD	Submission of Inspection and Test Plan (ITP) for the on-site fabrication and supply of steel piles 28 days prior to prior to commencement of fabrication	Acceptance by Superintendent prior to authorising the release of the hold point
Delivery of piles	12.4.4	HOLD, WITNESS	Submission of all quality data for materials and components including statement of compliance, no later than 28 days before delivery to site	Acceptance by Superintendent prior to authorising the release of the hold point Compliance Form Witnessed as cross checked on delivery
Delivery of piles	12.4.5	HOLD	Proposed stacking arrangement, no later than 28 days before delivery to site	Acceptance by Superintendent prior to authorising the release of the hold point
Pile installation	12.5.1	HOLD	Submission of ITP for Pile Installation and Acceptance, no later than 28 days before the commencement of pile installation	Acceptance by Superintendent prior to authorising the release of the hold point
Pile pitching	12.5.2	HOLD	Submission of document outlining size, tolerance straightness and integrity of piles, at least 24 hours in advance of pitching	Acceptance by Superintendent prior to authorising the release of the hold point
Pile driving	12.5.4	HOLD	Submission of survey of plan location of each pile showing the pile being within tolerance, at least 24 hours prior to pile driving	Acceptance by Superintendent prior to authorising the release of the hold point

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD POINT
Pile driving	12.5.5	HOLD	Submission of pile driving proposal, at least 28 days prior to commencement of pile driving	Acceptance by Superintendent prior to authorising the release of the hold point
Pile driving	12.5.6	HOLD	Submission of pile installation method statement details regarding piling plant, detailed method statements and piling calculations at least 28 days before commencement of pile driving.	Acceptance by Superintendent prior to authorising the release of the hold point
Pile driving	12.5.7	HOLD	Submission of vibration monitoring methodology, repair or avoidance proposals where damage is likely to be caused, at least 28 days before commencement of pile driving.	Acceptance by Superintendent prior to authorising the release of the hold point
Pile driving	12.5.9	HOLD	Submission of methodology for overcoming ground obstructions, at least 28 days before commencement of pile driving.	Acceptance by Superintendent prior to authorising the release of the hold point
Pile driving	12.5.10	HOLD	Submission of work method statement for jetting or auguring, 28 days prior to commencement of pile driving	Acceptance by Superintendent prior to authorising the release of the hold point
Pile driving	12.7.1	HOLD	Submission of proposed testing company, their proposed equipment and curriculum vitae of staff, 28 days prior to commencement of pile driving, 28 days prior to commencement of pile driving	Acceptance by Superintendent prior to authorising the release of the hold point

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD POINT
Pile driving	12.7.1	HOLD	Submission of daily field results, within 1 day of each test	Acceptance by Superintendent prior to authorising the release of the hold point
Pile driving	12.7.1, 12.7.2	HOLD	Submission of CAPWAP analyses, results and comparison and remedial actions if required within 2 days of each test	Acceptance by Superintendent prior to authorising the release of the hold point
Reinforced toe extension casting	12.5.11	WITNESS	Inspection of material from pile excavation for extensions to pile toes	The Superintendent will inspect the material prior toe extension casting
Pile Cut off	12.5.4	HOLD	Submission of level and plan location survey of each pile after pile driving, within 24 hours of pile installation	Acceptance by Superintendent prior to authorising the release of the hold point
Pile Cut off	12.5.10	WITNESS	Witnessing of final set of each pile.	The Superintendent will inspect the final set prior to pile cutoff
Pile Cut off	12.7.1	HOLD	Submission of PDA testing, within 2 days of each test	Acceptance by Superintendent prior to authorising the release of the hold point
Pile Cut off	12.7.3	HOLD	Pile Drive Records, 24 hours in advance of planned cut off	Acceptance by Superintendent prior to authorising the release of the hold point
Pile commissioning	12.6	HOLD	Submission of piling records, within 24 hrs after installation	Acceptance by Superintendent prior to authorising the release of the hold point
Concrete pouring in pile section	12.7.4	HOLD	Testing of the inter-pile connections to ensure that continuity has been achieved in that portion of the work to the satisfaction of the Superintendent, no later than one day before concrete is poured in any section	Acceptance by Superintendent prior to authorising the release of the hold point

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD POINT
Pile commissioning	12.7.5	HOLD	Submission of pile installation documentation including quality and test data, no later than 28 days after System installation	Acceptance by Superintendent prior to authorising the release of the hold point
Inspection and Test plan for coating application	12.8.1	HOLD	28 days before coating application	Acceptance by Superintendent prior to authorising the release of the hold point
Confirmation of Manufacturer Dry Film Thickness	12.9.2	HOLD	28 days before procurement	Acceptance by Superintendent prior to authorising the release of the hold point
Submission of pile inspection and coating repair records	12.9.5	HOLD	14 days prior to handover and no later than 28 days after completion of the site repairs	Acceptance by Superintendent prior to authorising the release of the hold point
Submission of manufacturer's Material Safety Data Sheets	12.9.6	WITNESS	28 days before coating procurement	
Submission of nominated pile jacket system installer.	12.10.2	HOLD	No less than 28 days prior to procurement of the system	Acceptance by Superintendent prior to authorising the release of the hold point
Pile is cleaned and prepared to System installation specification requirements	12.10.3	HOLD	In accordance with System installation specification requirements	Acceptance by System installation Contractor
Acceptance of pile jacket system installation	12.10.5	HOLD	Not later than 28 days after System installation	Acceptance by Superintendent prior to authorising the release of the hold point

13 Concrete

13.1 General

This specification covers the requirements for the main reinforced concrete elements for the Berth 104 wharf extension in Port Kembla Inner Harbour. This section of the Specification covers the supply of materials, workmanship, testing and construction for structural reinforced concrete.

The concrete requirements stipulated in this section are not applicable to the following concrete elements:

- Concrete pavement,
- Pavement kerbing
- Fence and gate post footings

13.1.1 Definitions

The following definitions shall be applicable to this Specification:

- **Binder:** The total combination of cement, fly ash, ground granulated blast-furnace slag and silica fume that makes up the cement system.
- **Cement:** Material conforming to TfNSW Specification QA 3323. It comprises General Purpose cements, Blended cements and supplementary cementitious materials (SCMs).
- **Cement mortar:** A mixture of cement, water and fine aggregate, with or without the addition of chemical admixtures or other materials, proportioned to produce a plastic mixture without segregation of the constituents, all of which separately and when combined conform to this Specification, with a compressive strength at 28 days not less than 40 MPa at bearings and 32 MPa elsewhere.
- **Chloride Threshold Level (CTL):** The chloride concentration of concrete, expressed as weight % mass, in contact with reinforcement that is considered to greatly increase the risk of depassivation of the reinforcement.
- **Concrete:** A thoroughly mixed combination of binder, aggregates and water, with or without the addition of chemical admixtures or other materials, all of which separately and when combined conform to this Specification.
 - Concrete Class Normal: Concrete which is specified primarily by a standard compressive strength grade and otherwise in accordance with AS1379 clause 1.5.3.
 - Concrete Class 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 AS1379 clause 1.5.4
- **Concrete Quality Plan:** A document prepared by the Contractor for the purpose of ensuring that required quality standards for concrete are attained, covering all aspects of concrete supply, placing, finishing and testing.
- **Concrete Placing Method Statement:** A document submitted by the Contractor to the Superintendent as part of the Concrete Quality Plan, detailing how the concrete will be placed, compacted finished and cured.
- **Concrete Production Method Statement:** A document submitted by the Contractor to the Superintendent as part of the Concrete Quality Plan, detailing how the concrete will be produced.
- **Contract documents:** Any documents issued to the Contractor and forming part of the Contract to construct the works.
- **Curing:** The process or operation for control of temperature and moisture in the concrete until the concrete has developed required properties.

- **Standard Moist Curing:** Standard Moist Curing as defined in AS 1012, Part 8.
- **Wet Curing:** Curing at ambient temperature in which the concrete surface is effectively covered with water or placed in a fog room/chamber with a relative humidity exceeding 98%.
- **Sealed Curing:** Curing at ambient temperature in which the concrete surface is sealed with a curing compound conforming to this Specification, or in which the concrete surface is sealed by the retention in place of impermeable forms.
- **Heat Accelerated Curing:** Curing concrete at artificially elevated temperatures such that the concrete temperature does not exceed 70°C where the concrete surface is protected against early age drying. Steam curing at atmospheric pressure is typical heat accelerated curing. Steam curing at high pressure (autoclaving) is excluded from this definition.
- **Cover (c):** The distance between the outside of the reinforcement and the nearest permanent surface of the member excluding any surface finishing material.
- **Drawings:** That part of the Contract documents showing the structures to be built and which may include notes describing how the work is to be carried out.
- **Design Life:** The design life required for the reinforced concrete element is 50 years. “Design life” is defined in the Specification as the period over which an asset or component must perform its intended function with anticipated maintenance but without replacement, refurbishment or significant additional maintenance.
- **Fine Amorphous Silica:** Silica fume or geosilica in any form provided it complies with AS/NZS 3582.3
- **Early Age Strength:** A mean compressive strength at 7 days exceeding the values shown in AS1379 Table 1.2.
- **Exposure Classification:** Refer to Clause 4.3 of AS 5100.5:2004.
- **Grout:** A mixture of cement and water, with or without the addition of fine sand or chemical admixtures or other materials, proportioned to produce a pourable liquid without segregation of the constituents, all of which separately and when combined conform to this Specification with a compressive strength at 28 days not less than 32 MPa when sampled and tested in accordance with TfNSW T375.
- **Joints**
 - **Construction Joint:** A joint provided to suit construction sequence with reinforcement continuous across the joint.
 - **Contraction joint:** An unreinforced joint with a bond-breaking coating separating the concrete joint surfaces.
 - **Dowelled joint:** A contraction joint with dowels installed across the joint in accordance with the structural drawings.
 - **Control joint:** A weakened plane 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 pre-moulded strip.
 - **Isolation joint:** A joint without keying, dowelling, or reinforcement, which imposes no restraint on movement.
- **Self-compacting concrete:** Concrete that is able to flow and consolidate under its own weight, completely fill the formwork even in the presence of dense reinforcement, whilst maintaining homogeneity and without the need for additional compaction. Also called self-consolidating concrete or super-workable concrete.
- **Silica fume:** Silica fume as defined in AS/NZS 3582.3
- **Supplementary Cementitious Materials (SCM):** Fly ash, Slag or Fine amorphous silica.
- **Surface Chloride Level (Sc):** The chloride concentration at the exposed surface of the concrete that forms within a short time after exposure. This is the level that is used in diffusion calculations to calculate the life of the structure.

- **Time to Activation (To):** The time from construction to the time at which the chloride concentration at the reinforcement reaches the Chloride Threshold Level (CTL).
 - **Water/Binder Ratio (w/b):** The ratio, by mass, of total free water including water contained in admixture solutions, to total cementitious materials in the concrete mix.
 - **Water/Cement Ratio (w/c):** The ratio, by mass, of total free water including water contained in admixture solutions, to total cement content.
-

13.2 Construction Sequence

The design of the beams and deck elements considers all the construction stages, from the lifting of precast elements through to intermediate construction stages where elements are required to carry the weight of wet concrete from the in-situ topping and associated construction loads, to the final operational stages. Details of the step-by-step design considerations for each element group is described in further detail in the following sections.

The intended construction sequence is summarised as follows:

- 1 Locally remove existing revetment rock
- 2 Install the piles
- 3 Reconstruct existing revetment
- 4 Installation of precast pile muff (pile capital)
- 5 Installation of precast “U” trough beams
- 6 Installation of precast deck planks
 - i Precast planks between gridlines A & C to be placed prior installation of fender precast downstand
 - ii Precast planks PS5 shall only be placed on CB1 and CB2 cantilever once the first stage pour concrete (to top side of “U” trough beams i.e. Step 7 below) is completed and has achieved at least 32MPa compressive strength.
- 7 First stage pour of concrete up to the topside of U trough beams.
- 8 Second (Final) stage pour of in-situ topping slab, including kerb and drainage outfalls.

Alterations from this construction staging will require checking and written approval by the Superintendent before any variation can be made.

13.3 Construction Staging and Loading

The design of the deck has been considered in the following stages:

- Stage 1- Lifting and installation of “U” trough precast beams and precast planks
- Stage 2 – First stage pour – concrete filling in “U” trough precast beams. Construction live load of 5kPa has been considered. The precast beams have been designed to consider following loads:
 - Self-weight
 - Dead load from the precast planks
 - Construction live load of 5 kPa
 - Weight from wet concrete fill from the first stage pour

The first stage pour concrete shall achieve minimum 32 MPa before moving to the final stage pour.

- Stage 3- Final stage pour – remining concrete up to finished deck surface. The precast planks and headstock/beam up to first stage pour concrete have been designed to consider following loads:
 - Self-weight
 - Construction live load of 5 kPa
 - Weight from wet concrete fill above precast plank and first stage pour concrete.
- Stage 4 - Operational – full depth configuration considered in the FEA model for all operational and seismic load cases, considering the slab acting continuously across the crossbeams.

The stage 1 analysis relates to the assessment of lifting the precast deck planks. Similar to the beams, WSP have checked to ensure that if lifted each end, the beams remain under the serviceability limit state load. It is the responsibility of the Contractor to design the lifting system in accordance with the lifting plan, making provision for the relevant Australian Standards. Minimum concrete compressive strength for lifting of precast units shall be 32MPa.

During the stage 2 and stage 3, and until the concrete has set and hardened, the precast planks are acting as simply supported. Consequently, the stresses from the self-weight of the precast slabs and the wet concrete are locked in to the structure and carried into the next stage.

A construction load of 5kPa has been included to account for any extra forces that result from the construction itself.

Note that such load is applied to the slab prior to the pouring of the topping slab. The construction load is transient and therefore, does not induce locked in stress in the precast slab reinforcement.

13.4 Australian and International Standards and Guides

Concrete and its constituent materials shall comply with the current requirements of the following codes and standards except were modified by this specification.

Table 13.1 List of Australian and international standards for concrete

STANDARD / CODE NO.	TITLE
SA HB 79:2015	Alkali Aggregate Reaction. Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia
SA HB 84:2018	Guide to concrete repair and protection (AS/ACRA)
AS 1012 all current parts	Methods of testing concrete
AS 1141 all current parts	Methods for sampling and testing aggregates
AS 1289	Methods of testing soils for engineering purposes
AS 1379	The specification and manufacture of concrete
AS 1478.1, AS 1478.2	Chemical admixtures for concrete, mortar and grout - Admixtures for concrete
AS 2350	Methods of testing Portland and blended cements
AS 2758.1	Aggregates and rock for Superintending purposes - Concrete aggregates
AS/NZS 3582.1	Supplementary cementitious materials for use with Portland cement - Part 1 Fly ash

STANDARD / CODE NO.	TITLE
AS 3582.2	Supplementary cementitious materials for use with Portland cement - Part 2 Slag – Ground Granulated Iron Blast Furnace
AS/NZS 3582.3	Supplementary cementitious materials for use with Portland cement - Part 3 Silica fume
AS 3583 all current parts	Methods of test for supplementary cementitious materials for use with Portland cement
AS 3600	Concrete Structures Code
AS 3610	Formwork for concrete
AS 3799	Liquid membrane-forming curing compounds for concrete
AS 3972	Portland and blended cements
AS 5100.5	Bridge Design - Concrete
AS/NZS ISO 9001	Quality management systems - Requirements
TfNSW Specification B80	Concrete Work for Bridges
ASTM C 295/C295M	Standard practice for petrographic examination of aggregate for concrete
ASTM C1202	Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
ASTM E 1155/E1155M	Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers
BS 8204: Part 2	In-situ flooring: Code of practice for concrete wearing surfaces
C&CA (UK)	Chaplin Abrasion Tester
ICRI 310.2R-2013	Technical Guide - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair
NT Build 443	Measurement of Chloride Ion Diffusion Coefficient (Dc)
NT Build 492	Measurement of Chloride Ion Migration Coefficient (DRMC)

13.5 Abbreviations

A summary of typical abbreviations found in this Specification is summarised in the table below.

STANDARD / CODE NO.	TITLE
AS	Australian Standard
ASTM	American Society for Testing Materials

STANDARD / CODE NO.	TITLE
HAT	Highest Astronomical Tide (Drawings refer to RL)
FA	Fly Ash
GGBS	Ground Granulated Blast-furnace Slag
SCM	Supplementary Cementitious Material
SF	Silica fume
T0	Time to corrosion initiation
TA	Ambient temperature
TC	Temperature of concrete as received on site
TR	Temperature rise of concrete after placing as calculated using the method described herein
TD	Maximum allowable temperature differential in a concrete pour between two points as defined herein
TM	Maximum allowable temperature of concrete for 31 days after placing
w/b	water to binder ratio
w/c	water to cement ratio

13.6 Concrete Quality Plan Requirements

The information to be submitted by the Contractor as part of its Concrete Quality Plan shall include, but not be limited to, the following:

- Procedure for storage, handling and adding admixtures where any admixtures are to be added on site.
- Details of the methods to be used to assess, monitor, and control temperatures due to heat of hydration.
- Verification of the compliance of any proposed heat accelerated curing method with the Specification requirements
- Any annual or periodic maintenance requirements arising out of the construction method or materials proposed by the Contractor to ensure the structure achieves its design life.
- Concrete Placing Method Statement in accordance with the relevant sections of this specification. The personnel required to carry out the operations together with proof of any relevant training and experience shall be included.
- Concrete Production Method Statement in accordance with Sections 13.8 and 13.9.
- The Concrete Quality Plan shall be submitted within 30 days from award of contract and a minimum of five (5) days prior to placing of any concrete.

HOLD POINT

Submission of concrete quality plan within 30 days from award of contract, minimum of 5 days prior to placing any concrete.

13.7 Concrete Materials

This Concrete Specification shall be read in conjunction with TfNSW QA Specification B80 Concrete Work for Bridges, Ed.7 Rev.5 (Feb, 2021).

The Contractor shall submit a Concrete Mix Design Report giving details of proposed concrete mixes for approval. This information shall include the sources of all materials, aggregate gradings, the ready-mixed concrete supplier and data confirming compliance with the performance requirements of this specification.

HOLD POINT

Submission of concrete mix design report, minimum of 14 days prior to concreting.

The Contractor shall also supply full details of the proposed admixture dosage/s and the manufacturer's product data sheet/s for the admixtures. All admixtures shall comply with AS 1478.1 and AS 1478.2. Where admixtures are used in combination, they must be sourced from the same manufacturer and written advice provided to confirm compatibility.

Trial mixes shall be prepared and tested for the proposed mixes, and full details of the concrete mixes shall be presented to the Superintendent in accordance with Section 13.8.7.

HOLD POINT

Submission of concrete mix tests, minimum of 14 days prior to concreting.

13.7.1 *Cementitious Materials*

13.7.1.1 Cement

All cement shall comply with the requirements of AS 3972 "Portland and blended cements" and the requirements of this specification.

Cement that has been in storage for more than three months from the date of initial sampling and testing or cement that is suspected to have been moistened or dampened shall not be used unless it has first been retested for conformance with AS 3972. Cement older than six months from the date of manufacture shall not be used.

Low heat cement will be required for mass concrete elements.

13.7.1.2 Fly Ash

Fly ash (FA) shall comply with the requirements of AS/NZS 3582.1. Only Fine Grade fly ash as defined in Table 1 of AS/NZS 3582.1 shall be used without written approval of the Superintendent.

13.7.1.3 Silica Fume

Any densified silica fume (SF) used in concrete mixes shall be finely divided and comply with the requirements of AS/NZS 3582.3.

13.7.1.4 Ground Granulated Blast Furnace Slag General

Any ground granulated blast furnace slag used in concrete mixes shall comply with the requirements of AS3582.2.

13.7.2 Fine and Coarse Aggregate

All aggregates used in the works shall comply with AS 2758.1 and Clauses 2.4 and 2.5 of the current version of TfNSW Specification QA B80.

13.7.3 Water

The mixing water for concrete shall conform to AS 1379. Water used in concrete manufacture and curing shall be clean, potable and free from amounts of suspended material, sugars, organic matter, alkali salts or any other impurities which may adversely affect the properties of the concrete or have harmful effects on the reinforcement or prestressing system, or other fixtures embedded within.

13.7.4 Admixtures

Admixtures shall comply with AS 1478.1 and AS 1478.2. Admixtures may be used in concrete to modify the workability. Admixtures other than water-reducing, superplasticising (high range water reducing) and set-retarding admixtures shall not be used without written approval of the Superintendent. Calcium chloride and other chloride-bearing admixtures shall not be used. The Contractor shall supply full details of the proposed admixture dosage/s and the manufacturer's product data sheet/s for the admixtures.

An anti-washout chemical admixture, "Rheomac UW 450", or approved equivalent, shall be used to minimize the segregation of concrete or grout that is placed under water. The chemical admixture shall be used in the dosages recommended by the Supplier. The anti-washout admixture shall be compatible with other chemical admixtures that are used in the concrete.

The use of other admixtures shall only be permitted subject to the Contractor carrying out prior testing on trial mixes in accordance with this specification. Where allowed, the admixture(s) shall comply with AS 1478. The mix shall be so proportioned that it will not bleed or segregate during transportation, placement, and setting. In addition, shrinkage and dosage sensitivity characteristics shall be taken into account and documented. The admixture(s) shall be chloride free. Where two or more admixtures are incorporated in a concrete mix, the Manufacturer shall certify their compatibility.

13.7.5 Concrete Production and Delivery

The plant and equipment, production, and delivery of ready-mixed concrete shall comply with AS 1379 Specification and manufacture of concrete and the relevant clauses of this specification.

13.7.6 Grout

13.7.6.1 Additional Material Requirements

Fine aggregate, if used, must have maximum nominal size of 1.0 mm and conform to AS 2758.1 for normal weight, concrete exposure classification B2, and maximum water absorption of 2.0%.

Mixing water must be clean and free of oil, acid, alkali, organic or vegetable matter, not be harmful to steel or grout, and have a chloride ion content of less than 500 mg/l.

Expansive admixtures where used must be the pre-hardening type and not include iron or aluminium powders. The chemical reactions between grout constituents or materials in contact with the grout must not produce gases.

Grout mixes may be pre-packaged so that only water and admixtures need to be added to the dry mix on-site, or mixes may be designed to meet Project specifications for site batching.

Grouts must have high bleed resistance, low shrinkage and high fluidity and conform to Table 13.2 when tested as specified.

Table 13.2 Performance requirements for grout

PROPERTY	TEST METHOD	CRITERIA	COMMENTS
Bleeding	ASTM C940	Final bleeding < 0.5%	Measured when two successive readings show no further expansion or bleeding.
Volume Change	ASTM C1090	Maximum height change @ 1 & 28 days 0.1% and 0.3%	
Early Expansion	ASTM C940	< 2% at 3 hours.	Temperature tolerances are $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$.
Fluidity	AS 1478.2 Appendix C ²	Immediately after mixing: Efflux time < 20 s 45 minutes after mixing: Change in efflux time $\leq \pm 3\text{s}$	Target efflux time for the site conditions must not vary from the nominated value by more than $\pm 2\text{s}$
Minimum Compressive Strength	AS 1478.2 Appendix A	40 MPa at 7 days 50 MPa at 28 days	In planning the work and sequence of concrete pours connecting to the existing B104, the Contractor must ensure that all concrete elements in the Contract works will achieve at least 32 MPa strength before the end of the berth shutdown period.

A modification may be introduced to the test method as follows:

Fill the flow cone to the top instead of to the standard level. Measure the efflux time as the time measured to fill the one litre container placed directly under the flow cone.

13.7.6.2 Mix Design and Testing

The addition of Superplasticiser to achieve the required pumpability of the grout mix is permitted if it can be demonstrated to the approval of the Superintendent that long term compatibility with the grout and anchor components. Do not use other additives unless it can be demonstrated to the approval of the Superintendent that the additives will not harm grout performance or anchor components.

13.7.6.3 Non-shrink Grout

Non-shrink grout shall be SikaGrout 212 HP (or approved equivalent).

The storage, handling and placement of the grout must be in strict accordance with the manufacturer's instructions.

13.8 Design of Concrete Mixes

13.8.1 General

The exposure classification is outlined in AS 5100.5. The concrete mixes for the concrete elements shall comply with the criteria given Table 13.3 and this specification generally.

Concrete mix properties from the trial mix process shall be determined and advised to the Superintendent in accordance with this specification and TfNSW Specification QA B80.

Concrete for large concrete components having minimum thicknesses greater than 1 m, including capping beams, bollard foundation and pile top plug, shall comply with the additional controls as set out in section 13.9.5 To meet the temperature limits, set out in section 13.9.5, mix designers should target a total cementitious content which is as close as possible to the minimum binder content given in Table B80.8 and incorporate the optimum maximum fly ash replacement to achieve the peak temperature limit. Under such circumstances, the chloride diffusion and migration requirements must still be met.

The Contractor shall submit calculations confirming that the thermal and durability requirements of the Specification will be met by the proposed mixes.

HOLD POINT

Submission of calculations confirming that the thermal and durability requirements will be met by the proposed mixes. Trial results including temperature monitoring results of trial pour, minimum of 14 days prior to concreting.

Trial concrete pours for mix design approvals for large elements shall incorporate temperature monitoring as per Section 13.9.5.5.

HOLD POINT

Trial results including temperature monitoring results of trial pour, minimum of 14 days prior to concreting.

13.8.2 Design for Durability

13.8.2.1 General

For concrete durability, conform to Table B80.8 of TfNSW Specification QA B80 and the following:

- a For exposure classifications A and B1, concrete made with blended cement must contain a minimum of 240 kg/m³ of General Purpose or Shrinkage Limited cement conforming to Specification TfNSW QA 3323, to limit carbonation.
- b Use blended cement containing amorphous silica only for precast concrete members. Do not use blended cement containing amorphous silica for cast-in-place concrete members.
- c Precast concrete members in exposure classification C2 must contain a corrosion inhibitor in accordance with Clause 2.3.3 of TfNSW Specification QA B80, except as provided for in item (d) of this Clause or in Annexure B80/F, to limit chloride induced reinforcement corrosion.
- d For precast concrete members requiring durability suitable for exposure classification C2 but which are not in a chloride aggressive environment, the corrosion inhibitor is not required.
- e The water/cement ratio must not be less than 0.32 for cast-in-place concrete and 0.28 for precast concrete, to ensure cement hydration, except for cast-in-place concrete bridge decks and slabs where it must not be less than 0.40, to limit cracking. As per AS 3600, for higher exposure classifications B1, B2, C1 and C2, the design crack width is limited to a maximum of 0.1 mm

- f Curing equivalent to a minimum of 3 days wet curing or better must be provided to limit cracking.
- g In addition to the above items, self-compacting concrete (SCC) and high workability concrete (HWC) must conform to the requirements of Annexure B80/G and Annexure B80/A2.

13.8.3 Permissible Tolerances

The permissible tolerances for batch ingredients shall be as for AS1379-2007. No changes other than adjustments to maintain the composite aggregate grading shall be made to the concrete mix after the mix design has been approved.

13.8.4 Concrete Elements

Concrete used in the works shall fall into four concrete mix types as follows and as described in:

Concrete Mix A (Exposure classification B2). This applies to concrete used in:

- Pits
- Minor land-based works

Concrete Mix B (Exposure classification C1 and C2). This applies to concrete used in:

- All headstock beams, deck slabs
- Mooring dolphin
- Toe sockets
- Headwall
- Pile Plugs

Table 13.3 Summary of Concrete Mix Design Criteria

MIX DESIGNATION	MIX A	MIX B	MIX C
Description	Within 1 km	Elements > 1m above wave crest level	Lean concrete mix called up on drawings
Exposure classification	B2	C1 and C2	n/a
Concrete Grade	S40	S50	N20
Min Cementitious Content	370 kg/m ³	420 kg/m ³	n/a
Max Cementitious Content	500 kg/m ³	550 kg/m ³	n/a
Max w/b ratio	0.46	0.40 (C1) 0.36 (C2)	n/a
Max DRMC ¹	8.0 x 10-12 m ² /s	4.0 x 10-12 m ² /s	n/a
Max Dc ²	3.5 x 10-12 m ² /s	2.0 x 10-12 m ² /s	n/a
Drying shrinkage (56 days)	650	600	n/a

MIX DESIGNATION	MIX A	MIX B	MIX C
Min Fly Ash /Slag content as cement replacement in mix design	25% fly ash or 50% slag	For C1: 25% fly ash or 50% slag For C2: 65% slag, or alternatively use ternary blended cement adopting combination A per Table 3211/A.2 of TfNSW 3211.	n/a
Min Cover (mm)	50	50 (C1), 65(C2)	n/a
Max Washout ^{3,4}	n/a	n/a	n/a
Peak Temperature	80 °C	80 °C	80 °C
Max Differential Temperature	25 °C	25 °C	25 °C

- (1) DRMC denotes rapid migration coefficient when tested in accordance with Nordtest NT Build 492 after 28 days moist curing. Compliance with the minimum fly ash or slag replacement and maximum w/b ratio does not ensure compliance with the required migration coefficient or design life requirement. DRMC shall be measured during trial mix stage and ongoing compliance testing.
- (2) Dc denotes effective diffusion coefficient when tested in accordance with Nordtest NT Build 443 after 56 days moist curing. Compliance with the minimum fly ash or slag replacement and maximum w/b ratio does not ensure compliance with the required diffusion coefficient or design life requirement. Dc shall be measured during trial mix stage but is not required for ongoing compliance.
- (3) Washout to be determined in accordance with CRD-C 61-89A.
- (4) The use of a proprietary anti-washout admixture and/or silica fume may be required to achieve acceptable performance.

13.8.5 Workability

The workability of the fresh concrete shall be such that the concrete is suitable for the conditions of handling and placing as described in this specification so that after compaction it surrounds all reinforcement and completely fills the formwork. Workability shall be measured for each batch in accordance with AS 1012.3.1 and shall be within the tolerance limits given in AS 1379 - 2007. For applications requiring higher workability (i.e. tremie or congested reinforcement), workability may be assessed by slump flow (The mean diameter of the spread of fresh concrete using a conventional slump cone). The slump flow diameter shall be within ± 50 mm of the agreed value but shall not exceed 750 mm.

Where cohesive mixes are proposed, lower values of slump may be accepted by the Superintendent provided adequate compaction of concrete has been demonstrated.

Concrete which does not comply with the required workability shall not be used in the permanent works.

Mix designs shall be approved in writing by the Superintendent. For the purposes of this clause, changes to the supply of any source materials including admixtures or changes to batch quantities other than adjustments to maintain the composite aggregate grading or within the allowable tolerance, shall constitute an alteration and require approval of the Superintendent.

HOLD POINT

Submission for approval of mix designs, within 14 days prior to placing any concrete.

13.8.6 Compliance Testing

The Inspection and Test Plan must nominate the proposed testing frequency to verify conformity of the item and it must be not less than that specified in Table 13.4 below for each concrete mix.

Table 13.4 Testing and Minimum Frequency Requirements

CHARACTERISTIC ANALYSED	TEST METHOD	MINIMUM FREQUENCY OF TESTING
Coarse Aggregate		
Grading	AS 1141	Every 500m ³ of concrete
-75 micron	AS 1141	
Flakiness Index	AS 1141	
Particle Density (SSD)	AS 1141	Every 1000m ³ of concrete
Absorption (%)	AS 1141	
Wet Dry Strength	AS 1141	
Los Angeles	AS 1141	
Marginal and Unsound Stone	AS 1141	Every 1000m ³ of concrete
Weak and Light Particles	AS 1141	
Impurities All Tests	AS 1141	
Sodium Sulphate Loss	AS 1141	One/Project
ASR – Petrographic	AS 1141	
Fine Aggregate		
Grading	AS 1141	Every 500m ³ of concrete
-75 micron	AS 1141	
Organic Colour Test	AS 1141	
Flakiness Index	AS 1141	
Particle Density (SSD)	AS 1141	Every 1000m ³ of concrete
Absorption (%)	AS 1141	
Impurities All Tests	AS 1141	Every 1000m ³ of concrete
Sodium Sulphate Loss	AS 1141	One/Project
ASR – Petrographic	AS 1141	

CHARACTERISTIC ANALYSED	TEST METHOD	MINIMUM FREQUENCY OF TESTING
Admixtures		
Compliance Test Certificates		As received for each delivery
Report on Compliance		Weekly
Cement		
Compliance Test Certificates		Weekly
Report on Compliance		Weekly
Fresh Concrete		
Bleed	AS1012 Part 6	1 per 500 m ³ of concrete
Slump (Visual)	Trained Operator	Each load at site
Slump (Measured)*	AS1012. 3.1	1 per 3 loads at site
Concrete Discharge Temperature		1 per 3 loads at site
Air Content and Plastic Unit Weight	AS1012.4 Method 1	1 per 500 m ³ of concrete
Hardened Concrete		
Unit Weight	AS1012	On all concrete cylinders
Water Quality Analysis		
Sulphate Content of Concrete		1 per 500 m ³
Chloride Content of Concrete		1 per 1500 m ³
Compressive Strength at 3, 28 & 56 days	AS1012.9	1 pair per 25 m ³
Shrinkage 75mm Prism	AS1012.13	Set of 3 per 500 m ³
Flatness and Levelness	Trained Operator	All exposed surfaces
Measurement of Chloride Ion Migration Coefficient	NT Built 492	One set per 500 m ³
Relative compaction of concrete	AS 1012.12.2 Annexure B80/L5	TfNSW QA B80 and as directed by the Superintendent
Concrete cover to reinforcement	Annexure B80/L6	TfNSW QA B80 table B80/L6.1
Resistivity	MRWA Test Method 622.1	As directed by the Superintendent

13.8.7 Trial Mixes

Three samples of concrete shall be taken from the batch in accordance with AS 1012.1 and tested in accordance with the relevant requirements as outlined in this specification for each batch of concrete. The testing shall be conducted as follows:

- Slump: Immediately upon discharge from the mixer and 15, 30 and 45 minutes later;
- Bleed: 30, 60 and 90 minutes after discharge from the mixer;
- Setting time: 2 tests;
- Density (fresh concrete): 2 tests;
- Density (hardened concrete): 2 tests;
- Compressive strength: 3 cylinders at 1 day, 3 cylinders at 28 days;
- Chemical content: 2 tests;
- Shrinkage: 2 tests.
- Chloride Diffusion NT Build 492 (28 days) and NT Build 443(56 days): 2 tests each

The batch shall be tested to establish uniformity of mixing in accordance with AS 1379. If the concrete fails to meet the requirements of this Specification, the Contractor shall re-design the mix and resubmit the details as described above, to the Superintendent for approval.

HOLD POINT

Submission of re-designed concrete mix, minimum of 14 days prior to concreting.

When trial mixes satisfying the requirements of this clause have been developed the Contractor shall submit full details for the mix including calculations, strength results, chloride diffusion coefficient reports, grading of individual aggregates, combined grading, mix proportions, water to cement and aggregate to cement ratios, slumps and compaction factors to the Superintendent. Full details shall be submitted to the Superintendent not less than two (2) weeks before concreting commences.

HOLD POINT

Submission of full concrete mix details, minimum of 14 days prior to concreting.

The Superintendent may require additional testing to that set out in this Specification for any material proposed that does not have a proven history of use.

13.8.8 Variation to Mix Designs

Other than adjustments to aggregate content to maintain the approved composite grading, there shall be no variations to the mixes other than those given in AS 1379. If the Contractor wishes to vary the mixes beyond the allowance in AS 1379 the permission of the Superintendent shall be sought, who will consult the concrete consultant.

13.9 Supply and Delivery of Concrete

13.9.1 General

Concrete shall be produced and delivered to the site of the works or to a precasting yard in accordance with the requirements of AS 1379 and the additional requirements of this Specification.

All concrete for use in the works shall be classified as Special Class and designated "S" in accordance with Clause 1.6.4 of AS 1379.

13.9.2 Moisture Content of Aggregates

The moisture content of the fine and coarse aggregates shall be determined prior to concrete production for each day and whenever conditions change, either by a moisture meter or by other equivalent devices or methods. Corresponding corrections shall be made to the mass of all aggregates and the volume of water used in the mix.

13.9.3 Submissions

The Contractor shall make submissions as follows:

13.9.3.1 Product conformity

General: Submit current assessments of conformity as follows:

- Certificate of conformity by a JAS-ANZ accredited third party.
- Declaration of conformity by an AS/NZS ISO9002 quality management system certified supplier.
- Report by a NATA accredited laboratory describing tests and giving results which demonstrate that the product conforms.

HOLD POINT

Submission of product conformity certificates, declarations and reports, at least 3 days prior to pouring concrete.

13.9.3.2 Design documentation

Loading: Submit details of proposed construction systems, loads and procedures, including propping and re-shoring.

HOLD POINT

Details of proposed construction systems, load and procedures, at least 7 days prior to the placing of concrete in the works.

13.9.3.3 Construction proposals

- Concrete: Submit proposals for mixing, placing, finishing and curing concrete including the following:
 - Changes to the plastic concrete mix.
 - Curing and protection methods.
 - Cutting or displacing reinforcement.
 - Handling, placing, compaction and finishing methods and equipment, including pumping.
 - Placing under water.
 - Sequence and times for concrete placement, and construction joint locations and relocations.
 - Site storage, mixing and transport methods and equipment, if applicable.
 - Temperature control methods.
 - Retempering with superplasticiser.
 - Target strength, slump and proposed mix for each type and grade of concrete.
 - Repair of concrete deemed not satisfactory by the Superintendent.
 - High early strength cement.

- Cutting or coring: If cutting or coring of hardened concrete is proposed, provide details.
- Loading: If proposed construction systems, loads and procedures, including propping and re-shoring, differ from submitted design documentation, submit details.

HOLD POINT

Submission of proposals for the items above, minimum of 14 days prior to concreting.

13.9.3.4 Product proposals

- General: Submit details of proposed sources of materials.
- Foamed concrete: Submit details, including aggregate grading and mix proportions.
- Concrete mixes: Submit details, for each grade and type of concrete including any proposed use of special-purpose cement types.
- Curing compounds: If it is proposed to use a liquid membrane-forming curing compound submit the following information:
 - Certified test results for water retention to AS 3799 Appendix B.
 - Evidence of compatibility with concrete, and with applied finishes including toppings and render, if any, including methods of obtaining the required adhesion.
 - For visually important surfaces, evidence that an acceptable final surface colour will be obtained.

HOLD POINT

Submission of proposals for the items above, minimum of 14 days prior to concreting.

13.9.3.5 Pre-mixed supply

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

HOLD POINT

Submission of delivery dockets upon delivery of pre-mixed supply batch.

- 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.

HOLD POINT

Submission of subcontractor details at least 7 days prior to the placing of concrete in the works.

13.9.3.6 Construction documentation

Cores, fixings and embedded items: If the locations of these items are not shown or are shown diagrammatically (anchors for brackets for utilities), submit shop drawings showing the proposed locations, clearances and cover. Indicate proposed repositioning of reinforcement.

HOLD POINT

Shop drawings and bar bending schedule, at least 7 days prior to incorporation in the Works.

13.9.3.7 Tests

Material tests: Before supplying concrete, submit test certificates based on samples from the most recent production or from stockpiles for the project, for the materials and properties listed in the Material tests schedule.

HOLD POINT

Submission of material test certificates, at least 3 days prior to pouring concrete..

Submit additional certificates at the scheduled frequency during the course of the works.

HOLD POINT

Submission of additional material test certificates, at least 3 days prior to pouring concrete..

Dissemination of production information: Submit copies of the reports.

HOLD POINT

Submission of report outlining dissemination of product, at least 3 days prior to pouring concrete..

Embedded pressure pipes: Submit the results of leak tests.

HOLD POINT

Submission of leak test results, at least 3 days prior to pouring concrete..

13.9.3.8 Additional Requirements for Batching & Mixing

Equipment

Bulk storage of materials

Bulk storage facilities shall comply with AS 1379 Clause 3.6.

All materials: stockpile bins, silos, and storage areas shall be clearly labelled such that operators can read the labels from their normal working locations (e.g. front end loader operator from driving seat).

Any cross contamination from one storage area to another shall be treated as a non-conformance.

Mixer

Continuous mixers shall not be used.

Batch size

Unless specialised small capacity trucks are used, no batch shall be less than 2m³ nor greater than the rated mixing capacity of the truck, unless mixer uniformity testing in accordance with AS 1379 Appendix A, has been performed on the mixers to be used and confirms compliance for the volume required to be mixed. Where truck mixers have a capacity of greater than 5m³, relevant information will be provided to the Superintendent.

HOLD POINT

Submission of truck mixers with a capacity of greater than 5m³, at least 7 days prior to the placing of concrete in the works.

The Concrete Supplier shall be required to use truck mixers which comply and have been maintained in accordance with the requirements of AS1379. The Superintendent may request documentary evidence of compliance.

Discharging of mixer

The entire contents of the mixer shall be discharged before charging it with a new batch.

Batching and mixing

Batching and mixing shall be as per AS1379 except that water shall not be added to a mixed batch.

In addition, the following shall occur:

- The mixing water and superplasticiser shall be added at the batch plant so that the maximum allowable w/b ratio is not exceeded and such that the agreed workability of the concrete will be achieved upon delivery.
- In the event that the concrete workability is less than agreed, a technician can add the required amount of superplasticiser at the job site to reach the specified slump approximately 10 minutes before discharge is scheduled to commence. The concrete shall be thoroughly mixed before discharge if any superplasticiser is added
- The quantity of superplasticiser added on site will be recorded with all other relevant information.

Where by reason of delay it is necessary to hold a batch in the mixer, mixing may be continued for a maximum of ten minutes except for split drum mixers where the maximum shall be five minutes.

For longer delays the batch may be held in the mixer and turned over at regular intervals, subject to the time limits specified for incorporation of the concrete into the works not being exceeded.

Delivery

Concrete mixed at a remote central mixing plant shall be transported to the point of discharge by truck-mounted drum mixers complying with the requirements of AS 1379 and this Specification. On completion of mixing, the concrete shall be continuously agitated until it is fully discharged. The agitation speed shall be as specified by the manufacturer of the equipment.

Period for completion of discharge

Ensure that the elapsed time between the wetting of the mix and the discharge of the mix at the site is in conformance Section 4.4.3 of B80 requirements. Place and compact the concrete within 1.5 hours from the time of batching. Do not discharge at concrete temperature below 10°C or above 32°C.

Ready mixed supply

Method: Use the batch production process. Deliver in agitator trucks.

Admixtures: Do not provide admixtures containing significant chlorides.

Plastic cracking: Design the concrete mix to minimise plastic settlement and shrinkage cracking.

Addition of water: Do not add water on site unless permitted in Delivery docket (refer section 13.9.3.5). If permitted, water can be added within 1 hour of batching to achieve the required slump, and the amount of water added should not exceed the maximum water cement ratio for the mix design.

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

Site mixed supply

Emergencies: If mixing by hand is carried out, provide details.

Plant: Mix concrete in plant located on the construction site.

Batch records and test results

The Contractor shall keep full and detailed records, and these will be made available to the Superintendent on request. These records will be kept and made available on request at any time up to 7 years after project completion, as per statutory requirements.

Slump

The slump of the concrete shall be checked in accordance with AS 1379 except for the frequency of sampling, which shall be in accordance with Section 13.8.6.

For batches produced with a high level of control, the Superintendent may accept proposals for a reduced frequency of slump checking provided the proposals demonstrate that the appropriate high level of control is being achieved during production.

If the measured slump is not within the agreed limits, one repeat test shall be made immediately from another portion of the same sample. If the value obtained from the repeat test falls within the specified limits, the concrete represented by the sample shall be deemed to comply with the appropriate specified value, otherwise the load shall be rejected.

The slump will be tested after any superplasticiser is added at site and mixing completed after the discharge of 0.2m³. Discharge shall be halted until the slump result is obtained.

Addition of Water to a Mixed Batch

Do not add water on site unless permitted in Delivery docket (refer section 13.9.3.5). If permitted, water can be added within 1 hour of batching to achieve the required slump, and the amount of water added should not exceed the maximum water cement ratio for the mix design.

Temperature at Point of Delivery

Concrete shall be placed within the temperature limit provided in the thermal analysis and not increased until site monitoring confirms that the temperature limits can be met using a higher placement temperature. At no time should the placement temperature exceed 35°C.

Setting Time

The Contractor shall make every endeavour to maintain a consistent setting time throughout each pour and through the project.

The concrete mix setting time shall be maintained as consistently as possible by changing from water reducing admixture to water reducing retarder to suit ambient conditions.

Addition of Superplasticiser

The Contractor shall develop a method statement for the addition, measurement and monitoring of superplasticiser and submit this to the Superintendent as part of the Concrete Placing Method Statement.

Testing

General

Sampling and testing of specimens: Submit test certificates and also retain results on site.

HOLD POINT

Submission of material test certificates, at least 3 days prior to pouring concrete.

Construction Tests

Frequency: Conform to AS1379 for each property test at least two specimens from each sample.

Concrete Testing Methods

General: Sample, test and assess the concrete for compliance.

Testing methods: Conform to AS1012.

Sampling, identification and testing: Sample the concrete on site, at the point of discharge from the agitator to AS1012.

Drying shrinkage: Test 3 specimens of each type of concrete every month or every 500m³ placed concrete. Base assessments on the average of the 3 specimens test results. Conduct 2 sets of tests on trial mixes.

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

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

- Sampling frequency: To the Project Assessment Strength Grade Sampling Table.
- Specimen size: Nominally 200 x 100mm diameter but, if aggregate size exceeds 20mm, nominally 300 x 150mm diameter.

Concrete Testing

Dissemination of production information: Register the project in accordance with AS1379 Clause 6.4.3.

Control Tests

General: Determine strength using site cured specimens.

Acceptance criteria:

- Average strength of all samples must exceed the required value at 28 days
- Strength of any one sample must be at least 0.85 of the required value.

Control tests requirements: The supplier shall predict the expected compressive strength at 28 days from the 3 day value and inform the Superintendent if the predicted strength falls below the specified requirement together with proposed mitigation measures.

Project Assessment

Standard: To AS1379.

Test Authority

General: Concrete supplier or NATA registered laboratory.

Test Records

Records and reports: To AS1012.

Inspection

Notice

- Inspection: Give a minimum of one working day (24 hours) 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.

Insufficient Notice

No claim for delay shall arise from the giving of insufficient or unreasonably short notice. In the notice given, allow time for the inspection and any rectification work as instructed by the Superintendent.

Initial check

Check all work (and rectify faults) prior to requesting an inspection by the Superintendent. Work which has not been prior checked by the Contractor may not be inspected. Any delays caused by failure of the Contractor to undertake such checks will be at the Contractors expense. No extensions of time will be granted for such delays.

Covering up

If the Specification requires notice of inspection to be given in respect of any part of the work under the Contract, that part of the work shall not have further work placed thereon or be covered up or put out of view without the prior approval of the Superintendent.

Repair

If the Superintendent deems concrete to be unsatisfactory, the Contractor is to submit details of suggested repair methods for approval. Repair methods will also need approval by the Superintendent and may be dependent on the finish to be applied to the area in question.

HOLD POINT

Submission of repair methods for unsatisfactory concrete, minimum of 14 days prior to concreting.

13.9.4 Concrete Protection and Curing

The Contractor shall calculate the rate of water evaporation from the concrete under the range expected environmental conditions based on ACI 305. The Contractor shall ensure that the concrete is not adversely affected by the climatic factors, namely, high air temperature, low relative humidity and wind velocity. Where calculations show that the rate of water evaporation exceeds 0.75 kg/m² per hour (or 0.5 kg/m² per hour if silica fume is used), special precautions shall be taken. Special precautions may include a combination of dampening the subgrade and the forms, erecting sunshades and windbreaks and the application of evaporation retarder or use of fog sprayers. The Contractor shall submit a detailed method statement on the hot weather protection procedures to be adopted under expected environmental conditions for the Superintendent's review and comment.

HOLD POINT

Submission of detailed method statement on the hot weather protection procedures, at least 28 days prior to batching concrete.

- 1 Curing shall commence as soon as the exposed surface of the concrete has hardened sufficiently to prevent damage. All marine exposed concrete (C1, C2) shall be cured continuously for a period not less than 14 days by with wet curing with potable water, or with an approved curing compound compatible with proposed after-trades. Any curing compound must fully oxidise and leave the concrete surface after not less than 55 days when subject to UV exposure. Use of curing compounds as an alternative to wet curing shall be subject to the approval of a methods statement and review of the technical data sheet for the proposed material by the superintendent.
- 2 Landside elements (B2 exposure) shall be continuously cured for a period not less than 7 days by either wet curing or approved curing compound that is compatible with proposed after-trades or will completely oxidise after a period not less than 55 days.
- 3 An excess replacement percentage refers to any amount of fly ash (FA) or slag used over the respective minimum percentages stipulated in Table 13.3, with a +5% tolerance as stipulated in AS 3972. Where there is an excess replacement percentage of fly ash or slag used to achieve thermal or durability performance requirements, additional attention must be taken to ensure the development of all other required hardened properties of the concrete as stipulated in Table 13.3. If wet curing is implemented, this shall remain in place for at least 14 days.

- 4 All concrete shall comply with the peak and differential temperature requirements outlined in section 13.8.4.
- 5 Contractor shall also be aware of surround port operations and the risks they may pose on the works, particularly relating to the exposure of air borne contaminates such as grain dust which could contaminate the concrete. The Contractor shall include in their detailed method statement how they will mitigate the risks associated with surrounding port operations, such as by regular meetings with the surround port users and scheduling works appropriately.

13.9.5 Thermal Control

Concrete pours for the structural elements with a minimum dimension greater than 500 mm including capping beam, dolphin cap and pile top plug will require additional measures to control the heat of hydration and limit the formation of cracks. The Contractor shall ensure that maximum temperatures in the concrete shall not exceed 80°C and that differential temperatures shall be kept below 25°C. The Contractor shall submit a written work method statement indicating how the peak concrete temperatures and differential temperatures shall be kept below the specified limits together with the supporting thermal analysis, at least 28 days prior to batching concrete. Work shall not commence until written approval is received from the Superintendent.

HOLD POINT

Submission of work method statement pertaining to thermal control, at least 28 days prior to batching concrete.

The use of insulation and concrete placing temperatures as specified below form the basis of the procedure adopted for design. The procedure below may be amended by the Contractor's own method statement.

13.9.5.1 Concrete Placement Temperature

Concrete shall be placed within the temperature limit provided in the thermal analysis and not increased until site monitoring confirms that the temperature limits can be met using a higher placement temperature. At no time should the placement temperature exceed 32°C.

Water may be substituted with flake ice provided the approved w/b ratio is not exceeded in order to meet the maximum concrete placing temperature.

13.9.5.2 Formwork Temperature

If it is likely that the ambient air temperature may fall to 5°C or less during placement of the concrete, then the forms shall be covered for at least 12 hours prior to concreting and the enclosed space shall be heated so that the temperature of the form faces is not below 5°C at the time of concrete placement.

If it is likely that the ambient air temperature may rise to more than 32°C during placement of the concrete, then the forms shall be adequately shaded or sprayed with water so as to prevent the temperature of the form faces rising above 32°C.

13.9.5.3 Insulation

Insulation requirements (including the use of thicker formwork) shall be informed by the outputs of thermal modelling.

The top surface of each large concrete element shall have an insulation layer to control the heat of hydration and limit the formation of cracks, Acceptable forms of insulation include:

- A thermal blanket; or
- A ponded layer of water that contains coarse sand or foam to maintain a stable water layer in contact with the concrete surface in the event of rain or leakage. In no case shall the water be flowing over the concrete

The insulation layer shall remain in place for a minimum of 7 days after the placement of concrete unless an approved equivalent is provided.

Refer to Section 13.9.4 for curing requirements. Additionally, curing and insulation requirements must adhere and accommodate berth shutdown periods also stipulated in Section 13.9.4.

Large concrete elements subject to thermal control shall be protected from rapid cooling due to rain events.

Forms shall not be stripped until the maximum concrete temperature in the element has cooled to 50°C or 25°C above the average ambient air temperature, whichever is the lower. However, curing must be continued as per Section 13.9.4.

13.9.5.4 Casting of Adjacent Elements

The casting of the adjacent concrete should commence as soon as practicable after the previously cast element has cooled to between 40°C - 50°C to minimise differential temperatures but to allow significant thermal contraction to occur. No loads shall be placed on concrete until 24 hours has elapsed since casting and the concrete in the top layer has reached a compressive strength of 15 MPa.

13.9.5.5 Thermal Monitoring

The temperatures in each large concrete element (the least dimension of the member exceeds 500 mm and the volume of placed concrete cast is greater than 5 m³) shall be monitored for 7 days after placement of concrete or until the maximum concrete temperature has reduced to 40°C or 25°C above the minimum ambient air temperature.

Thermocouples shall be placed in key locations to monitor the concrete, ambient, and ponded water temperatures. As a minimum, the centre and one side face shall be monitored. A drawing showing the location of thermocouples shall form part of the work method statement. Pairs of thermocouples are required at the centre and surface locations in case of failure in a thermocouple.

HOLD POINT

Submission of thermal monitoring work method statement, at least 28 days prior to batching concrete.

Use Type K thermocouple extension wire to increase the length for connection to the datalogger. Wires and thermocouples shall be located to minimise damage during placement of concrete or fixing of steel reinforcing. Kinks in the wires shall be avoided. Each thermocouple is to be tested after installation with ice water to confirm that it is correctly measuring temperature and correctly labelled. Data shall be collected at 30-minute intervals and recorded to the nearest 0.1 degree and downloaded and forwarded to the Superintendent at intervals not exceeding 24 hours. The download interval may have to be reduced if concerns are raised about the operation.

The following issues should be addressed when logging data from the thermocouples.

- 1 Make sure the data logger is not powered by a generator. Battery or mains power are acceptable.
- 2 Test the thermocouples using ice water and ambient temperature.
- 3 The datalogger should be started before the concrete pour commences.
- 4 The datalogger shall have a back-up facility to ensure that no data is lost in the event of a problem.
- 5 Data shall be supplied to the Superintendent in a format suitable for importing into an Excel spreadsheet.

Maximum recorded concrete temperatures shall be below 80°C and concrete differential temperatures shall be below 25°C. Removal of forms and/or insulation shall be a hold point.

HOLD POINT

Submission of form indicating removal of forms and/or insulation, at least 28 days prior to batching concrete.

After monitoring is completed, the wires shall be cut off flush with the surface of the concrete and the ends treated to minimise any effect on durability and appearance.

13.9.6 Construction

13.9.6.1 Joints in Concrete

Where in-situ concrete is to be placed against precast or existing concrete structures, the precast concrete surface shall be roughened to remove loose concrete, surface laitance and other contaminants and to expose the aggregate, the surface should be damp but not have liquid water to help establish a good bond.

Construction Joint Preparation

Construction joints will only facilitate the construction process of the Works if the Contractor considers them required for their proposed construction methodology. Construction joints are to be prepared to achieve a closely spaced 6mm profile with all near surface aggregate exposed (equivalent to ICRI Concrete Surface Profile CSP 9 or CSP 10). This may be achieved either mechanically or via the use of a retardant followed by high pressure washing subject to compliance with the Contractor's Environmental license and approval of the Superintendent.

HOLD POINT

Submission to Superintendent for approval of construction joint locations, at least 28 days prior to supply.

Prior to commencing the permanent works, the Contractor shall prepare a sample of the proposed construction joint for inspection by the Superintendent. Once the Superintendent approves the quality of construction joint, the Contractor shall retain the sample at site for the duration of the project.

HOLD POINT

Submission of sample construction joint, 14 days before supply.

Prior to placing the adjoining concrete, remove all loose material and clean the surface of the construction joint and the projecting reinforcement. Saturate the concrete surface with water conforming to Clause 11.5.3 and remove all excess water.

Concrete Drilling

It is requirement of this Specification that drilling of holes in hardened concrete for fasteners to be kept to a minimum using cast in stainless steel sockets (ferrules).

Where it becomes necessary to drill holes in concrete for the placement of anchors or other fixings, the Contractor shall locate and mark the location of reinforcement in the area. Holes shall be located to avoid the reinforcement by at least 25 mm where epoxy grouted anchors are used. Mechanical anchors shall not be used.

All holes including core holes for testing shall be drilled with a diamond tipped bit. Diameter of test cores shall be 25 mm. Percussion drilling shall not be permitted.

Holes and Fitments

Where shown on the Drawings or directed by the Superintendent, holes, mortices, chases, etc. shall be formed by the provision of the necessary inserts at the time of casting the concrete.

Holding down bolts shall be set accurately to the positions and levels shown on the marking plan and detail drawings to be supplied by the steelwork fabricator or, if no erection drawings are applicable, to the details shown on the structural drawings. Holding down bolts shall be rigidly held in position by attachment to suitable steel templates prior to placing the concrete and shall not vary from the positions shown on the Drawings by more than the allowable tolerance of AS4100 Section 111.3.

Where bolts, pipes and bars are used to form holes in members, they shall be well greased and so arranged that they may be removed from the concrete before removal of forms without excessive jarring or hammering.

If the Contractor wishes to make use of lifting holes or recesses which are not shown on the Drawings, they must first obtain approval of the positions chosen for the holes from the Superintendent. They shall be placed in such a way as will not materially affect the strength or appearance of the finished work and will not impose excessive stresses on the

members during handling. Such holes and recesses shall afterwards be made good to the satisfaction of the Superintendent.

Cores, Fixings and Embedded Items

Adjoining Elements

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

Protection

General: Grease threads. Protect embedded items against damage.

Compatibility: Ensure inserts, fixings and embedded items are compatible with each other, with the reinforcement and with the concrete mix to be used and surface finish requirements.

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

Structural Integrity

General: 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.

Tolerances

General: Maximum deviation from correct positions:

- Anchor bolt groups for structural steel: To AS4100.
- Cores and embedded items generally: 10 mm.
- Other fixing bolts: 3 mm.

Planned Construction Joint – Gridline 12

Planned construction joint for the B104 extension is at southern face of the cross beam at Grid 12. Timing of concreting of connection to existing wharf to be coordinated with NSW Ports so that no operations (berthing, mooring and ship loader) occur at the Wharf until concrete has reached minimum 32 MPa strength.

The sequence for the planned construction joint is explained below:

Table 13.5 Construction Joint (Sequence)

Sequence	Sketch presentation
1. Install pile and pile capitals. Wharf upstand on B104 to be demolished.	

2. Place longitudinal beams.	
3. Place cross beams and precast planks (between gridlines A & C). Dowel holes to be drilled into existing structure. Existing wharf surface to be prepared for construction joint (note surface preparation at the beam locations needs to be completed prior to the first pour, as access could be obstructed by reinforcement)	
4. Chemset dowels into existing wharf. With the dowels + starter bars protruding through the vertical formwork in position, the first stage pour of pile plug, cross beams and longitudinal beams can occur.	
5. The final stitch pour will be carried out concurrently with the second stage pour. This will mark the beginning of the B104 shutdown period. Operations at B104 will not be permitted to resume until the concrete has achieved a compressive strength of 32 MPa.	

Optional Construction Joint – Between Gridlines C and D

The Contractor may elect to introduce a construction joint running parallel to the quay alignment, located between gridlines C and D. The proposed location of this joint is shown on drawing PK-MAR-B104-FY25-100-MT-DRG-1610. The joint may comprise both the in-situ pour of the U trough beams and the in-situ deck slab.

If this option is selected, the construction joint shall incorporate a hybrid expanded mesh system at the specified location. This system is designed to create a mechanical key between successive concrete pours.

Installation of the expanded mesh shall be carried out in strict accordance with the manufacturer's instructions.

Note: Hy-rib Expanded Mesh Formwork must maintain the same concrete cover as the reinforcement. Temporary timber formwork shall be used to ensure correct cover zones are achieved.

Note: Hy-rib Expanded Mesh Formwork must extend over the full length of the cold joint, including both the deck and beam components.

Emergency Construction Joint

In the event of an unplanned emergency Construction Joint, the Contractor shall ensure the face of the concrete is generally vertical, normal to the direction of placing with a location that complies with the permitted location of Construction Joints. The finished surface of the unplanned concrete face shall be cut back to broadly approximate a single plane and the edge face made vertical. Treatment of the unplanned construction joint shall be as per the treatment of a construction joint

Berth Operations

Berthing and mooring operations onto the existing berth as well as significant vertical live loads in the proximity to the Northern extension shall not be allowed during the construction of the doweled joint until the new concrete has reached at least 32 MPa. The Superintendent shall inform Contractor on the occasions when these works cannot take place with at least 48 hr in advance or as agreed with the Contractor based on the number of berthings so that neither construction works nor berth activity is significantly disrupted.

Sealant

A sealant shall be installed to cover the recess between the abutment and transition slab to prevent moisture ingress. The sealant shall be Sikaflex Pro3 purform 3 or an approved equivalent. Material installation shall be in accordance with the Manufacturer's written recommendations.

Repair of Existing Surfaces at location of Isolation and Dowelled Joints

Existing concrete surfaces in contact with the isolation joints and dowelled joints where demolition works are required (i.e. kerbing) shall be made good prior to the installation of the joint using the following methodology.

These surfaces shall be roughened to expose aggregates and thoroughly cleaned with pressurised water. In areas where steel reinforcement is cut at the face, the existing concrete shall be broken back to a depth beyond the existing face of the beam and the reinforcement trimmed to maintain the required cover. Existing reinforcement exposed during demolition shall be protected with a zinc rich primer such as FOSROC Nitoprime or an approved equivalent. Following reinforcement treatment, the concrete surfaces shall be repaired using FOSROC Renderoc HB40 plus repair mortar or an approved equivalent. These products shall be installed in accordance with the manufacturer's instructions.

13.9.6.2 Placing and Compaction

Compaction

Methods: Use immersion and screed vibrators accompanied by hand methods as appropriate to remove entrapped air and to fully compact the mix except when an approved self-compacting concrete mix is used.

Vibrators: Do not allow vibrators to come into contact with set concrete, reinforcement or items including pipes and conduits embedded in concrete. Do not use vibrators to move concrete along the forms. Avoid over-vibration that may cause segregation.

Horizontal transport

General: Use suitable conveyors, clean chutes, troughs or pipes. Do not use water to facilitate the movement.

Placing

General: Use placing methods which avoid segregation and loss of concrete, shrinkage cracking and which minimise plastic settlement. Maintain a generally vertical and plastic concrete edge at faces during placement.

Layers: Place concrete in layers maximum 300 mm thick, such that each succeeding layer is compacted into the previous layer before previous layer has taken initial set.

Placing slabs and pavements: Place concrete uniformly over the width of the slab so that the face is generally vertical and normal to the direction of placing.

Sequence of Pours

If construction joints have been deemed necessary by the Contractor and their locations have been approved by the Superintendent, minimise thermal shrinkage effect and edge restraint by pouring the sections of the work between construction joints in a continuous sequence such that there will be suitable time delays between adjacent pours to allow temperature reduction.

Refer to Section 13.9.5.2 regarding the casting of adjacent concrete sections once peak temperatures are within the appropriate limits.

Placing records

General: Keep on site and make available for inspection a logbook recording each placement of concrete, including the following:

- Date.
- Specified grade and source of concrete.
- Slump measurements.
- The portion of work.
- Volume placed.

Rain

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

Protection: Protect surface from damage by covering until hardened.

Vertical elements

General: In vertical elements, limit the free fall of concrete to 1500 mm per 100 mm element thickness, up to a maximum free fall of 3000 mm, using enclosed vertical chutes or access hatches in forms. As far as practicable keep chutes vertical and full of concrete during placement, with ends immersed in the placed concrete. A tremie is to be used if free fall of concrete is greater than 3000 mm.

Cement

General: Do not use high alumina cement.

Placing

Concrete: Maintain the temperature of the freshly mixed concrete at $\geq 5^{\circ}\text{C}$.

Formwork and reinforcement: Before and during placing maintain temperature at $\geq 5^{\circ}\text{C}$.

Severe Weather

The Contractor shall plan for concreting and curing to be completed during a period of suitable weather to minimise the risk of severe weather impacting the concrete quality. Planning protocols shall be outlined in the concrete quality plan.

Placing in hot weather

General: Refer to section on Temperature Control below.

Handling

General: 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 schedule.

Placing

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

Formwork and reinforcement: Before and during placing maintain temperature at $\leq 32^{\circ}\text{C}$ using protection, cold water spraying, or other effective means.

Temperature control

General: Select one or more of the following methods of maintaining the specified temperature of the placed concrete at $< 35^{\circ}\text{C}$:

- The measures specified under Thermal Control
- Cool the concrete using liquid nitrogen injection before placing.
- Cover the container in which the concrete is transported to the forms.
- Spray the coarse aggregate using cold water prior to mixing.
- Use chilled mixing water or flake ice.

Table 13.6 Hot Weather Placing Table

CONCRETE ELEMENT	TEMPERATURE LIMIT
Normal concrete in footings, beams, columns, walls and slabs	35°C
Concrete in sections ≥ 1 m in all dimensions except for concrete of strength 40 MPa or greater, in sections exceeding 600 mm in thickness	27°C

Unless thermal modelling indicates that the characteristic maximum crack width as well as the required peak and differential temperatures will be achieved with a higher placement temperature.

Evaporation control

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

Protection: If the concrete temperature $> 25^{\circ}\text{C}$ or if not protected against drying winds, protect the concrete using a fog spray application of aliphatic alcohol evaporation retardant

13.9.7 Tremie Concreting

13.9.7.1 General

At least two (2) weeks prior to the proposed date for commencement of supply of the concrete for tremie operations, the Contractor shall submit to the Superintendent the following details:

- Details of the Contractor's site supervisor who has a demonstrated previous experience with tremie concrete applications.
- The proportions of the concrete mix as designed by the Contractor.
- Details of any admixtures proposed to be used.

- Details of proposed tremie equipment and methods of placement to be adopted (including type f formwork).
- Details of sampling and testing.

HOLD POINT

Submission of details above regarding tremie operations, 14 days before supply.

The Contractor shall allow for one (1) week for the Superintendent's response.

Testing of the tremie concrete shall be carried out as described in this Specification.

13.9.7.2 Application

The base of the tremie pipe(s) shall be continuously immersed beneath the top surface of the concrete at all times during the pour and the tremie pipe(s) shall be fully charged with concrete and lifted at such a rate as to permit a continuous flow of concrete. At the commencement of tremie work, the concrete shall be separated from the water. The volume of the placed concrete shall be monitored and the level checked as required by sounding. The Contractor shall conduct this.

When the concrete reaches the top of the formwork, it shall continue to be pumped until the concrete being discharged is free of air voids and uniformly mixed. The displaced concrete shall be collected and disposed of in accordance with EPA guidelines for the disposal of building materials.

The Contractor shall ensure that no segregation or voids are created during mixing or placement.

13.9.7.3 Formwork for Tremie Concrete

Where required the Contractor shall design, supply, fix and align any formwork/supports. Formwork shall be designed and constructed as to avoid flexure of formwork due to hydrostatic pressures during placement.

Timber or steel formwork shall be coated with an approved release agent correctly applied to prevent absorption of moisture and adhesion to the concrete. All rubbish, particularly chippings, shavings, and sawdust, shall be removed from the interior of all formwork immediately before the repair material is placed. Care shall be taken that oil is kept out of contact with the reinforcement and does not accumulate at the bottom of the formwork.

Formwork fasteners shall be marine Grade 316 stainless steel or other approved material and shall be chemically embedded into concrete. At completion of works fastenings shall be ground off flush with concrete surface.

13.9.7.4 Inspections and Testing

The Superintendent will conduct a minimum of three (3) random inspections of the concrete works. The Contractor shall provide labour and equipment to facilitate these inspections.

If the Contractor uses a permanent form then a 300 mm x 300 mm area of the permanent form shall be removed from the piles selected by the Superintendent and the concrete surface photographed. If in the opinion of the Superintendent the condition of the concrete is unsatisfactory by evidence of voids, cracks or other features displaying poor integrity, the Contractor shall take a 100 mm diameter concrete core (minimum of 100 mm depth) for further inspection.

Where the concrete does not satisfy the specification, the mix shall be re-designed by the Contractor and/or the procedures modified at no additional cost to the Contract. Works shall cease until the Superintendent approves the proposed changes by the Contractor and additional trial mixes satisfying the specification have been performed.

Concrete repairs that have been found unsatisfactory shall be repaired at cost to the Contractor. The Contractor shall submit the details of the repair method for the concrete works to the Superintendent for approval.

HOLD POINT

Submission of tremie concrete repair methods, 14 days before supply.

13.9.7.5 Concrete for Pile Plugs

Following casting of concrete plugs, vibration to the pile plug is to be minimised and monitored. Activities to be carried out in the immediate vicinity of the plugs that would cause vibration to the pile plug until the concrete has achieved initial set shall be minimised. If damage to the fresh concrete is occurring, work that is causing the damage shall cease immediately.

13.9.8 Concrete Formwork and Surface Finish

13.9.8.1 Formwork General

Formwork together with any falsework required to support it shall be designed and constructed by the Contractor to produce concrete members which will conform to the shapes, lines, levels and dimensions and to the qualities of surface finish required by the Drawings and Specification.

13.9.8.2 Blinding Layers

Unless otherwise directed in writing by the Superintendent, reinforced concrete for foundations, footings and pit bases shall not be placed directly on excavated surfaces. A blinding layer of 75mm minimum thickness and single layer of heavy duty polythene sheeting 0.2mm minimum thickness will be laid over the fill material at the locations shown on the drawings before any reinforcement is placed.

HOLD POINT

Submission for approval of concrete pour onto rock faces, 14 days before supply.

13.9.8.3 Codes and Standards for Formwork

Formwork shall conform to the requirements and recommendations of AS 3610, Formwork for concrete.

The surface finish of all formed surfaces concrete works shall be classified as defined in AS 3610. The class of concrete works shall be as follows:

Class 2 Surface Finish

- Headstock Beams/Front Face of Wharf
- Deck soffits
- Northern mooring dolphin
- Headwall

Class 3 Surface Finish

- All other concrete works

Unformed concrete surfaces which will be subjected to traffic, including foot traffic shall have stiff broom finish.

13.9.8.4 Products

Profiled steel sheeting composite formwork

Material: Hot-dipped zinc-coated sheet steel to AS1397, minimum G500-Z350.

Minimum steel grade: G550.

Corrosion protection: Zinc coating weight of Z450.

Accessories: Adopt material and corrosion protection to match the profiled steel sheeting.

Plywood formwork

Material: Plywood sheeting to AS6669.

Grade: To meet the design dimensions, loading and surface quality specified to AS3610.1.

Joints: Seal the joints consistent with the surface finish class.

Tolerances: To AS3610.1 Table 3.3.3.

Form linings and facings

Compatibility: Compatible with finishes applied to concrete.

Lost formwork

General: Not to contain timber or chlorides and not to impair the structural performance of the concrete members.

Release agents

Compatibility: Compatible with finishes applied to the concrete.

Void formers

Material: Cardboard or fibreboard, collapsible on absorption of moisture.

Tie Wire

Tie wire used to hold forms in position shall be galvanised where tied to reinforcement.

13.9.8.5 Formwork Design

Formwork shall be designed in accordance with the requirements of AS 3610 and this Specification. The Contractor shall be responsible for the design of all formwork and shall submit to the Superintendent, on request, calculations substantiating the formwork designs indicated by the formwork shop drawings.

HOLD POINT

Submission of formwork calculations, as indicated by shop drawings, at least 14 days prior to erection of formwork.

Formwork shall be constructed of metal, planed boards, sound well-seasoned clean timber or other approved materials and shall be constructed so as to be rigid during the casting of concrete and sufficiently watertight to prevent loss of grout. All forms shall be adequately propped, braced and fixed in their correct position and shall be sufficiently strong to resist the pressure of wet concrete or disturbance due to flotation. Formwork shall be strong enough to withstand the action of vibrators without displacement, distortion or leakage and to carry the necessary constructional traffic. Forms shall be thoroughly cleaned out to remove all tie wire, dirt, timber and all other foreign matter before concreting.

Timber and plywood forms shall be constructed of sound, well-seasoned timber and patching of plywood panels on visually exposed surfaces will not be permitted. All joints shall be sufficiently tight to prevent grout leakage. Caulking of open joints will not be permitted when the finished concrete surface will be visible when stripped.

Unless otherwise shown on the Drawings or instructed by the Superintendent, joints in forms shall be regular in pattern either vertical or horizontal and to the approval of the Superintendent.

Formwork for all precast concrete units shall be of steel construction. Steel forms shall be treated in such a manner as to keep concrete surfaces free from stains.

Internal steel ties or through section ties are not permitted.

13.9.8.6 Loads and Effects

The formwork shall be designed to withstand all static and dynamic forces, both vertical and horizontal resulting from dead, superimposed, wind any other loads or effects which could occur during the period within which the formwork is in use.

The combinations of magnitudes and durations of loads and effects used in the design shall be those necessary and sufficient to ensure the adequacy of the formwork.

Where materials are to be stacked on formwork and falsework, formed and cast concrete and stripped concrete elements, such stacking and superimposed loads, their position and other limitations shall be approved by the Superintendent who may impose certain restrictions to safeguard short and long term integrity of the completed structure or element.

13.9.8.7 Deflection

The formwork shall be so designed that the sum of:

- Its deflection under loads and effects and
- The falsework settlement including foundation settlement, and
- Its initial accuracy in position will not exceed the deviations from correct position permitted by this Specification.

In addition, the overall movement of the formwork shall be limited to prevent excessive deformation of the concrete and to thus prevent plastic cracking of the concrete.

13.9.8.8 Provision for Lateral and Longitudinal Movements

The formwork shall be so designed that the forms and falsework shall permit the occurrence of dimensional changes, deflections and cambers resulting from temperature changes, concrete creep and shrinkage.

13.9.8.9 Use of Clamps and Bolts

Wedges and clamps shall be used wherever possible instead of nails. No though section or wire ties shall be permitted.

13.9.8.10 Sloping Faces

Concrete sloped at an angle greater than 30 degrees to the horizontal shall have formwork to the upper face. Such top formwork shall be anchored down or be weighted so as to resist the upward thrust from the concrete.

13.9.8.11 Adjustment of Falsework

Falsework shall be so designed as to allow adjustment to be made to facilitate erection and stripping of forms and to compensate for any movements which may occur.

13.9.8.12 Tolerances

Except where otherwise noted on the Drawings, formwork shall be designed and constructed such that concrete surfaces shall be formed within the tolerances provided in AS 3600, AS 3610 and this Specification. Where tolerances conflict, the lesser tolerance shall be adopted. For in-situ construction, the following additional tolerances shall apply:

Table 13.7 Summary of Acceptable In-situ Tolerances

DEVIATION FROM SPECIFIED DIMENSIONS	MAXIMUM DEVIATION FROM TRUE DIMENSION IN CROSS SECTION
Concealed elements generally	20 mm
Exposed elements generally	10 mm
Elements with critical dimensional control	5 mm

The deviation of unformed surfaces from a 3-metre-long straight edge shall not exceed 10 mm nor shall abrupt irregularities exceed 3 mm.

Concrete work for which the deviation from profile line, level, grade or dimension exceeds the tolerance limits, and is considered by the Superintendent to be detrimental to the alignment of adjacent structural components or to the appearance of the structure, shall be rejected.

The dimensions lines, levels and grades of the formwork shall be checked by the Contractor immediately prior to the placing of the concrete and again immediately after placement of concrete.

13.9.8.13 Erection of Formwork on Finished Concrete Surfaces

Formwork shall not be erected on finished concrete surfaces until the surfaces have attained sufficient strength to support the formwork without damage and not before 3 days after placement of the concrete. Suitable protective materials shall be placed between formwork bases and monolithically finished surfaces as directed.

13.9.8.14 Use of Permanent Works as Falsework

Where formwork is suspended from already cast concrete elements, the method of attachment shall be submitted for comment prior to construction.

HOLD POINT

Submission of method of attachment for formwork suspended in already cast concrete elements, at least 14 days prior to use.

13.9.8.15 Preparation of Pile Shaft for Reinforced Concrete Toe Sockets

The pile shaft over the length of the concrete toe socket shall be free of any dust, clay smear, oil, loose scale or other coatings detrimental to obtaining concrete to steel bond. Any and all methods necessary to obtain pile shaft cleanliness and demonstrate pile cleanliness shall be utilized. Such methods may include but shall not be limited to:

- Wire brushing of the inside of the pile using brushes affixed to clean augers.
- Washing by means of high-pressure water jet.
- Facilitating visual inspection with spotlights.
- Providing tools for scraping and sampling the side of the pile shaft.

13.9.8.16 Concrete Drilling

It is requirement of this Specification that drilling of holes in hardened concrete for fasteners be kept to a minimum using cast in stainless steel sockets (ferrules).

Where it becomes necessary to drill holes in concrete for the placement of anchors or other fixings, the Contractor shall locate and mark the location of reinforcement in the area. Holes shall be located to avoid the reinforcement by at least 25 mm where epoxy grouted anchors are used. Mechanical anchors shall not be used.

All holes including core holes for testing shall be drilled with a diamond tipped bit. Diameter of test cores shall be 25 mm. Percussion drilling shall not be permitted.

13.9.8.17 Holes and Fitments

Where shown on the Drawings or directed by the Superintendent, holes, mortices, chases, etc. shall be formed by the provision of the necessary inserts at the time of casting the concrete.

Holding down bolts shall be set accurately to the positions and levels shown on the marking plan and detail drawings to be supplied by the steelwork fabricator or, if no erection drawings are applicable, to the details shown on the structural drawings. Holding down bolts shall be rigidly held in position by attachment to suitable steel templates prior to placing the concrete and shall not vary from the positions shown on the Drawings by more than the allowable tolerance of AS 4100 Section 111.3.

Where bolts, pipes and bars are used to form holes in members, they shall be well greased and so arranged that they may be removed from the concrete before removal of forms without excessive jarring or hammering.

If the Contractor wishes to make use of lifting holes or recesses which are not shown on the Drawings, they must first obtain approval of the positions chosen for the holes from the Superintendent. They shall be placed in such a way as will not materially affect the strength or appearance of the finished work and will not impose excessive stresses on the members during handling. Such holes and recesses shall afterwards be made good to the satisfaction of the Superintendent.

HOLD POINT

Submission for approval of lifting holes and recesses, 3 days prior to use.

13.9.8.18 Release Agents

Form linings or form facings shall be coated prior to placing of concrete with a suitable release agent which satisfies the requirements of this Specification. The Contractor shall ensure that the release agent does not "puddle" due to excessive application and so cause staining or retardation of the concrete surface.

No part of the reinforcement or construction joints shall be coated with the release agent.

Where colour control of a concrete surface is required by this Specification or shown on the Drawings then prior to the first use of a form lining or facing and subsequent to the application of the release agent, it shall be coated with a cement wash which after drying shall be removed and the lining or facing then made ready for use by again coating the release agent. In the case of absorbent form linings or facings this process shall be repeated until even absorbency is obtained. In the case of steel linings or facings a rust inhibiting release agent shall be used.

13.9.8.19 Cleaning of Forms

Forms shall be thoroughly cleaned, and dust, debris and rust and other stains shall be removed prior to application of the form release agent and again before concrete placement.

Free water shall be removed from the forms. In order to facilitate the removal of major debris from within the forms and to allow inspection immediately before the placing of concrete certain of the forms shall be readily removable. Minor debris, dust, etc. shall be removed by vacuum cleaning, compressed air or similar approved method.

13.9.8.20 Removal of Formwork

Formwork stripping times shall comply with the recommendations of AS 3610, unless authorised otherwise by the Superintendent.

All formwork shall be so constructed as to permit easing and removal without jarring the concrete. Particular care shall be taken to avoid damaging the concrete when removing formwork from concrete surfaces which will be left permanently exposed and the time of removal of the formwork from such concrete shall be such as will ensure that the finished surface is not damaged.

No forms shall be removed before the concrete has attained sufficient strength to carry the stresses induced in the concrete by such removal and, if required, the Contractor shall produce evidence to demonstrate that this requirement will be met.

HOLD POINT

Submission of evidence that concrete has attained sufficient strength for formwork prior removal.

When props are to be left in position under suspended members the formwork shall be constructed in such a way that the props are in no way disturbed when the remainder of the formwork is removed.

13.9.8.21 Waterproof Formwork

Where concrete is to be placed in forms subject to seawater inundation, all formworks shall be completely watertight to prevent the ingress of seawater during concreting operations.

13.9.9 Reinforcement and Cast in Fitments

13.9.9.1 General

Reinforcing steel used for replacement or augmentation shall be Grade D500N and comply with AS/NZS 4671 and AS3600

Tolerances on fabrication and fixing shall be to AS3600, and reinforcement shall be detailed to AS1100.501

The reinforcement shall be assessed, cleaned and prepared in accordance with this section. The bar diameters required will be determined based on the amount of section loss. The original cover to reinforcement shall not be reduced but maintained or increased if applicable.

Steel for reinforcement shall be free from loose or thick rust, loose mill scale, grease, paint, oil, dirt, any other coating detrimental to the bond between the steel and concrete and/or detrimental to the durability of the concrete.

All surfaces in contact with in-situ concrete shall be roughened to expose aggregates.

Lifting point recess & type shall be designed by the Contractor. After placing the unit, where applicable all lifting recesses at the surfaces which are exposed after completion shall be filled using non-shrink grout providing at least 50 mm cover. Grout is not required for the surfaces where lifting points are covered with in-situ concrete pour.

The Contractor shall prepare the shop drawings /bar bending schedule for the reinforcement.

WITNESS POINT

Submission of shop drawings and bar bending schedule 14 days in advance of reinforcement procurement.

All projecting reinforcement shall be provided with plastic safety caps.

13.9.9.2 Design and Method of Work

The design life of the concrete works shall nominally be 50 years to match the design life of the marine structure as stipulated in the Basis of Design document. The concrete cover to reinforcement shall be as the Drawings with a maximum of 100mm where is required to be increased to accommodate varying surface slopes. The tolerance on the cover to reinforcement shall be 0, +5 mm.

The Contractor shall provide a detailed Design (including mix design where applicable) and Work Method Statement for all concrete repair systems as required. This information shall be submitted to the Superintendent with its design documentation. The Contractor shall allow for one (1) week for the Superintendent's response.

HOLD POINT

Submission of detailed design and work method statements for concrete repair systems, 28 days in advance of the work.

13.9.9.3 Delivery, Unloading and Storage

Fabricated reinforcing steel shall be bundled and securely tied to ensure that it does not sustain damage during delivery or unloading.

Each bundle or piece shall be identified by a wired-on metallic tag showing the 'mark' of that bundle. The 'mark' shall refer to the bending schedule.

Fabricated reinforcing steel shall be unloaded and stored on site in such a manner that it does not sustain damage or become contaminated by material liable to influence its effectiveness as reinforcing in concrete.

All reinforcement at the Site shall be kept stacked above ground with sizes and types segregated, and protected from damage, contamination and degradation.

Contractor shall provide documentation to show that reinforcement supplier and mill complies with AS/NZS4671.

13.9.9.4 Contractor Submissions

The Contractor shall make the following submissions to the Superintendent:

Execution – proposals for supply, fixing and protection

The submissions will include information on the following:

- Changes: If changes are proposed to reinforcement shown on the Drawings, submit details.

HOLD POINT

Submission of proposed changes to reinforcement.

- Damaged galvanizing: If repair is required, submit proposals to AS/NZS4680 Section 8.

HOLD POINT

Submission of repair proposal for damaged galvanising.

- Mechanical splices: If mechanical bar splices are proposed or required, submit details and test certificates for each size and type of bar to be spliced.

HOLD POINT

Submission of details and test certificates for mechanical bar splices, at least 7 days prior to incorporation in the Works.

- Provision for concrete placement: If spacing or cover of reinforcement does not comply with AS3600.

HOLD POINT

Submission of drawings for concrete placement, if spacing or cover does not comply with AS3600, at least 7 days prior to incorporation in the Works.

- Splicing: All splices, except where indicated on the Drawings, will require the approval of the Superintendent.

HOLD POINT

Submission for approval of all splices not indicated on the Drawings, at least 7 days prior to incorporation in the Works.

- Welding: Give notice before welding reinforcement.

HOLD POINT

Submission of notice of reinforcement welding, at least 7 days prior to incorporation in the Works.

Products – documentation

Type-tests: Submit type-test reports to verify conformance for each reinforcement type as follows:

- Strength and ductility: To AS3600 Table 3.2.1.

HOLD POINT

Submission of strength and ductility report for reinforcement, at least 7 days prior to incorporation in the Works.

Design

Bending schedules:

The Contractor shall arrange for the preparation of detailed reinforcing bar schedules for the bar shapes and marks shown in the Drawings, showing the mass for each bar mark together with the total mass. Reinforcement shall be measured to the net length as shown in the Drawings and allowance shall be made for laps, hooks, bends and cogs. No allowance shall be made for rolling margin. Specialist bar chairs and spacers are similarly to be scheduled as required by Superintendent.

Tests

Certificate of compliance: Submit either the manufacturer's certificate of compliance with the relevant standard, or an independent testing authority's test certificates demonstrating compliance.

HOLD POINT

Submission of reinforcement compliance test certificate, at least 7 days prior to incorporation in the Works.

13.9.9.5 Bending

Unless otherwise shown on the Drawings, the reinforcement shall be cut and bent or otherwise fabricated to dimensional tolerances in conformity to AS 3600. Reinforcement shall not be hot bent or re-bent.

Except for specific situation outlined below, no bars partially embedded in concrete shall be field bent except as shown on the plans or permitted by the Superintendent.

Reinforcement that protrudes out of precast elements into in-situ concrete shall be bent on site or on the precast yard where required to accommodate varying surface slopes where the cover to reinforcement was to exceed 100 mm.

13.9.9.6 Fixing

Reinforcement shall be accurately fixed as shown on the Drawings and shall be securely held by blocking from the forms, by supporting on concrete blocks.

At the pile locations, where the in-situ bottom longitudinal reinforcement of the beams shall run through the vertical reinforcement from the pile plugs, nominated bars spacing may be adjusted to accommodate horizontal bars in between vertical bars.

Note that plastic bar chairs shall not be used on faces of elements exposed to seawater, submerged, tidal and splash zones.

Where concrete blocks are used, they shall be manufactured from the same type of concrete as the member and shall contain stainless steel tie wire. The bars shall be firmly wired together at intersections with the wire ends turned into the main body of the concrete. The surface roughness of concrete bar chairs in contact with cast in-situ concrete shall be equivalent to that required by the Concrete Specification for construction joints.

Steel reinforcement shall not be supported on metal supports extending to the concrete surface, wooden supports or on pieces of coarse aggregate. Footing reinforcement shall not be placed until the mass concrete blinding layer has been laid and cured. Care shall be taken that no damage occurs to any waterproofing membrane or vapour barrier in which case a metal or plastic plate or equivalent shall be placed under each chair.

The Contractor shall provide, at no extra cost to the Contract, reinforcing bars in addition to those shown on the Drawings for the purpose of supporting ducts, conduits and such like to the standard required by this Specification. Further, the Contractor may also provide additional reinforcement at their own cost in order to:

- Improve the rigidity of reinforcement as fixed in the forms.
- Improve the rigidity of prefabricated reinforcing cages for handling purposes.

All such extra reinforcement shall comply with the cover requirements given on the Drawings and this Specification.

The positioning and fixing of reinforcing in each section of the work shall be inspected and approved by the Superintendent prior to any concrete being poured in the section and 24 hours' notice shall be given to allow time for inspection.

WITNESS POINT

Allowance for Superintendent to inspect reinforcement prior to concrete pour.

The concrete cover to steel reinforcement shown on the Drawings is the minimum clear distance between the surface of the concrete and any reinforcement, including ligatures and stirrups and unless otherwise specified the minimum distance between any embedded fixing or fitting and any reinforcement including ligatures and stirrups.

Reinforcement shall be cleaned of any concrete spilt or splashed onto it during previous pours before concrete placing commences.

13.9.9.7 Splicing

Where practicable reinforcement shall be placed with a minimum number of splices. All splices, except where indicated on the Drawings, will require the approval of the Superintendent.

HOLD POINT

Submission for approval of splices (except where indicated on the Drawings), at least 7 days prior to incorporation in the Works

Not more than 50% of bars in any face shall be spliced at any section. For this condition, the splice lengths shall be at least the length indicated on the Drawings.

Bars forming the splice shall be placed in contact for the length of the splice and securely wired together in at least two places.

Substitution of thermal or mechanical splices will be considered where lap splices are shown on the Drawings provided they are of an approved design and do not reduce minimum cover requirements or increase congestion. Tension splices shall develop not less than 100 percent of the specified minimum ultimate tensile strength of the un-spliced reinforcing bar. Similarly, substitution of welded splices for lap splices will be considered provided they comply with the requirements of this Specification.

13.9.9.8 Welding of Reinforcement

Welding of reinforcement shall be carried out in accordance with the provisions of AS 1554 Part 3 and AS 3600 and to the approval of the Superintendent. Where a significant quantity of welded reinforcement is to be used, the Superintendent may require the Contractor to carry out random testing of production welds during progress of the work.

HOLD POINT

Submission for approval of reinforcement welding procedure and testing, 28 days prior to commencement.

The locations and details of all welds are to be shown on the “As Constructed Drawings”.

13.9.9.9 Electrical Continuity of Reinforcement

Where noted on the design drawings, reinforcement shall be welded to ensure electrical continuity. The electrical continuity of all reinforcement within precast and cast in-situ elements shall be tested in accordance with the requirements of AS2832.5. Continuity shall be confirmed, details recorded, and non-compliances rectified prior to casting concrete.

Acceptable electrical continuity shall be demonstrated by a point to point resistance between discrete elements of less than 2 ohms (excluding the resistance of all test leads) or potential difference of less than 1 mV.

HOLD POINT

Details and test certificates of reinforcement electrical continuity, within 24 hours of testing.

13.9.9.10 Bundled Bars

Where bundled bars are specified on the Drawings, they shall be placed in the closest possible contact to act as a unit and shall be tightly bound by wires not smaller than 2.5 mm at centres of not more than 24 diameters of the smaller bar in the bundle.

13.9.9.11 Protection in Hot or Cold Weather

Where there is the likelihood of an ambient air temperature greater than 32°C occurring during the placement of the concrete then the reinforcement shall be adequately shaded or sprayed with water so as to prevent its temperature rising above 32°C.

Where there is a coating of frost on the reinforcement the frost shall be removed by water washing and excess water shall be removed from the forms prior to the placement of the concrete.

13.9.9.12 Integrity of Reinforcement

Reinforcement shall not be cut to provide space for core holes or embedment and any repositioning of reinforcement to provide for them shall be to the approval of the Superintendent.

13.9.9.13 Cast in anchors/ferrules

Where noted on the Drawings, cast in anchors/ferrules shall be electrically isolated from the reinforcement. Where a cross bar is required to enhance load capacity, this bar shall be either:

- Non-metallic (e.g. FRP); OR
- electrically isolated from other bars using concrete spacer blocks; OR
- electrically isolated using PVC electrical isolation tape.

Cast-in anchors shall have at least 25mm clearance from reinforcement. If 25 mm clearance cannot be achieved, adjacent rebars shall be wrapped with a PVC insulation tape or butyl rubber tape approved by the Superintendent.

13.9.9.14 Post fixed anchors

All post fix anchors shall have at least 25 mm clearance from reinforcement. The Contractor shall locate rebar with cover meter or similar and mark out reinforcement positions to achieve minimum 25 mm clearance to the reinforcement. If 25 mm clearance cannot be achieved, adjacent rebars shall be wrapped with a PVC insulation tape or butyl rubber tape approved by the Superintendent.

WITNESS POINT

Superintendent to inspect 24 hours prior installation to ensure 25 mm clearance to the reinforcement.

Prior to the drilling of holes for post-fix anchors, the Contractor shall locate all reinforcement locations using a handheld GPR or handheld magnetic cover meter and mark reinforcement and anchor fixing locations using a resilient but non-permanent marker.

13.10 Precast Concrete

It should be noted that the following section takes precedence over the requirement to read this Construction Specification in conjunction with TfNSW QA B80, as stipulated in Section 13.7. As such, where there is ambiguity in the requirements, the body text of the Project Specification takes precedence along with the respective standards that are referenced.

13.10.1 General

All precast concrete elements, whether factory produced, or site manufactured, shall be indelibly marked with a unique reference mark that includes the date of casting and identification of the manufacturer. No shipment of any precast concrete shall be made without the acceptance of the test certificates by the Superintendent. All delays subject to this shall be deemed to have been allowed in the costs.

HOLD POINT

Submission of precast concrete test certificate, at least 3 days prior shipment of the precast concrete element.

For all precast concrete elements:

- Precast concrete to be grade 50 (cylinder strength 50 N/mm²).
- All surfaces in contact with in-situ concrete shall be roughened to expose aggregates.
- All exposed surfaces shall be coated with two coats of silane.
- All exposed surfaces shall have 25x25mm chamfers unless noted otherwise.
- Precast U-troughs with end walls (i.e. CB1, CB4, CB5, CB6 and LB11 to LB16) shall be provided with 35x35mm chamfers between the inner base and inner end wall to allow for sufficient cover of the longitudinal reinforcement at the bend.
- Lifting point & type shall be designed by the Contractor. After placing the unit, where applicable all lifting recesses at the surfaces which are exposed after completion shall be filled using non-shrink grout providing at least 50 mm cover. Grout is not required for the surfaces where lifting points are covered with in-situ concrete pour.
- The Contractor shall prepare the shop drawings for all precast units and all units shall be marked to their location at site/precast yard.
- The precast kerb outstands are to be supported on Temporary supports provided by the Contractor during construction.

HOLD POINT

Submission of precast unit shop drawings, at least 7 days prior to batching concrete for precast concrete.

13.10.2 Drawings and Schedule of Weight

The Contractor will be required, before commencing work on precast concrete to prepare shop drawings of each section of the work showing elements to be produced. Shop drawings shall also be prepared for each type of unit showing in detail the grade of concrete, finishes to concrete, joint details, reinforcement, joggles, mortices for dowels, clamps, cramps, lifting hooks and the like.

The Contractor shall also supply to the Superintendent, as soon as possible after the start of the Contract, a schedule of weights for each type of element.

HOLD POINT

Submission of precast concrete shop drawings and a schedule of weights for each type of element, at least 7 days prior to batching concrete for precast concrete.

Fabrication from the shop drawings may not proceed until accepted by the Superintendent has been granted. Any delays shall be at the Contractor's own expense.

13.10.3 Approval of Plant and Working Methods

Full details of the plant and equipment to be used and method and location of precast concrete manufacture, curing, handling, storage, transportation and installation in the works shall be submitted to the Superintendent for approval before any work is commenced on the manufacture.

HOLD POINT

Submission of plant and equipment details, and the location of precast concrete works, at least 28 days prior to batching concrete for precast concrete.

13.10.4 Handling, Storage and Protection

Precast concrete elements shall be lifted or supported only at designated lifting and support points. Elements shall be handled and placed without impact. At all stages of construction elements shall be properly protected to prevent damage to concrete surfaces especially arises and other features.

Except where these are already detailed on the Drawings, the Contractor shall make provision for all lifting hooks, etc. which are required for handling, lifting, and erecting the units in position.

All such lifting and fastening devices shall be subject to the prior approval of the Superintendent and shall be shown on the Drawings prepared by the Contractor for the Superintendent's approval. In designing and locating such devices the Contractor should note the requirements of this Specification for avoiding damage or distress due to handling, maintaining concrete cover to embedded metal and providing the required standard of finish, particularly on exposed faces. Every attempt should therefore be made to incorporate any such devices on faces which will not be exposed in the finished works. The lifting design shall be certified by a qualified chartered structural engineer.

Contractor shall provide reinforcement as is necessary to prevent damage and distress due to cracking occurred during various handling stages of precast elements before being permanently installed i.e. loading, transporting, off-loading and erecting in position in addition to the reinforcement required for structural stability of completed works. Such additional reinforcement shall also be shown on the Drawings prepared for the Superintendent's approval.

HOLD POINT

Submission of lifting and fastening devices and certification, and any additional reinforcement, shown on drawings, , at least 7 days prior to batching concrete for precast concrete.

Elements shall be stored in a manner such that additional bending stresses in the elements are prevented. The accumulation of trapped water and deleterious matter in the elements shall be prevented. Care shall be taken to avoid rust staining, efflorescence, and the effects of salt spray.

13.10.5 Moulds

All moulds shall be of adequate strength and stiffness to carry without deformation the loads and pressures of wet concrete during the casting and compaction operations. Moulds shall be sufficiently tight to prevent leakage of the concrete and shall be adequately supported, braced and maintained so as to produce units within the tolerances specified. Details of materials to be used in the manufacture of the moulds or formwork must be submitted to the Superintendent for their approval before commencing work.

HOLD POINT

Submission of details of mould or formwork material, at least 7 days prior to batching concrete for precast concrete.

The assembled moulds shall be checked for accuracy immediately prior to the first casting of each type of unit, and thereafter prior to every third casting or at such closer intervals as the Superintendent may require.

The Contractor must allow in their price for a sufficient number of moulds to enable them to maintain the required progress of the works. No extras will be allowed in the event of additional moulds being required to achieve the stated programme. Each mould shall be allocated a code number and all units cast in that mould shall have the mould code number and date of casting marked on.

Moulds are to be thoroughly cleaned between each casting and all deleterious matter removed.

13.10.6 Curing of Elements

Curing of precast concrete elements shall be in accordance with AS3600 for exposure classification C2.

The maximum temperature of the concrete during curing shall not exceed 65°C.

The maximum temperature of a pour with smallest dimension more than 750 mm shall be assessed by the Contractor by a method agreed with the Engineer (for instance with reference to CIRIA guide C660) and where it exceeds 60°C the

Contractor shall prepare a concreting plan detailing the measures proposed to control the maximum concrete temperature including the maximum temperature of the fresh concrete and the maximum shade air temperature during the concrete pour and predicted during the curing period for the agreement of the Engineer.

Curing compounds may be used provided that they comply with AS3799 and they do not affect floor finishes.

PVA-based curing compounds are not acceptable.

All proposals for accelerated curing shall be fully detailed including all arrangements for ensuring the effectiveness of curing under all possible climatic conditions.

13.10.7 Surface Finishes

Surface finishes of precast elements, including permanent formwork, shall comply with the requirements stipulated in AS3610

- Concrete surfaces in:
 - Exposed form:
 - all precast concrete surfaces shall have Class 2 finish.
 - where exposed and visible, formed surfaces shall have a Class 2 finish.
 - where hidden, formed surfaces shall have a Class 3 finish.
 - unformed concrete surfaces shall have a wood float finish, except those areas which will be subject to traffic, including foot traffic, which have a stiff broom finish.
 - Internal:
 - internal faces of the precast shall have an exposed aggregate type of finish or surface deliberately roughened to ensure bond and key with in-situ concrete in accordance with Table 8.4.3 of AS 3600.

No construction joints will be permitted within any precast element. Joints in permanent formwork shall be made tight to prevent grout leakage. Any construction joints required for constructability within precast elements shall be to the approval of the Superintendent and have a roughened surface as per AS3600 Table 8.4.3 to ensure bond with newly placed concrete.

13.10.8 Rejection of Precast Elements

All finished elements, whether erected in position or not, which do not comply with the Drawings and Specifications shall be removed and replaced with new items to the Superintendent's satisfaction.

WITNESS POINT

Inspection of precast elements.

Reasons for rejection of units shall include the following:

- The presence of cracks or repairs. As per AS 3600, for higher exposure classifications B1, B2, C1 and C2, the design crack width is limited to a maximum of 0.1 mm
- The presence of broken edges whether reinforcement is exposed or not.
- Concrete cover to any reinforcement being less than that required by this Specification.
- A surface finish inferior to that indicated on the Drawings and/or defined in this Specification.
- Out of tolerance dimensions from the tolerances as specified on the drawings.
- Excessive grout loss

13.10.9 Sampling and Testing

Where precast concrete elements are manufactured off site, unless specifically provided for herein, all costs involved in sampling and testing required by the Specification shall be borne by the Contractor.

13.10.10 Certificate of Manufacture

For precast concrete elements which are manufactured off site, the Contractor shall supply to the Superintendent, prior to any element being delivered to site, a certificate stating that that element complies in all respects with the Drawings and Specifications.

HOLD POINT

Submission of precast concrete test certificate, at least 3 days prior shipment of the precast concrete element.

13.10.11 Erection Specifications

The Contractor shall prepare and submit to the Superintendent for agreement an erection specification which shall include provisions for the handling and on-site storage, supports, props, placing and adjustment, jointing and completion works of precast concrete elements and shall include the sequence of on-site operations thereto.

HOLD POINT

Submission of erection specification, at least 7 days prior to batching concrete for precast concrete.

13.10.12 Tolerances

The members must be placed in their correct positions and the as shown on the Drawings. Positional and construction tolerances shall be as defined on the drawings.

Overall dimensions of the precast “U” trough units are critical to buildability. A typical 10 mm gap has been provided between the interface of precast units at the pile location. Precast units CB1’s, CB2’s and CB3’s are supported and/or continuous over longitudinal precast beams (LB’s). The gap of 5mm has been allowed in cross beams precast units supported over longitudinal precast beams. Therefore, a typical tolerance of 0 to -5 mm has been allowed for the construction and the placement of precast elements. Where applicable, check all alignment dimensions before finally fixing and grouting the units. 0 to -5 mm tolerances apply to the final overall dimensions of units in hardened state including surface treatment.

Precast pile muffs (pile capital) are supported over steel tubular pile walls through steel fin plates. Pile cut off tolerance of +/-5mm flatness are allowed for. To ensure 100% load transfer when pile capital is loaded, steel shim plates shall be used to achieve the regular surface contact between fin plates and steel pile walls.

13.11 TfNSW QA Specifications

The relevant TfNSW QA Specifications are listed below:

- TfNSW Specification QA 3323 (3211)
- TfNSW Specification QA B80

It should be noted that the requirements stipulated in the body text in the Project Specification takes precedence over the requirements in TfNSW B80, as the curing and precast sections have been written to comply with project specific requirements such as the 7-day shutdown period of the existing wharf during the connection to the Northern Extension Wharf. As such, where there is ambiguity in the requirements, the body text of the Project Specification takes precedence along with the respective standards that are referenced.

13.11.1 TfNSW Specification QA 3323

The following Clauses are amended:

13.11.1.1 Clause 8

Deleted

13.11.2 TfNSW Specification QA B80

The following Clauses are amended:

13.11.2.1 Annexure B80/A – Project Specific Requirements

A1 and A2 are not used. No members are in exposure classification U.

13.12 Summary of Hold/Witness Points

All hold and witness points during concrete works are outlined in Table 13.8Table 13.8, and all required tests are outlined in Table 13.9.

Table 13.8 Hold/Witness Point Schedule

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Concrete design mix testing	13.6	HOLD	Concrete quality report, within 28 days from award of contract, minimum of 5 days prior to placing any concrete.	The Superintendent will consider the submitted document prior to authorising the release of the Hold Point.
Concrete mix redesign testing (if initial mix fails testing)	13.8.7	HOLD	Submission of re-designed concrete mix within 14 days prior to placing any concrete.	The Superintendent will consider the submitted document prior to authorising the release of the Hold Point.
Concrete mix redesign testing (if initial mix fails testing)	13.8.7	HOLD	Submission of full re-designed concrete mix details within 7 days prior to placing any concrete.	The Superintendent will consider the submitted document prior to authorising the release of the Hold Point.
Concrete design mix testing	13.9.6.1	HOLD	Detail of construction joint locations, at least 7 days prior to incorporation in the Works	The Superintendent will consider the submitted document prior to authorising the release of the Hold Point.

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Concrete design mix testing	13.9.4, 13.9.5, 13.9.5.5	HOLD	Detailed method statements, including hot weather protection procedures, thermal control and monitoring, at least 28 days prior to batching concrete	The Superintendent will consider the submitted document prior to authorising the release of the Hold Point.
Formwork placement	13.9.8.5	HOLD	Details of formwork calculations and shop drawings, at least 14 days prior to erection of formwork	The Superintendent will consider the submitted document prior to authorising the release of the Hold Point.
Formwork placement	13.9.8.14	HOLD	Details of method of attachment for formwork suspended in already cast concrete elements, at least 14 days prior to use	The Superintendent will consider the submitted document prior to authorising the release of the Hold Point.
Reinforcement delivery	13.9.9.4	HOLD	Report of strength and ductility of reinforcement, and compliance certificate, at least 7 days prior to incorporation in the Works	The Superintendent will consider the submitted document prior to authorising the release of the Hold Point.
Reinforcement placement	13.9.3.6, 13.9.9.1, 13.9.9.4	HOLD	Shop drawings and bar bending schedule, at least 7 days prior to incorporation in the Works	The Superintendent will consider the submitted document prior to authorising the release of the Hold Point.
Reinforcement placement	13.9.9.4	HOLD	Proposed changes to reinforcement, at least 7 days prior to incorporation in the Works	The Superintendent will consider the submitted document prior to authorising the release of the Hold Point.

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Mechanical bar splices	13.9.9.4	HOLD	Details and test certificates for mechanical bar splices, at least 7 days prior to incorporation in the Works	The Superintendent will consider the submitted document prior to authorising the release of the Hold Point.
Splices	13.9.9.4, 13.9.9.7	HOLD	Details of location of splices not indicated on the Drawings, at least 7 days prior to incorporation in the Works	The Superintendent will consider the submitted document prior to authorising the release of the Hold Point.
Reinforcement welding	13.9.9.4	HOLD	Notice of reinforcement welding, 7 days prior to welding.	The Superintendent will consider the submitted document prior to authorising the release of the Hold Point.
Reinforcement welding	13.9.9.8	HOLD	Submission for approval of reinforcement welding procedure and testing, 28 days prior to commencement.	The Superintendent will consider the submitted document prior to authorising the release of the Hold Point.
Reinforcement welding	13.9.9.9	HOLD	Details and test certificates of reinforcement electrical continuity, within 24 hours of testing.	The Superintendent will consider the submitted document prior to authorising the release of the Hold Point.
Concrete delivery	13.7, 13.8.1, 13.8.5, 13.8.7, 13.9.3.4	HOLD	Concrete mix design report, mix test results and properties, thermal and durability calculations, product conformity certificates, temperature monitoring results of trial pour, minimum of 14 days prior to concreting	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Concrete delivery	13.9.9.2	HOLD	Detailed design and work method statements for concrete repair systems, minimum of 14 days prior to concreting	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Concrete delivery	13.9.9.4	HOLD	Concrete placement drawings, if spacing or cover does not comply with AS3600, minimum of 14 days prior to concreting	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Concrete delivery	13.8.7	HOLD	If a batch fails to meet the requirements of this specification, submission of re-designed concrete mix details, minimum of 14 days prior to concreting	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Concrete delivery	13.9.3.2	HOLD	Details of proposed construction systems, load and procedures, at least 7 days prior to the placing of concrete in the works	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Concrete delivery	13.9.3.3	HOLD	Proposals for mixing, placing, finishing and curing concrete, minimum of 14 days prior to concreting	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Concrete delivery	13.9.3.1, 13.9.3.7, 13.9.3.8	HOLD	Material test certificates, at least 3 days prior to pouring concrete.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Concrete pour	13.9.9.6, 13.9.9.14	WITNESS	Inspection of reinforcement, 24 hours' notice	The Superintendent will inspect the reinforcement prior to the concrete pour.

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Concrete pour	13.9.3.5	HOLD	Delivery dockets, on the day of the concrete pour.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Concrete pour	13.9.3.5	HOLD	Subcontractor details, at least 7 days prior to the placing of concrete in the works	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Concrete pour	13.9.3.8	HOLD	Details of truck mixers with a capacity greater than 5m ³ , at least 7 days prior to the placing of concrete in the works	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Concrete pour	13.9.8.2	HOLD	Details of concrete pour onto rock faces, 14 days before supply	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Full concrete pour	13.9.6.1	HOLD	Sample construction joint, 14 days before supply.	The Superintendent will consider the submitted sample prior to authorising the release of the Hold Point.
Tremie concrete supply	13.9.7.1, 13.9.7.4	HOLD	Details of tremie operations, 14 days before supply	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Use of lifting holes or recesses	13.9.8.17	HOLD	Submission for approval of holes and recesses, 3 days prior to use of lifting holes or recesses.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Removal of formwork and/or insulation	13.9.5.5	HOLD	Details of thermal monitoring, at least 28 days prior to batching concrete	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Removal of formwork	13.9.5.5, 13.9.8.20	HOLD	Evidence that concrete has attained sufficient strength, at least 1 day prior to the time proposed to strip the formwork.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Poured concrete commissioning	13.9.3.8, 13.9.8.17	HOLD	Repair methods for unsatisfactory concrete, including holes and recesses, at least 3 days prior to commencing the repairs	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Precast concrete delivery	13.10.3	HOLD	Plant and equipment details, location of precast concrete works, at least 28 days prior to batching concrete for precast concrete	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Precast concrete delivery	13.10.11	HOLD	Erection specification, at least 7 days prior to batching concrete for precast concrete	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Precast concrete delivery	13.10.1, 13.10.2	HOLD	Precast unit shop drawings and a schedule of weights, at least 7 days prior to batching concrete for precast concrete.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Precast concrete delivery	13.10.4	HOLD	Details of lifting and fastening devices, additional reinforcement requirements, at least 7 days prior to batching concrete for precast concrete.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Precast concrete delivery	13.10.1, 13.10.10	HOLD	Precast concrete test certificate, at least 3 days prior shipment of the precast concrete element.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Precast concrete delivery	13.10.5	HOLD	Details of mould or formwork material, at least 7 days prior to batching concrete for precast concrete.	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.
Placement of precast elements	13.10.8	WITNESS	Inspection of precast elements, at least 7 days prior to proposed placement in the Works.	The Superintendent will inspect all precast elements.

Table 13.9 Works Testing

ACTIVITY	TEST METHODS	MINIMUM FREQUENCY	ACCEPTANCE CRITERIA
Grout bleeding	ASTM C940	When two successive readings show no further expansion or bleeding	Final bleeding < 0.5%
Grout volume change	ASTM C1090	1 & 28 days	Maximum height change @ 1 & 28 days 0.1% and 0.3%
Grout early expansion	ASTM C940	3 hours	< 2% at 3 hours.
Grout fluidity	AS 1478.2 Appendix C ²	Immediately after mixing, 45 minutes after mixing	Immediately after mixing: Efflux time < 20 s 45 minutes after mixing: Change in efflux time <± 3 s

ACTIVITY	TEST METHODS	MINIMUM FREQUENCY	ACCEPTANCE CRITERIA
Grout minimum compressive strength	AS 1478.2 Appendix A	7 days, 28 days	40 MPa at 7 days 50 MPa at 28 days
Rapid migration coefficient of concrete mix	Nordtest NT Build 492	28 days	Mix A: $8.0 \times 10^{-12} \text{ m}^2/\text{s}$ Mix B: $4.0 \times 10^{-12} \text{ m}^2/\text{s}$
Diffusion coefficient of concrete mix	Nordtest NT Build 443	56 days	Mix A: $3.5 \times 10^{-12} \text{ m}^2/\text{s}$ Mix B: $2.0 \times 10^{-12} \text{ m}^2/\text{s}$
Washout of concrete mix	CRD-C 61-89A	n/a	n/a
Compliance testing of concrete	As specified in Table 13.4.		

A modification may be introduced to the test method as follows:

- (5) Fill the flow cone to the top instead of to the standard level. Measure the efflux time as the time measured to fill the one litre container placed directly under the flow cone.

14 Wharf Furniture

14.1 General

This section of the specification covers the supply and installation of bollards, fender and miscellaneous wharf furniture.

Except as specified herein or as shown on the Drawings the fitting and installation of wharf furniture shall be to the manufacturer's specifications.

14.1.1 Codes and Standards

The governing code for fendering and mooring systems is:

- BS 6349 Part 4 2014, Maritime structures: Code of practice for design of fendering and mooring systems

The procedure to determine and report the performance of the fenders shall be as per:

- PIANC Report of Working Group 211, Fender guidelines (2024)
- Steel design as per: AS 3678 Structural steel
- Steel – Hot rolled plates, floorplates and slabs

14.1.2 General

The term "fender" means the complete assembly comprising a rubber fender unit, steel fender panel, low friction facing boards, chains, fixings, brackets, connections and all other items associated with design, manufacture, delivery to site, installation and certification of the complete assembly to the specified performance.

The Contractor shall provide all calculations, design and technical data, quality documentation, commissioning and maintenance manuals for the supplied fenders. Access shall be given to the Superintendent to inspect the manufacturer's factory where the fender units are being produced, if required.

The Contractor shall procure and install the fender assemblies, including the procurement, protection, fitting and installation of the cast-in items, inserts, etc to the manufacturer's details, to the approval of the Superintendent. The Contractor shall ensure that the fender supplier delivers all cast-in items, inserts, plugs, templates (for correct placement of the inserts), etc. and detailed installation manuals and specifications in time for the required installation date.

The design of rubber fender units must ensure that bolts/anchors do not contact the fender or the vessel during compression of up to the rated deflection.

The Contractor shall submit detailed technical documentation from the fender supplier to verify that the supplied fender meets or exceeds the fender design requirements provided in Section 14.1.3 and Section 14.2.

HOLD POINT

Fenders - Submission of technical and quality documentation, 28 days before procurement.

14.1.3 Quality Assurance and Certification

The fender system certification shall include:

- Manufacturer's test certificate for rubber compound
- Compression test results for all rubber fender units
- Mill certificates for all steel fabrications
- Paint thickness inspection certificate

- Galvanised thickness inspection certificate
- UHMW polyethylene
- Proof test certificate for chains
- Manufacturer's warranty certificate

14.1.4 Design Requirements

Table 14.1 Design Vessels

Parameter	UoM	Existing Dry bulk	Indicative Existing Design Vessel	RORO – 265m LoA	RORO – 200m LoA	Bulk Carrier – 170m	Bulk Liquid - 142m
Indicative vessel	-	Moshill	Eastern Glamour	Salome	Tannhauser	Eastern Cape	Golden Sky
DWT	t	120,000	115,461	43,878	24,155	28,195	16,297
Fully Laden Displacement UNO	t	139,120 (full) 80,000 (50% ballast)	134,307 (full) 18,846 (light)	70,448	46,400	34,589	21,008
LOA	m	259.82	254.00	265.00	199.90	169.40	142.00
LBP	m	254	-	249	-	-	-
Beam	m	39.6	43.1	32.3	36.5	27.3	22.0
Laden draft UNO	m	16.453 ¹ (full) 11.1 (50% ballast)	14.5	12.3	11.0	9.8	9.1
Ballast draft	m	5.7	-	7.38	-	-	-
Moulded depth	m	22.4	-	22	-	-	-

¹It is noted the dredged depth of the existing berth is -16.3 m CD so the berth can only accommodate this vessel when partially laden /50% ballasted according to as-built Drawings.

Table 14.2 Fender design parameters

PARAMETER	VALUE
Berthing Type	Quarter-point
Allowable Hull Pressure	300kPa
Berthing Angle	4 deg
Partial energy factor	1.5
Vessel Belting	Not considered
Chains between fender and quay	As per manufacturer's recommendation

Fenders shall meet the following performance requirements:

- Rated Energy per Fender = 1330 kNm
- Rated Reaction per Fender = 1916 kN

The rubber material for the fenders shall be a compound of natural and synthetic rubber of high quality having high resilience, anti-aging, weather and wear resisting properties.

The physical properties of the rubber fenders shall comply with the following:

- Minimum adjusted energy means the rated energy of a single fender unit multiplied by derating factors for manufacturer's tolerance, angular performance, shear (due to friction co-efficient = 0.25 min) and temperature.
- Maximum adjusted reaction force means that rated reaction force increased by factors for manufacturer's tolerance, angular performance and shear (due to friction co-efficient = 0.25 min) and temperature.

Normal and abnormal berthing energies shall be calculated in accordance with the design methods given in:

- PIANC Report of Working Group 211, Fender guidelines (2024)
- BS6349: Part 4: Maritime structures: Code of practice for design of fendering and mooring systems

Fenders shall be designed for single fender berthing. Fenders shall be designed for the most unfavourable position of the ship's hull. Rated energy and deflections values shall be reduced, where necessary, using manufacturer's factors, to take account of berthing and flare angles.

Fenders shall be designed to absorb berthing energy from abnormal impacts, within the rated deflection of the fender. The fender system shall be designed for either quarter point vessel impact, or for a point of contact determined from the hull geometry and berthing angle, whichever gives the worst case.

Fender front panels shall be positioned to accommodate berthing of the full range of laden, partially laden and un-laden vessels at all states of the tide, values of which are given on the Drawings.

The effect of belting on vessel hulls shall be taken into account in design of the fender system.

The design of fenders should take into account the effects on fender performance within the temperature range of:

- Max. Ambient Temperature 35°C
- Min. Ambient Temperature 5°C

Chains and fixings shall be designed to resist horizontal and vertical shear using a friction factor of not less than 0.25.

Fender design shall take account of manufacturing performance tolerances for rubber by reducing the manufacturers rated energy absorption by 10% and increasing the manufacturers rated reaction by 10%.

14.2 Fenders

14.2.1 Rubber Properties

The rubber raw material shall meet or exceed the performance requirements outlined in PIANC: Guidelines for the Design of Fender Systems: 2024. A “Type Approval” certificate as per PIANC 2024 shall be submitted to the Superintendent for approval. In case the performance requirements of PIANC WG211 cannot be met before the end of the transition period between WG 33 and WG 211 to reorganise fender suppliers' catalogues according to the new guidelines, they shall as a minimum meet the requirements of previous Guidelines for the Design of Fender Systems: 2002: Appendix A. Where there is a discrepancy between the Technical Specification and relevant guideline, the most critical requirement out of the two shall be met to the approval of the Superintendent.

HOLD POINT

Submission of Type Approval, 28 days before procurement .

Rubber for fender elements shall be resistant to deterioration by oil, grease, ozone, UV radiation, seawater and aging. Each type, size and grade of rubber for fender elements shall comply with the requirements shown below.

Table 14.3 Rubber properties requirements

PROPERTY	STANDARD (OR EQUIVALENT)	BASIC VALUE	AGES VALUE
Tensile Strength	DIN 53504	15 N/mm ² minimum	12.8 N/mm ² minimum for

PROPERTY	STANDARD (OR EQUIVALENT)	BASIC VALUE	AGES VALUE
			168 hours at 70° degrees
Elongation at break	DIN 53504	350 % minimum	280% for 168 hours at 70°C
Hardness	DIN 53504	75° shore A maximum	+5° increase maximum for 168 hours at 70° C
Tear resistance	DIN 3507	80 N/cm minimum	
Abrasion Resistance	DIN 3516	100mm ³	
Compression Set	DIN 3517		40% maximum for 22 hours at 70° C
Ozone Resistance	DIN 53509		No cracks visible by eye (50 pphm at 20% for 40 hours at 40° C)
Seawater Resistance	DIN 86076		Shore A: ±10° maximum Volume +10%/-5% maximum for 28 days at 95°C ±2°C
Dynamic Fatigue	ASTM D430 – 95, Method B	15,000 cycles, grade 1	
Bond strength – Rubber to steel	ASTM D429, Method B	7 N/mm minimum	

Manufacturing dimensional tolerances for rubber shall be within ± 2 mm or $\pm 3\%$, whichever the greater dimension. The allowable performance tolerance shall be $\pm 10\%$. Results of tests on at least one of the fender units shall be submitted for approval.

14.2.2 Fixings

Fender unit and chain fixings and associated nuts and washers shall conform to AS 2312 and shall be stainless steel Grade 316L and to have a polished finish.

All fixings to the supporting structure shall be cast in wherever possible although resin anchored fixings may be permitted in pre-cast blocks subject to approval from the Superintendent. Approved anchor resin shall be supplied in either cartridge or capsule form; bulk resin shall not be used.

14.2.3 Fender Panels

Fender panels shall be fabricated from AS 3678 Grade 300 steel in accordance with the requirements listed below. The Contractor shall submit steelwork shop drawings to the Superintendent for review as part of the submission referenced in Section 14.1.2. Steel fender panels shall be open box type construction.

The design shall comply with the following minimum steel thicknesses:

- External plates exposed both faces: 12 mm minimum
- External plates exposed one face: 10 mm minimum
- Internal plates (not exposed): 8 mm minimum
- The fender supplier shall advise the unit weight of the fender panel.

- Manufacturing tolerances for steel dimensions shall be within ± 1 mm.

The design shall consider bending, shear and local buckling associated with the maximum reaction developed by the fender unit, including the simultaneous application of a friction force in either vertical or horizontal direction loads and environmental forces. Panel rib spacing is to be minimised to ensure uniform pressure distribution on the vessel hull to the limits provided in PIANC Working Group 211 (2024). Deflection of the face plate is to be not greater than 2L/1000, in accordance with the Japanese Shipbuilding Quality Standards.

Pad-eyes shall be provided for lifting and chain attachments, and shall be designed in accordance with the requirement of API RP2A Clause C.5.5. Sufficient lifting pad-eyes shall be provided to allow easy handling, and the frame shall have sufficient rigidity and strength to avoid damage during handling and installation.

Front vertical edges of the fender panels shall be splayed in order to reduce damage to facing panels (caused by vessels with intermittent belting and vessels ‘rolling’ at the berth). Minimum dimensions for front vertical edge splays shall be 200mm by 200mm.

Fender panels shall have a splayed bevel at the top and bottom of the panel to reduce damage to the fender panel from hull protrusions and vessel movements. Minimum dimensions for top and bottom edge splays shall be 300 mm by 200 mm.

Fixing for the UHMW-PE facing panel shall be with M20 stainless steel studs.

14.2.4 Corrosion Protection and Maintenance

Prior to fender coating, corrosion protection bond cable tabs shall be installed on the fenders. The bond cables are to connect to the nearest piles.

The fender system shall be protected from corrosion with a very high build, glass flake reinforced epoxy paint coating system conforming to the EVH3 system designation defined in Table C1 of AS 2312.1. Corrosion protection shall be designed to provide a life to first maintenance of 15 years. Details of the system and proposed inspection and testing plan shall be submitted as part of the Contractor’s submission referenced in Section 14.1.2.

Fender panels shall be fitted with a connection bar for the CP system as shown on the CP drawings. Corrosion protection coatings, fender framing, fixings and chains shall be compatible with the cathodic protection system adopted. Prior to installation of the anodes system, details of the system shall be submitted as part of the Contractor’s submission referenced in Section 14.1.2.

The colour of the corrosion protection system shall be a black, unless otherwise approved by the Superintendent. The corrosion protection system shall not be coal tar epoxy or bitumastic based.

All damage to painted surfaces during transport, handling, lifting and installation shall be repaired to the approval of the Superintendent with a complete coating system at Contractor’s expense.

A detailed repair and maintenance manual shall be provided with details of programmed, regular maintenance at periods of five years. Where possible, units of the fender shall be demountable enabling the replacement of one part of the system.

14.2.5 Installation and Workmanship

All steel works shall be executed in accordance with the Specifications. The Contractor shall submit all necessary shop drawings for the steel works as part of the Contractor’s submission referenced in Section 14.1.2. All holes shall be made by drilling. All free edges and corners shall be rounded by grinding, with radius greater than 2 mm.

Manufacturing tolerances shall be within:

- For rubber: ± 2 mm or $\pm 3\%$, whichever the greater dimension
- Positioning tolerances of the fender assembly relative to the lines and levels shown shall be within +/- 20 mm.

- Washers shall be used under bolt heads in order to avoid damage to the paint. A water sealant compound shall be applied on all bolt thread connections to ensure water and air tightness of the fender panel.
- Fender fixings shall be accurately set out to ensure that fenders are installed without distortion to the rubber.
- A qualified representative of the fender supplier shall attend site to advise on fender installation methods and to verify the fender installation and the Superintendent shall Witness the Installation.

WITNESS POINT

Installation of fenders on site.

14.2.6 Testing

The fenders shall be subject to third party inspection and witnessing by an accredited agency to certify that fabrication quality assurance, fender performance and physical property tests conform to this Specification.

All fenders shall be performance tested prior to shipment. The performance testing shall be carried out in accordance with PIANC ‘Guidelines for the Design of Fender Systems 2024’. In case the performance requirements of PIANC WG211 cannot be met before the end of the transition period between WG 33 and WG 211 to reorganise fender suppliers’ catalogues according to the new guidelines, they shall as a minimum meet the requirements of previous Guidelines for the Design of Fender Systems: 2002: Appendix A. Where there is a discrepancy between the Technical Specification and relevant guideline, the most critical requirement out of the two shall be met.

Any fender failing to meet the Specification will be rejected.

A certificate showing the manufacturers name, the date and the place of manufacturer and showing that the rubber fenders, including the rubber used in manufacturing the fenders, comply with the requirements stated in this Specification shall be submitted for each batch of rubber fenders delivered on the site.

14.2.7 Fender Pre-compression

Prior to shipment, all fenders shall be supplied already compression tested and certified as having the immediate and sustained specified performance characteristics taken as the average of the second and third compression test results. Compression test results of all fenders units shall be supplied as soon as tested.

14.3 Bollards

14.3.1 General

Bollards shall be Trelleborg bollards to the type and minimum safe working load as shown on the Drawings and shall be supplied and installed to the manufacturer’s specifications, or similar as approved by the Superintendent. The safe working load shall apply for vertical angles between -15 degrees and +60 degrees to the horizontal and +/- 90 degrees in plan measured perpendicular to the berthing line.

The Contractor shall provide all design calculations, technical data, material specifications, quality documentation, commissioning and maintenance manuals for the supplied bollards. The Contractor shall procure and install the bollard assembly, including the protection, fitting and installation of the cast-in items, inserts, etc to the manufacturer’s details, to the approval of the Superintendent. The Contractor shall ensure that the bollard supplier delivers all cast-in items, inserts, plugs, templates (for correct placement of the inserts), etc. and detailed installation manuals and specifications in time for the required installation date.

The design of bollard assembly must ensure that tops of any bolts/anchors do not contact the mooring lines.

HOLD POINT

Bollards - Submission of technical and quality documentation, 28 days before procurement.

14.3.2 Materials

The type and grade of steel used shall be at the manufacturer's specifications but evidence by way of calculation and/or test results of the adequacy of the bollard shall be submitted for approval as part of the Contractor's submission above.

The castings shall have a smooth sand finish free of fins of roughness and shall be left in the "as cast" condition except for a minimum of fettling as approved. Bollards with an unacceptable surface finish shall be rejected and be replaced at the Contractor's expense.

Bollards shall be painted with protective coating B as specified in Table 16.1.

14.3.3 Installation

Bollards shall be installed in accordance with the manufacturer's instructions. The Superintendent shall Witness the Installation of the bollards.

WITNESS POINT

Installation of bollards on site.

14.4 Capstan

The running line pull load of each capstan shall be 3 tonne. Startup pull capacity is twice the line pull. The rope speed shall be 30 m/min. The Capstan shall be the vertical drum type. Minimum drum diameter shall be 250 mm.

All motors and motor frames shall be designed, constructed and tested in accordance with the latest amendments of AS 1359 - "Rotating Electrical Machines - General Requirements" and with all relevant SAA Specifications. The Contractor shall select motors with regard to torque requirement of the load, the speed torque characteristics of the motors and the torque reduction due to the voltage drop caused by the starting current. All motors shall be suitable insulated to limit motor temperature rise (TR).

All insulating materials shall be non-hygroscopic. High voltage motor insulation shall be capable of withstanding voltage spikes. It shall be possible to disconnect and remove all motors with a minimum of disruption to motor cabling. All bearings shall be designed for an L10 life of 50,000 hours with an a2, a3 life adjustment factor not greater than 1.0 in accordance with AS 2729 – "Rolling bearings - Dynamic load ratings and rating life". Rotor cages shall be designed to withstand the starting duty specified and minimise vibration.

Motors of the same output shall be identical (for spares standardisation). Each motor shall supply rated output in either direction of rotation. All motors shall be able to receive cables from the right and left hand side. This feature may be achieved by either providing the cable termination box(s) on the top of the motor or by providing a symmetrical motor frame. All motors shall be totally enclosed, fan cooled, and equipped for exterior cooling by means of a fan or fans integral with the machine (TEFC) but external to the enclosing parts. All motor enclosures shall be rated minimum IP 66 and shall be vermin proof.

All motors shall be provided with a means of lifting comprising a lifting bolt set in a tapped hole. The tapped holes for the lifting bolts shall not pass completely through the motor frame. The electricity-operated motor shall be equipped with a foot switch. The capstan shall also be reversible and shall be equipped with a brake designed to hold 150% of the running pull. All motors shall be supplied complete with fault rated terminal boxes, which are completely sealed off from the motor winding space. Motor windings shall be brought out to adequately sized fixed terminals. Connections from terminals to the motor winding shall not use natural rubber as insulation. All motor bearings (ball and roller) shall be fitted with labyrinth seals to prevent the ingress of abrasive dust and moisture.

The Contractor shall provide all calculations, design and technical data, quality documentation, commissioning and maintenance manuals for the supplied capstans. Access shall be given to the Superintendent to inspect the manufacturer's factory where the capstan units are being produced, if required.

The Contractor shall procure and install the capstan assemblies, including the procurement, protection, fitting and installation of the cast-in items, inserts, etc to the manufacturer's details, to the approval of the Superintendent. The Contractor shall ensure that the capstan supplier delivers all items, fluids, commissioning parts, cast-in items, inserts, plugs, templates, etc. and detailed operating and installation manuals and specifications in time for the required installation date.

HOLD POINT

Capstans - Submission of technical and quality documentation, 28 days before procurement.

14.4.1 Installation

Capstans shall be installed in accordance with the manufacturer's instructions. The Superintendent shall Witness the Installation.

WITNESS POINT

Installation of capstans on site.

14.5 Miscellaneous Furniture

Railings, safety barriers and ladders shall be fabricated and installed as shown on the Drawings. Lifebuoy shall be SOLAS approved and be provided with cover and rope.

New ladders shall conform to the requirements of AS4997. Existing ladders shall be removed from the locations identified on the Drawings.

Handrails shall be compliant with AS1657. Alternative details to those presented in the drawings shall be approved by the Superintendent.

Safety barriers shall be HammerBeam or equivalent approved by the Superintendent.

HOLD POINT

Submission for approval of Technical detail 28 days before procurement.

14.5.1 Installation

Miscellaneous Furniture shall be installed in accordance with the manufacturer's instructions and equipment/parts. The Superintendent shall Witness the Installation.

WITNESS POINT

Installation of Miscellaneous Furniture on site.

14.6 Summary of Hold/witness Points

All hold and witness points during construction of wharf furniture are outlined in Table 14.4.

Table 14.4 Hold/Witness Point Schedule

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Fender procurement	14.1.2	HOLD	Submission of fender technical and quality documentation, at least 28 days before procurement	Acceptance by Superintendent prior to authorising the release of the hold point

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Fender procurement	14.2.1	HOLD	Submission of Type Approval certificate, at least 28 days before procurement	Acceptance by Superintendent prior to authorising the release of the hold point
Installation of fenders on site	14.2.5	WITNESS	Inspection of fenders prior to and during installation	The Superintendent will inspect the fenders prior to authorising the release of the Witness Point.
Bollard procurement	14.3.1	HOLD	Submission of technical and quality documentation 28 days before procurement	Acceptance by Superintendent prior to authorising the release of the hold point
Installation of Bollards on site	14.3.3	WITNESS	Inspection of bollards prior to and during installation	The Superintendent will inspect the bollards prior to authorising the release of the Witness Point.
Capstan procurement	14.4	HOLD	Submission of technical and quality documentation at least 28 days before procurement	Acceptance by Superintendent prior to authorising the release of the hold point
Installation of capstans on site	14.4.1	WITNESS	Inspection of capstans prior to and during installation	The Superintendent will inspect the capstans prior to authorising the release of the Witness Point.
Miscellaneous furniture procurement	14.5	HOLD	Submission of technical and quality documentation at least 28 days before procurement	Acceptance by Superintendent prior to authorising the release of the hold point
Installation of Miscellaneous Furniture on site	14.5.1	WITNESS	Inspection of miscellaneous furniture prior to and during installation	The Superintendent will inspect the miscellaneous furniture prior to authorising the release of the Witness Point.

15 Cathodic Protection

15.1 General

This specification sets out the requirements for the installation of the Cathodic Protection system for steel piles associated with the Berth 104 extension project.

15.2 Standards and Codes

The following standards and codes shall apply to the construction (including commissioning) of cathodic protection:

Standard / Code	Description
AS 1852	International electrochemical vocabulary
AS 2239	Galvanic (sacrificial) anodes for cathodic protection
AS 2832.3	Cathodic protection of metals: Part 3 Fixed immersed structures
AS/NZS 2053	Conduits and fittings for electrical installations (series)
AS/NZS 3000	Electrical installations (known as Australia/New Zealand Wiring Rules)
AS/NZS 3100	Approval and test specification — General requirements for electrical equipment
AS/NZS 5000.1	Electrical cables - Polymeric insulated. Part 1 For working voltages up to and including 0.6/1 (1.2) kV)
AS/NZS 60479.1	Effects of current on human beings and livestock. Part 1 General aspects
AS/NZS 60479.2	Effects of current on human beings and livestock. Part 2 Special aspects
AS/NZS 61386.21	Conduit systems for cable management. Part 21— Particular requirements – Rigid conduit systems
AS/NZS 61386.22	Conduit systems for cable management. Part 22— Particular requirements – Pliable conduit systems
AS/NZS 61386.23	Conduit systems for cable management. Part 23— Particular requirements – Flexible conduit systems
AS/NZS 61558	Safety of Power Transformers, Power Supplies, Reactors and Similar Products (series)
	Electricity Supply (Corrosion Protection) Regulation 2020
NSW ECG2023 RedBook	Guide for the Measurement of Electrolysis Corrosion Interference

15.3 General requirements

A new Impressed Current Cathodic Protection (ICCP) system (including Transformer Rectifier (TR), cabling and anodes) shall be supplied, installed and commissioned to protect the new piles constructed as part of the Berth 104 Northern Expansion works.

For the Southern Expansion of Berth 104, new piles shall be bonded into the existing ICCP system. New anodes and cabling shall be installed and terminated within the existing TR unit.

For future cathodic protection of the reinforced concrete elements, all steel within the precast and in-situ concrete elements shall be made electrically continuous (refer Section 13.9.9.9). For future cathodic protection of the reinforced concrete elements, all steel within the precast and in-situ concrete elements shall be made electrically continuous (refer Section 13.9.9.9).

De-energisation of the existing ICCP system on Berth 104 will be required during construction and maintenance operations and if/when divers are in the water to prevent electric shock.

15.3.1 Signage

Cathodic protection name plates on the proposed key cathodic protection components, which would include:

- Transformer Rectifier Unit stating “CP TR UNIT”, similar to the utility marker plate mounted on the cabinet.
- Junction boxes stating “CP JUN BOX” mounted next to the junction box, similar to the utility marker plates and fixing (examples below)

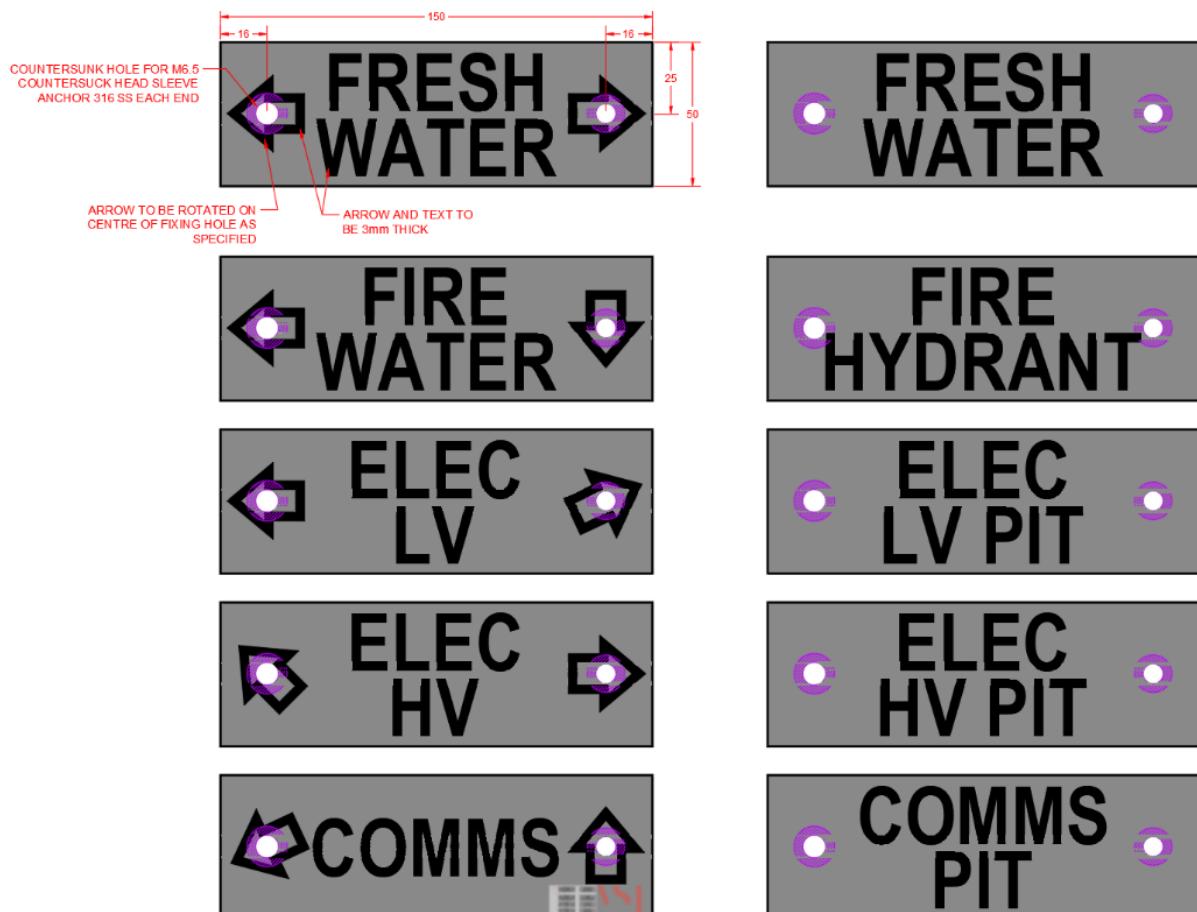


Figure 15.1 Cathodic protection signage

15.4 Anodes

A total of sixteen (16) anodes shall be supplied for the works. Twelve (12) anodes shall be installed for the northern extension and four (4) anodes shall be installed at the southern extension. The anode specification is as follows:

- Ø25 mm x 1200 mmL active length MMO (mixed metal oxide coated titanium) anodes with slotted PVC shields & PVC/SWA/PVC cable tails.
- All anodes to be rated at 30 Amp continuous output capacity for 25 years.

HOLD POINT

Submission of technical data sheet for anode assemblies (anode, cable, shields) 28 days before procurement.

15.5 Cathode (Structure) Connections

For the Berth 104 Northern Expansion works, the Contractor shall supply and install three (3) connection points for the structure. These connection points will be terminated within junction boxes and connected via three (3) negative (dc) cable connections to the new TR unit.

For the Berth 104 Southern Expansion works, the Contractor shall supply and install one (1) connection point for the structure. The connection point will be terminated within a junction box and connected via one (1) negative (dc) cable connections to the existing TR unit.

15.6 Cathode Test Studs

Each pile shall be fitted with a 316 stainless steel test stud (Ø12 mm x 50 mm long). These studs shall be fitted 300 mm below the concrete pile muffs. Studs shall be installed prior to the installation of the pile protective coating system.

15.7 Junction Boxes

All junction boxes shall be constructed from galvanised with protection to IP 67. Junction boxes shall be mounted to the guard rail with a mounting plate, utilising galvanised steel fixings. The final positions and fixing method shall be as indicated on the Drawings but determined by agreement with the Superintendent.

HOLD POINT

Submission of a drawing showing junction box positions, considering interaction with other services.

Junction boxes and termination points shall not be installed within known hazardous areas (e.g. within 25 m of flammable liquids / combustible materials transfer points).

HOLD POINT

Confirmation of junction box positions 24hrs prior to installation.

Junction boxes shall contain the appropriate number of DIN rail mounted terminals (copper bus bar and dedicated terminal studs for anodes) of adequate size for the cables to be connected.

In addition:

- 1 Protect contents of each junction box against corrosion with vapour phase corrosion inhibitors.
- 2 Conduits shall be run short at the junction boxes and individual nylon cable glands (one per cable) be installed to maintain IP67 rating of junction boxes.
- 3 All copper connection lugs shall be fitted with heat shrink.

- 4 Termination bars shall be copper.
- 5 Termination studs shall be 316 stainless steel.

15.8 Conduit/Ducting

All conduits shall be UV rated and suitable for use in marine environments (uPVC). Conduits shall be fixed to the concrete, using Chemset or equivalent epoxy based anchoring systems. Conduit layout shall be followed as provided on the Drawings.

15.9 CP System Cabling

Positive and negative feeder cables shall be XLPE/PVC. The structure cables shall be PVC/PVC. Anode cable tails shall be PVC/SWA/PVC to cater for the suspended anode weight.

HOLD POINT

Submission of technical data sheets for cables, 28 days before procurement.

15.10 Transformer Rectifier Unit

Output Capacity

The Transformer Rectifier unit shall provide the following capacity:

- 250 Amp/12V DC Output

Cubicle

- All enclosures shall be custom manufactured and designed units, IP65 outdoor rated.
- The cabinet shall be fabricated from 2.5 mm thick marine grade aluminium and powder coated.
- The approximate size of the cabinet shall be 1800 mm H x 800 W x 600 D with stand.

Layout

- A rear gear panel shall house all components not requiring user access for normal operation.
- A hinged front panel shall house all controls, switches, indicators, circuit breakers and meters. This panel shall be set back from the front door opening and hinged on the left side. A fixed lower front panel shall be mounted with field terminators, etc. to provide easy access to all internal components should it be necessary.

Lightning HV Surge Protection

- The mains active input shall include a surge diverter to earth rated at 15kA/430V (275VAC).
- The DC outputs shall have surge diverters from positive to earth and negative to earth. Rated 25kA minimum.

AC & DC Circuit Protection

The AC & DC circuit protection shall include:

- A four-pole main isolator c/w lockout isolator to isolate the mains input to the transformer rectifier and act a main input terminal.
- Three pole circuit breakers on TR circuit.

- Single pole circuit breakers on auxiliary circuits, etc.
- DC outputs to be protected by a HRC fuse.

Controller

- The controller included within the TR unit shall allow for Constant Voltage and Constant Current operation with independently settable voltage and current limits.

Testing

The TR unit shall be subject to:

- Full load and function tests.
- Soak test.
- Other standard testing.

Wiring

- All wiring shall be colour coded and numbered (according to wiring drawings).

Labelling

- Labels shall be engraved traffolyte adhesive fixed to panels/cabinets/junction boxes.

Documentation

- An operating and maintenance manual and as-built drawings (including wiring diagrams) shall be provided.

HOLD POINT

Submission of all technical data sheets for Transformer Rectifier Unit and enclosure, 28 days before procurement.

15.11 ICCP System Installation

The ICCP System installation shall be undertaken and supervised by suitably experienced and accredited contractors as noted in AS2832.3. The Contractor is to ensure that during all instances where diving is required to install anodes, pile wraps and sea shields, the CP system should be turned off and de-energised. As a minimum the following installation documentation shall be prepared:

- Quality Assurance/Quality Checking plan
- Inspection and Test Plan

HOLD POINT

Submission of quality assurance/quality checking and inspection and test plans 28 days before procurement.

- Installation test testing records.

HOLD POINT

Submission of installation test testing records ≤ 28 days after installation.

15.12 Commissioning

The following section outlines the assessment and audit process to be followed by the Contractor to avoid commissioning risks leading to poor or unsafe design of electrical and ICCP systems.

15.12.1 Pre-energisation

Prior to energising, the following inspection and testing of the installed CP system shall be carried out:

- Visual inspection, to confirm that all components and cables are correctly installed and labelled at the junction boxes.
- Inspect the AC power supply.
- Verify integrity of all ICCP system cabling at TR unit.
- Measure the individual pile initial potentials, using a portable (Ag/AgCl) reference.

15.12.2 Initial Energisation Tests

Energise the TR unit to the design current. Measure and record the following:

- TR unit output voltage and current (including maximum output).
- Individual anode and negative cable currents.
- CP (On) potentials, to a portable reference at each pile.
- CP (Instant Off) potentials, to a portable reference at each pile.
- Interference testing as per AS 2832.3 shall be conducted to detect any stray currents from the CP system to the 25 mm Stainless Steel Grade 316L Schedule 40S fire water pipes that may be submerged when the tide reaches 2.1 m RL.

15.12.3 Initial Energisation Tests

Following a 2–4-week polarisation period, measure and record the following:

- TR unit output voltage and current.
- Individual anode and negative cable currents.
- CP (On) potentials to a portable reference at each pile.
- CP (Instant Off) potentials to a portable reference at each pile.

15.12.4 Reports

A commissioning report shall be submitted inclusive of:

- Description of the ICCP system.
- Discussion of results.
- Conclusion and Recommendations.
- Test results in table format.
- An operating and maintenance manual detailing:
 - Description of the ICCP system.
 - As-built drawings.
 - Transformer-rectifier unit operations.
 - Protection criteria, system adjustment and control procedures.
 - Alarm conditions and fault finding guidance.

- Routine inspection schedule and testing requirements.
- Templates for record keeping including commissioning, routine testing data, and maintenance activities
- Diver safety requirements associated with the primary B104 ICCP system.

HOLD POINT

Submission of cathodic protection commissioning inspection report \leq 28 days after installation.

15.13 Criterion for Protection

15.13.1 Fixed Immersed Structures

AS 2832.3:2005 Cathodic protection of metals: Fixed immersed structures state the criterion for cathodic protection of steel in sea water shall be the achievement of potentials equal to, or more negative than, $-0.80 \text{ V}_{\text{SSC}}$.

However, where steel structures may be subject to microbiologically influenced corrosion (MIC) or accelerated low water corrosion, a potential of $-0.90 \text{ V}_{\text{SSC}}$ (or more negative) is recommended.

To ensure that overprotection does not cause accelerated disbondment of the coating, or other deleterious effects, the polarised potential should not be more negative than $-1.15 \text{ V}_{\text{SSC}}$.

The above potentials should not include the error associated with the voltage gradient caused by the flow of cathodic protection current in the electrolyte, and hence, the instant off-potential should be measured.

15.14 Summary of Hold/witness Point

All hold and witness points during construction of cathodic protection are outlined in Table 15.1, and all required tests are outlined in Table 15.2.

Table 15.1 Hold/Witness Point Schedule

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Materials and equipment supply	15.4, 15.9, 15.10 15.4	HOLD	Materials technical data sheets for key components including: Cables, anodes, transformer-rectifier. At least 28 days before procurement	Acceptance by Superintendent prior to authorising the release of the hold point
Installation of junction boxes	15.7	HOLD	Confirmation of junction box positions at least 24hrs prior to installation of boxes.	Acceptance by Superintendent prior to authorising the release of the hold point

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Installation of junction boxes	15.7	HOLD	A drawing showing junction box positions, shall be provided prior to the running of cables and shall consider interaction with other services. 28 days before installation	Acceptance by Superintendent prior to authorising the release of the hold point
Installation of ICCP system	15.11	HOLD	Quality Management Plan and ITPs, to be submitted for review. Construction shall not proceed until hold point is released.	Acceptance by Superintendent prior to authorising the release of the hold point
Reinforcement continuity	13.9.9.9	HOLD	Test records for reinforcement continuity shall be documented and submitted for review prior to acceptance for the following stages: - All precast concrete deck panels and precast beam elements - Prior to casting in-situ concrete (where continuity requirements are specified)	The Superintendent will consider the proposed locations prior to authorising the release of the Hold Point.
Commissioning	15.11	HOLD	Installation test testing records, shall be submitted for review and hold point release prior to energization and commissioning. ≤ 28 days after installation	The Superintendent will consider the submitted documents prior to authorising the release of the Hold Point.

Table 15.2 Works Testing

ACTIVITY	TEST METHODS	MINIMUM FREQUENCY	ACCEPTANCE CRITERIA
Anode cable termination continuity	Electrical resistance technique	Each anode termination	Resistance less than 1 ohm excluding lead resistance
Reinforcement continuity	Electrical resistance technique/potential difference technique	Each precast component Every 50 square meters of in situ concrete	Resistance less than 2 ohm excluding lead resistance or potential difference of less than 1mV.
Electrical isolation from reinforcement	Electrical resistance technique	Each embedded element within concrete that must be isolated from reinforcement	>1 Mega Ohm
Transformer-Rectifier Unit FAT	Full load and function testing	Single test prior to delivery	Demonstrated and documented compliance with specified current / voltage outputs and functionality
Interference testing between CP system and Schedule 40S Grade 316L fire hose reel pipes located in areas that may be submerged.	as per AS 2832.3	Each foreign structure	Demonstrated there is no shift in potential between the foreign structure and a suitable reference electrode

16 Corrosion Protection

This section applies to the protective treatment of fabricated items where coatings are applied as part of the delivered works.

This section does not apply to miscellaneous procured metal items such as bolts, anchors, chains, shackles, safety barriers, etc., which shall be provided in accordance with the respective specification items and codes and standards referenced in this specification. For these items, the Contractor shall provide all quality documentation demonstrating code and specification compliance upon delivery of these items.

Protective treatment of the piles is covered in Section 12.8 and fenders in Section 14.2.4.

It is acknowledged that galvanising and coatings will be applied by specialist suppliers and all reference to “Contractor” in the sections below apply to those specialist suppliers for whom the term “Contractor” is used. The Contractor shall be completely responsible for the performance of those specialist suppliers.

16.1 Protective Treatment of Steelwork

All steelwork to be incorporated into the completed works shall be given protective treatment (unless specified otherwise) as specified here. The table below generally describes the system type and the surface finish.

Table 16.1 Proposed protective coating systems

COATING SYSTEM	GENERAL DESCRIPTION	STRUCTURAL ITEM	TOPCOAT COLOUR
A	Galvanised/ HDG + System 5D (It should be noted that proper application is required for a duplex galvanized coating)	Brackets, steel plates, gangway and supporting beams, fencing, gates, steel poles (if fabricated from base metal).	Natural
B	AS/NZS 2312.1 EVH2	Bollards, capstans, ladders,	Gloss Black

16.2 Quality Management of Coating System

The Contractor shall provide to the satisfaction of the Superintendent an Inspection and Test Plan (ITP) for coatings. The ITP will detail the procedures that will be undertaken by the Contractor in order to verify compliance with this Specification. The plan shall nominate an independent coating inspector and include a copy of any qualifications, a list of inspection equipment to be used and their calibration details, and sample report forms. The independent coating inspector will be responsible for checking the implementation of the ITP and can act on behalf of the Superintendent if approved to do so.

HOLD POINT

Submission of coating system ITP, 28 days prior to commencement, including nomination of independent coating inspector

At all times the Contractor shall allow the Superintendent access to the coating work in progress and shall provide every facility for inspection at all stages of the work. Any work rejected by the Superintendent as not complying with this Specification shall be made good.

These include maintaining quality assurance programmes to AS/NZS ISO 9001 for both galvanizing and other specialist coatings, as necessary to assure that work is performed in accordance with this specification and Drawings. The Contractor and its Coating Contractor shall prepare a Quality Plan as set out in AS/NZS 5131 Clause 4.5.2 and an

Inspection and Test Plan as set out in Clause 13.8 for the inspection of surface treatment, Clause 13.9 for the inspection of paint coatings and Clause 13.10 for the inspection of galvanized coatings.

HOLD POINT

Submission of coating quality plan, 28 days prior to commencement.

16.3 Surface Preparation

This Specification is written around the use of dry abrasive blasting as the preferred method of surface preparation. Where the Contractor proposes an alternative method, such as ultra-high-pressure water jetting, power or hand tool cleaning, the Contractor is to provide details of the proposed alternative surface preparation and provide documented evidence of its previous successful use on steel structures for the Superintendent's approval. Refusal by the Superintendent does not relieve the Contractor of their obligations under the contract.

Additionally, the appropriate surface preparation standards and requirements listed in Section 16.4 shall be met.

16.3.1 Pre-treatment

Any oil, grease or related contamination on the surfaces shall be removed using a process described in AS 1627.1.

All welding slag, spatter and dags shall be removed and welds, laminations and other irregularities shall be ground smooth. Sharp edges shall be deburred and bevelled. Any areas that cannot be blast cleaned should be thoroughly cleaned with hand or power tools. Typical methods for these procedures are given in AS 1627.2.

WITNESS POINT

Surface profile tested within range (40 to 80 μm unless otherwise specified), AS 3894.5 Method A.

WITNESS POINT

Sharp edges rounded to minimum 2mm radius, in accordance with AS/NZS 5131 clause 9.8.4.

WITNESS POINT

Masking where required.

16.3.2 Abrasive Blast Cleaning

Unless otherwise specified, all steelwork shall be dry abrasive blasted in accordance with AS 1627.4 to a class specified by the manufacturer for the coating system to be applied. Classes of blasting are given in AS 1627.9 and ISO 8501-1. The surface profile shall be within the range 40 to 80 microns and should be in the middle of the given range. Profile shall be measured using Testex Press-O-Film replication tape according to AS 3894.5 Method A. Testex tape records shall be affixed to inspection reports.

WITNESS POINT

Surface profile tested within range (40 to 80 μm unless otherwise specified), AS 3894.5 Method A.

The abrasive used for blasting shall be clean, dry and free from oil and other contamination. Slag, sand or abrasives containing free silica shall not be used for blasting. The Contractor shall ensure that the selected abrasive is suited to use on steel and shall conduct trials on representative sections of the structure to ensure that the materials and methodology selected do not cause damage to the platform structure.

All abrasives shall be approved with test certificates and batch numbers. Abrasives shall not be reused unless certified cleaned, resized and tested for contamination. Abrasive test certificates and batch numbers, and sample visual inspection report to verify the ability of the materials to provide the specified surface profile.

Blast cleaning shall only be carried out in conditions suitable for coating. Blast cleaning shall be permitted only during daylight unless suitable illumination is provided. Preliminary blasting may be permitted at night providing all surfaces are blasted to the specified standard in daylight. Blast cleaning shall not be permitted under the following conditions (or any more stringent, conditions recommended by the coating manufacturer) unless specifically agreed to by the Superintendent:

Dry abrasive blasting shall not be carried out on metal surfaces which have a surface temperature of less than 3°C above dew point and/or when the local relative humidity is greater than 85%. The Contractor shall determine the relative humidity and dew point, as well as the ambient and steel temperatures. These shall be measured and recorded at least four times per day, especially before start of blast cleaning and coating.

Note that the Contractor will be responsible ensuring that suitable, calibrated instrumentation is maintained at the site for recording the ambient and surface temperature, dew point and relative humidity and provide for the cost of this testing in the tender price.

Surface defects exposed following abrasive blasting, e.g.: laminations, weld porosity or pitting considered to be detrimental to the performance of the coating system shall be referred to the Superintendent before any coating work commences. Care shall be taken to blast clean the inside edges of all bolt holes and other penetrations in the steel work to be coated.

After blast cleaning, the surface shall be cleaned. It shall be made completely dry, free from dust, salts, dirt, loose scale, grease, weld spatter, and foreign matter before coating is applied. Surfaces that have been abrasive blasted shall be primed before any discolouration occurs, normally within four hours of blasting. Surfaces which have discoloured or bloomed, or which have been cleaned and left overnight, shall be re-blasted to the specified standard. In the event of any surface becoming contaminated with rust, oil, dirt, etc., after blast cleaning, the contamination shall be removed by repeated blast cleaning or, where appropriate, may be removed by the limited use of white spirit and clean cloth.

During abrasive blasting, the following precautions shall be adhered to:

- a Persons not directly concerned with the operations will not be permitted into the blast cleaning area.
- b Air compressors shall be fitted with adequate oil and water separators and in-line filters to ensure that the air supply used for blast cleaning is free from water and oil. Operators shall observe all safety precautions and wear the recommended safety clothing and breathing apparatus during abrasive blasting operations. The Contractor shall keep all equipment in good working order.
- c Following abrasive blast cleaning, and immediately before paint coating application, the Contractor shall verify soluble salts on the cleaned surface do not exceed 5 μ g/cm² when measured according to AS 3894.6 method A. Generally, a single test shall be sufficient after the completion of a single batch of blasting. Where re-treatment is required, additional testing should be completed. The Contractor's ITP shall include WORKS TESTING for the completion of soluble salt testing.

WITNESS POINT

The coating inspector shall verify contamination testing has been completed and remedial measures implemented as required.

16.4 Coating Systems General

Coatings shall conform to the requirement of this Specification and be suitable for application in the local climate. Materials shall meet the APAS or Australian Standard specifications or both (APAS 2975 and APAS 2976, AS 3750.1 and AS 3750.14), shown for each generic type, unless specifically approved by the Superintendent. All paints shall be supplied by the same coating manufacturer, whose QA systems shall have current certification by the Australian Paint Approval Scheme (APAS). The composition and performance of coating materials shall comply with the relevant product standard specified in the AS/NZS 3750 series.

All components of each coating system shall be compatible and shall be supplied from the same source unless otherwise approved. Different brands or types of coating shall not be intermixed. Where no specification is given, the manufacturer shall submit a written statement that the product is suitable for the given application. Suppliers who have products which do not meet APAS or Australian Standard specifications or who wish to have a product approved shall submit the following information to the Company to support this application:

- a A written statement that the product complies with the relevant specification.
- b A NATA test certificate confirming above.
- c Product data/application sheets.
- d Certified test results from independent test laboratories verifying the performance of the coating, including exposure test results and case histories.

HOLD POINT

Submission of written statement, NATA test certificate, product data/application sheets and certified test results regarding coating systems.

All coatings shall be supplied in the manufacturer's original containers, durably and legibly marked with a description of the contents. This shall include the specification number, colour reference number, method of application for which it is intended, batch number, date of manufacture, shelf life, expiry date and manufacturer's name or trademark.

No surface of the steelwork shall have the protective coating applied before the cleaned surface has been inspected for compliance with the Specification.

The protective coating shall be applied to give a uniform surface appearance, free from runs, sags, mud cracks, crazing and other imperfections. Any area of the applied coating that has become contaminated whilst wet may be rejected. If successive coats are required to give the necessary thickness of coating, then the recoating time specified by the manufacturer shall apply.

Each coating shall be spray applied in accordance with the manufacturer's instructions and shall have a distinct colour to enable it to be easily distinguishable from the blast cleaned steel or the preceding coat.

The outer (finished) coating shall be a Gloss and coloured to a shade chosen by the Superintendent from AS 2700 Colour Standards for General Purposes. Finish coat resins shall be sufficiently UV resistant to comply with the change in gloss allowance given in table 2.4 of AS/NZS 2728. Similarly, the coloured finish coats shall be sufficiently UV resistant to comply with the maximum fade and colour shift (dE) allowance given in table 2.4 of AS/NZS 2728. Use of tinted basecoats shall not be permitted, and colour pigmentation shall be added to the batch during its manufacture in the paint factory.

For each specified colour, the finish coat shall all be supplied from the same batch with sufficient additional quantity reserved to repair any defects or transport and erection damage.

For multi-coat systems, use different coloured coating layers to assist with ease of application and inspection; with the final finish coat as per the project specification and the requirements listed above.

16.4.1 Coating System A

This system shall be applied to all structural steelwork to be hot dip galvanised and shall provide a minimum protection of 15 years to first major maintenance in a category C5 (marine environment) according to AS/NZS 2312.2, 2014. The methods employed in the pre-treatment and hot-dip galvanising process shall be as recommended in AS/NZS 4680.

- Blast cleaning as specified sufficient to achieve a Class Sa2 ("Thorough Blast Cleaning") or higher surface finish as defined in AS 1627.4 and AS 1627.9.
- Acid clean or pickle.
- Hot dip galvanising in accordance with this Specification.

- Treatment in accordance with AS 1214 for threaded fasteners.

Before galvanising:

- All steelwork shall be thoroughly cleaned of all grease, paint, mill scale, rust, welding flux or any other deleterious substance in accordance with this Specification (Section 16.3).
- Traceability & steel certification for suitability (mechanical & chemical), in accordance with AS/NZS 5131 4.7 & 9.10.3, AS/NZS 2312.2 9.1 and AS/NZS 2313.2 clause 4 has been checked, along with additional requirements in accordance with AS/NZS 5131 9.2.3.2, 9.10 and 9.10.5.

WITNESS POINT

Superintendent to check traceability & steel certification for suitability (mechanical & chemical), in accordance with AS/NZS 5131 4.7 & 9.10.3, AS/NZS 2312.2 9.1 and AS/NZS 2313.2 clause 4.

WITNESS POINT

Superintendent to check special / supplementary requirements in accordance with AS/NZS 5131 9.2.3.2, 9.10 and 9.10.5.

- A comparison of vent and drain holes size and location shall be undertaken in accordance with AS/ZA 5131 9.6.

HOLD POINT

Submission of document outlining comparison of vent and drain holes size and location in accordance with AS/ZA 5131 9.6.

- A comparison of size and bath shall be undertaken in accordance with AS/NZS 5131 9.10.5

HOLD POINT

Submission of document outlining comparison of size and bath in accordance with AS/NZS 5131 9.10.5.

- A final check of the steel surface to be galvanised

WITNESS POINT

Superintendent to inspect surface condition of steel suitable for galvanizing in accordance with AS/NZS 5131 9.3.3, AS/NZS 2312.2 9.4, and AS/NZS 4680 Appendix C4

Zinc shall be applied to the steelwork at the rate of not less than 550 g/m² and shall average 600 g/m² of surfaces. The weight and quality of the coating shall be checked in accordance with AS/NZS 4680. The zinc coating shall be free from lumps, blisters, gritty areas, uncoated spots, acid and black spots, dross, flux and other imperfections.

Any member distorted during the galvanising process shall be straightened by a permitted method and made to conform to its original shape, size and condition, without cracking or otherwise damaging the member and/or its coating.

Any galvanising shown to be defective by inspection or by any of the tests carried out in accordance with the relevant Australian Standards will be cause for rejection. The defective galvanising shall be reported in accordance with AS/NZS 5131 9.10.9.

HOLD POINT

Reporting of defects, assessed for size and fit for purpose, in accordance with AS/NZS 5131 9.10.9.

Rejected galvanised coating shall be replaced by satisfactory coating complying with this Specification. Where material is damaged during galvanising, the damaged section shall be replaced or made good.

Galvanising thickness shall be reporting in accordance with AS/NZS 5131 13.10, AS/NZS 4680 9.2, AS/NZS 1214 8.3, GAA AN #37.3.

HOLD POINT

Report of checked galvanising thickness, in accordance with AS/NZS 5131 13.10, AS/NZS 4680 9.2, AS/NZS 1214 8.3, GAA AN #37.3.

Should transportation, handling, welding, bolting or any other cause, either during or following the execution of any protective treatment cause local damage to any part of the treated surface then the damaged area shall be cleaned to base metal and the coating made good by the application of not less than two coats of a two-part epoxy zinc rich paint.

Galvanized surfaces that are in contact with concrete or cementitious mortar that are exposed to the weather shall be precoated by the coating applicator with a 225 µm minimum DFT of a compatible epoxy barrier coat (i.e. AS/NZS 2312.2 system 3I). Similarly, surfaces that are to be completely embedded in concrete shall receive an additional 350 µm minimum DFT of compatible epoxy barrier coat (i.e. AS/NZS 2312.2 system 4I) to not less than 100 mm either side of the air/concrete interface after galvanizing and prior to embedment. Barrier coating to be coloured light grey.

All matters pertaining to the application of paint coatings over galvanizing shall be undertaken in accordance with section 9.11 of AS/NZS 5131, and the following additional specific requirements shall be applied in accordance with section 7.5 of AS/NZS 2312.2.

Complete QC documentation is to be provided before commissioning of the coating.

HOLD POINT

Complete QC documentation in accordance with AS/NZS 5131 13.10.2

16.4.2 Coating System B

Surface preparation and application of protective coating to prepared steel substrate in accordance the requirements of this specification and as specified in the following table:

Table 16.2 Coating System B Table

Coating System B		
Surface preparation and application	Degrease, wash and abrasive blast to AS 1627.4 Sa 2½ “very thorough blast cleaning” in accordance with section 16.3	
Coating System per AS/NZS 2312.1	EVH2* (Very High Build Epoxy) Years to First Maintenance, minimum 15 years	Apply one coat to achieve a total nominal DFT of 400 µm.

* For immersed components, high voltage continuity testing in accordance with AS 3894.1 or recommended by the coating supplier (see also section 12.9.3).

Dry film thickness range is a guide only but shall be used as a minimum standard. Applicator shall use the selected coating manufacturers recommended coating thickness range as detailed on the manufacturers Technical Data Sheet or approved equivalent.

16.4.2.1 Colours

The finish coat colour shall be as advised by the Superintendent. As per Table 16.1, gloss black colour is suggested for finish coat. As per Table 16.1, gloss black colour is suggested for finish coat.

16.4.3 Guarantee

The coating system guarantee shall be 15 years. This guarantee shall be provided by the Contractor and shall be endorsed by the manufacturer and supplier. In the guarantee the material supplier shall confirm that it is satisfied that the application methods used have met with the required standards in order to provide the respective service life guarantees. At the end of the specified guarantee period the coating shall be deemed to meet with the guarantee if the coating is in a good condition and less than 1% of the coating surface is suffering from deterioration.

16.4.4 Coating Subcontractor

All surface preparation, coating application and inspections shall be carried out by specialists who shall produce evidence of satisfactory experience in this field of application. Regarding the use of competent personnel (clause 9.9.1 of AS/NZS 5131), coating application on primary steelwork shall only be undertaken by specialist industrial painting contractors whose QA system has current accreditation from the Painting Contractors Certification Program (PCCP) administered by CSIRO or equivalent internationally recognised certification (such as AMPP CAS) acceptable to the Superintendent. Only applicators approved by the Superintendent shall be employed for the works.

The application of protective systems is specialised work and only a certified coating applicator who can submit evidence of a suitable history of successful completion of similar work will be approved. The Superintendent shall have the sole authority to approve or reject the nominated coating applicator.

HOLD POINT

Submission of nominated coating applicator and associated work method statements and Inspection and Test Plans 28 days before commencement.

16.5 Acceptance

Not later than 7 days after delivery of the coated items, the Contractor shall provide to the Superintendent a complete and detailed submission which includes all quality records, photographs and proof of satisfactory coated system installation including final sign off and acceptance by the Contractor and coating inspector and system guarantee in accordance with the ITP.

HOLD POINT

Submission of coating system installation QC documentation including system guarantee, no later than 7 days after delivery.

Where defects have been repaired, a report shall be submitted to the Superintendent in accordance with AS/NZS 5131 9.12.1-2.

HOLD POINT

Report of repaired defects, in accordance with AS/NZS 5131 9.12.1-2, no later than 7 days after delivery.

16.6 Summary of Hold/witness Points

All hold and witness points during construction of corrosion protection are outlined in Table 16.3, with all required tests outlined in Table 16.4.

Table 16.3 Hold/Witness Point Schedule

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Surface Preparation	16.2	HOLD	Coating system ITP including nomination of independent coating inspector, at least 28 days prior to commencement	Acceptance by Superintendent prior to authorising the release of the hold point

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Surface Preparation	16.2	HOLD	Coating system quality plan, at least 28 days prior to commencement	Acceptance by Superintendent prior to authorising the release of the hold point
Surface Preparation	16.4	HOLD	Submission of written statement, NATA test certificate, product data/application sheets and certified test results regarding coating systems, at least 28 days prior to commencement	Acceptance by Superintendent prior to authorising the release of the hold point
Surface Preparation	16.3	WITNESS	After surface preparation and before coating application	The Superintendent will inspect the surface before and after coating application before authorising the release of the Witness Point.
Coating application	16.3.1	WITNESS	Superintendent to inspect that weld splatter, slag deposits and flux residue removed, prior to coating application	The Superintendent will inspect the surface before authorising the release of the Witness Point.
Surface preparation	16.3.1	WITNESS	Superintendent to inspect that sharp edges rounded to minimum 2mm radius, in accordance with AS/NZS 5131 clause 9.8.4, prior to coating application	The Superintendent will inspect the surface before authorising the release of the Witness Point.
Surface preparation	16.3.1	WITNESS	Superintendent to inspect masking of site welds and machined surfaces in accordance with AS/NZS 5131 9.9.9	The Superintendent will inspect the surface before authorising the release of the Witness Point.

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Coating application	16.3.2	WITNESS	Profile tested within range (40 to 80µm unless otherwise specified), AS 3894.5 Method A, at least 3 day prior to coating	The coating inspector shall verify the profile tests within range and remedial measures implemented as required
Coating application	16.3.2	WITNESS	Surface soluble salts below 5µg/cm ² to AS 3894.6 Method A.	The coating inspector shall verify contamination testing has been completed and remedial measures implemented as required
Coating application	16.4	WITNESS	Coatings manufacture complies with standard and are the specified generic type, in accordance with AS/NZS 5131 9.9.3	The Superintendent will check documentation before authorising the release of the Witness Point.
Coating application	16.4	WITNESS	Coatings and thinners are all from same manufacturer and are compatible	The Superintendent will check documentation before authorising the release of the Witness Point.
Coating application	16.4	WITNESS	Coloured topcoats are from same batch and of correct colour and gloss and in sufficient quantity for project	The Superintendent will check documentation before authorising the release of the Witness Point.
Coating application	16.4	WITNESS	Coating correctly mixed before application in accordance with AS/NZS 5131 9.9.6-8	The Superintendent will check mix before authorising the release of the Witness Point.
Coating application	16.4	WITNESS	Inspection after priming in accordance with AS/NZS 5131 9.9.15-16	The Superintendent will check primer before authorising the release of the Witness Point.

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Coating application	16.4	WITNESS	Inspection equipment and used by competent personnel in accordance with AS/NZS 5131 9.9.15	The Superintendent will check equipment before authorising the release of the Witness Point.
Coating application commissioning	16.5	HOLD	Report of repaired defects, in accordance with AS/NZS 5131 9.12.1-2	Acceptance by Superintendent prior to authorising the release of the hold point
Coating application commissioning	16.5	HOLD	Complete QC documentation in accordance with AS/NZS 5131 9.9.20	Acceptance by Superintendent prior to authorising the release of the hold point
Hot dip galvanising application	16.4.1	HOLD	Comparison of vent & drain holes size and location, in accordance with AS/NZS 5131 9.6, at least 1 week prior to application	Acceptance by Superintendent prior to authorising the release of the hold point
Hot dip galvanising application	16.4.1	HOLD	Comparison of size and bath, in accordance with AS/NZS 5131 9.10.5, at least 1 week prior to application	Acceptance by Superintendent prior to authorising the release of the hold point
Hot dip galvanising application	16.4.1	WITNESS	Check traceability & steel certification for suitability (mechanical & chemical), in accordance with AS/NZS 5131 4.7 & 9.10.3, AS/NZS 2312.2 9.1 and AS/NZS 2313.2 clause 4.	The Superintendent will check steel certification before authorising the release of the Witness Point.
Hot dip galvanising application	16.4.1	WITNESS	Check special / supplementary requirements in accordance with AS/NZS 5131 9.2.3.2, 9.10 and 9.10.5	The Superintendent will check for the supplementary requirements before authorising the release of the Witness Point.

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Hot dip galvanising application	16.4.1	WITNESS	Check surface condition of steel suitable for galvanizing in accordance with AS/NZS 5131 9.3.3, AS/NZS 2312.2 9.4, and AS/NZS 4680 Appendix C4	The Superintendent will check the surface condition of the steel is suitable before authorising the release of the Witness Point.
Hot dip galvanising repair	16.4.1	HOLD	Report of defects, assessed for size and fit for purpose, in accordance with AS/NZS 5131 9.10.9, at least 1 week prior to repair	Acceptance by Superintendent prior to authorising the release of the hold point
Hot dip galvanising repair	16.4.1	HOLD	Report of checked galvanising thickness, in accordance with AS/NZS 5131 13.10, AS/NZS 4680 9.2, AS/NZS 1214 8.3, GAA AN #37.3, at least 1 week prior to repair	Acceptance by Superintendent prior to authorising the release of the hold point
Hot dip galvanising commissioning	16.4.1	HOLD	Complete QC documentation in accordance with AS/NZS 5131 13.10.2, at least 1 week prior to commissioning	Acceptance by Superintendent prior to authorising the release of the hold point
Epoxy coating application	16.4.2	HOLD	Submission of nominated coating applicator and associated work method statements and Inspection and Test Plans, at least 28 days before commencement.	Acceptance by Superintendent prior to authorising the release of the hold point

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Acceptance	16.5	HOLD	Submission of coating system installation QC documentation including system guarantee, no later than 7 days after delivery.	Acceptance by Superintendent prior to authorising the release of the hold point

Table 16.4 Works Testing

ACTIVITY	TEST METHODS	MINIMUM FREQUENCY	ACCEPTANCE CRITERIA
Weld splatter, slag deposits and flux residue removed		All welds	Visual
Sharp edges rounded		All edges	Minimum radius 2mm
Oil and grease removed by solvent cleaning	AS 1627.1.	All areas to be coated	Water break test
Masking where required		Where required	Weld margins
Abrasive blast cleaning to visual standard	AS 1627.9	All areas to be coated	Sa2 or Sa 2.5 as specified unless otherwise noted
Abrasive blast surface profile	AS 3894.5 Method A	All areas to be coated	(40 to 80µm unless otherwise specified),
Surface soluble salts below specified limit	AS 3894.6	All areas to be coated	5µg/cm ²
Abrasive media correct type, grade and cleanliness		All areas to be coated	Able to produce a sharp profile within specified range
Compressed air free of oil and water	ASTM D4285	All areas to be coated	Blotter test clean and dry
Adequate lighting		All areas to be coated	500 Lux minimum
Prewash black rust		Areas with black rust	Within the previous 48hrs in order to remove any salt contamination
Ambient weather conditions		On day of coating, every 4 hours	<85% relative humidity and surface temp >3°C above dew point
Dust removed	AS 3894.6	All areas to be coated	AS 3894.6 C Rating <2
Surface protected until primed		All areas to be coated	

ACTIVITY	TEST METHODS	MINIMUM FREQUENCY	ACCEPTANCE CRITERIA
Suitable ambient conditions	AS 3894.11	Every 4 hours	<85% relative humidity and surface temp >3°C above dew point
Coatings and thinners are all from same manufacturer and are compatible			As recommended on product data sheets (PDS)
Coloured topcoats are from same batch and of correct colour and gloss and in sufficient quantity for project			Same batch numbers. Calculation of requirements including repair
Coatings are correctly stored, within specified shelf life and containers are in good condition	AS/NZS 2312.1 Cl 7.3	All areas to be coated	As recommended on (PDS)
Masking of site welds and machined surfaces		All welds and machined surfaces	As required on drawings
Coating correctly mixed before application	AS/NZS 2312.1 Cl 7.4	All mix	Correct ratios, induction time and within pot life
Painting conditions and recoat times comply with data sheets and specification and are recorded	AS 3894.10	All areas to be coated	Manufacturer's technical data sheets
Prime and stripe coat over specified clean substrate	AS 3894.3	Within 4 hours	As specified
Masking of faying surfaces and bolted connections		As required on drawings	As required on drawings
Inspection after priming	AS 3894.3	All areas to be coated	Continuing with correct DFT
Application of coating to standard and specification	AS/NZS 2312.1	All areas to be coated	As specified or to PDS. If outdoors first check for contaminants and rewash if required
Check WFT and DFT and record for each coat	AS 3894.3	All areas to be coated	As specified or to PDS
Inspection equipment calibrated and used by competent personnel	AS 3894.3	All areas to be coated	Current calibration and certification
Holiday testing	AS3894.1, AS3894.2	All organic paint to be buried or immersed	AS3894.1, AS3894.2
Cure before handling	AS 3894.4	All areas to be handled	As specified or to PDS

ACTIVITY	TEST METHODS	MINIMUM FREQUENCY	ACCEPTANCE CRITERIA
Check surface condition of steel suitable for galvanizing	Visual check	All areas to be galvanised	AS/NZS 2312.2 cl 9.4 AS/NZS 4680 App C4
Check vent & drain holes size & location	Visual/dimensional check	All areas to be galvanised	AS/NZS 2312.2 App A GAA venting guidelines
Seal weld crevices	AS/NZS 1554.1	All seal welds	Crevices sealed
Check flame / plasma / laser cut faces ground & rounded	AS 1627.9 / AS 3894.5 Method A	All cut faces	Case hardened material removed
Check welds cleaned & porosity to limits	AS/NZS 1554.1	All welds	All slag & spatter removed & porosity to limits
Check size matches bath	Verify with GAA	All areas to be galvanised	Double dipping allowed
Check zinc quality	Supplier certification	Galvaniser	AS/NZS 4680 Cl 6.2 and supplier certification
Passivation	Specification	All areas galvanised	Specification
Sharp points removed	Visual check	All areas galvanised	No handling hazards
Defects assessed for size and fit for purpose	Visual check / AS 3894.5	All areas galvanised	Size of bare spots and other damage acceptable or repaired
Repair defects	AS 3894.3	All areas to be galvanised	Coating reinstated
Check galvanizing thickness	AS 3894.3	All areas to be galvanised	AS/NZS 4680 cl 9.2 AS/NZS 1214 cl 8.3 GAA AN #37.3

17 Metalwork

17.1 General

This Section covers the supply, fabrication, protective treatment, delivery to Site and installation of brackets, ladders, bolts and other steelwork for this Contract, other than steel piling that are covered elsewhere in this Specification.

17.1.1 Standards and Codes

All steelwork shall come from an approved source and shall comply with the relevant clauses of the appropriate current SAA Codes, Standards and Manuals, in particular, the following:

STANDARD / CODE NO.	TITLE
AS 1111	ISO Metric Hexagon Commercial Bolts and Screws.
AS 1112	ISO Metric Hexagon Nuts
AS 1163	Structural Steel Hollow Sections
AS 1214	Hot-Dip Galvanised Coatings on Threaded Fasteners
AS 1252	High Strength Steel Bolts (ISO Metric Series)
AS 1275	Metric Screw Heads for Fasteners
AS 1553	Covered Electrodes for Manual Welding Parts 1 and 2
AS 1554	SAA Structural Steel Welding Code
AS 1627-Part 4	Abrasive Blast Cleaning
AS 1627-Part 9	Pictorial Surface Preparation Standards for Painting Steel Surfaces
AS/NZS 4680	Hot Dipped Galvanised Coatings on Ferrous Articles
AS 1796	Certification of Welders and Welding Supervisors
AS 2074	Steel Castings
AS 2214	The Certification of Welding Supervisors in Structural Steel Welding
AS 2312	Guide to the Protection of Iron and Steel against Exterior Atmospheric Corrosion
AS 3678	Structural Steel – Hot-rolled Plates Floorplates and Slabs
AS 3679	Structural Steel – Hot-rolled Bars and Sections
AS 3990	Steelwork for Engineering Applications
AS 4100	Steel Structures
AS 1734	Aluminium and aluminium alloys—Flat sheet coiled sheet and plate
AS 1865	Aluminium and aluminium alloys—Drawn wire rod bar and strip
AS 1866	Aluminium and aluminium alloys—Extruded
AS 2848	Aluminium and aluminium alloys—Composition and designations

STANDARD / CODE NO.	TITLE
AS 4672	Steel prestressing materials
AS/NZS ISO 9001	Quality Management Systems - Requirements

17.2 Materials

All structural steel plates and hot rolled sections shall be Grade 350 to AS 3679.1 unless specified otherwise. All steel used in the fabrication of clutches shall be made from Low Corrosion Steel AMLoCor Blue 355 or approved equivalent.

Galvanising of all high strength and commercial black bolts shall conform to the requirements of Australian Standard AS 1214-1983. All fabricated steel work, except stainless steel, shall be galvanised unless noted otherwise.

Stainless steel plates, bolts, nuts and washers shall be type UNS S31803 complying with ASTM A240 and A276. Manufacturers' test certificates shall be provided for all steel used for fabrication and for bolts incorporated into the works. These shall include all the mechanical tests described in the appropriate specification and also a chemical analysis.

Dowels in dowelled joint are to be stainless steel duplex 2507 or equivalent approved. Positioning tolerance of dowels are +/-30mm to avoid clashes with existing reinforcement.

All metalwork shall be new and free from cracks, surface flaws, laminations, rough, jagged or imperfect edges and faces, slag inclusions and all other defects. Test certificates and supporting quality documentation for steel, miscellaneous metalwork and bolts and fasteners shall be provided to the Superintendent.

An Inspection and Test Plan (ITP) for the supply of steel, metalwork and bolts shall be provided along with certificates and supporting quality documentation, no later than 28 days prior to procurement.

HOLD POINT

Submission of Inspection and Test Plan (ITP) for the supply of steel, metalwork and bolts, 28 days prior to procurement.

17.3 Shop Drawings and Fabrication

Prior to fabrication of any steelwork fully detailed and dimensioned, shop drawings shall be prepared in accordance with this specification.

The Drawings shall show full and complete information regarding the size, location and type of welds and the sequence that shall be employed to minimise construction stresses and distortion. The approved welding Procedures shall also be fully detailed on the shop drawings and strictly adhered to in production.

All workmanship and fabrication shall be in accordance with AS 4100 for structural steel and BS 6744 for stainless steel dowels. All steel work shall be shop welded or site bolted. Site welding shall not be permitted, unless indicated on the Drawings, without prior approval.

17.3.1 Welding

Welding shall be carried out in accordance with AS 1554 and under the immediate and continuous supervision of a person having the qualifications required by AS 2214 and AS 1796. All welders shall be previously qualified by the practical tests prescribed in AS 1796 applicable to the process, electrode and welding position to be used. All welds shall be category SP using E48 electrodes.

When the temperature of the parts to be welded is below 50°C the parts shall be preheated to at least 200°C and maintained at this temperature until welding is completed.

Plates and components that are to be welded shall be assembled, aligned and retained in position for welding to ensure that the dimensions and tolerances specified for the particular joint preparation are maintained during welding.

Welding operations shall be planned and carried out to minimize member distortions.

All steelwork to be welded shall be free of paint, rust, grease or any other deleterious matter.

17.3.2 Workmanship of Welding

Workmanship and quality of welding shall comply with the requirements of Section 5 of AS 1554 Part 1 for steel structures and AS1554 part 6 for stainless steel.

No work shall be given any protective coating or be erected until it has been inspected and passed. Any work found defective, or which is not in accordance with the Drawings and Specification, may be rejected and shall, at once, be made good. Any requests for lifting or turning over of fabricated work for inspection shall be carried out.

17.3.3 Transport and Handling

Particular care shall be taken in the handling and transport of members which have been shop painted to ensure that the paint remains free from damage. Any such damage shall be made good in an approved manner.

All steelwork shall be stored under cover or covered with a tarpaulin to protect it from the weather. Steelwork shall not be stored directly on the ground but shall be raised 50 mm to rest on timber packers placed so that no damage or bending of the member occurs.

The stainless steel shall be wrapped or otherwise protected during transport to avoid contamination by ferrous products. If a plastic coating is used, all traces of adhesive shall be removed on removal of the plastic.

Stainless steel including reinforcement shall be handled and stored to maintain integrity. Minimum measures shall include:

- Carbon steel bundling wire is not to be used with stainless steel components
- Tools, which have been used on carbon steel, shall not be used on stainless steel under any circumstances.

Stainless steel shall be stored clear of the ground and not stored with carbon steel

17.3.4 Bolting Generally

Hot dip galvanised bolts shall be in accordance with AS/NZ 1214. Bolt types shall be as follows:

- 4.6/S commercial bolts to AS1111 and AS1112, snug tightened
- 8.8/S – high strength structural bolts to AS/NZS 1252, snug tightened only.

Stainless steel bolts shall be grade 316, unless noted otherwise, in accordance with AS/NZ 4673.

Bolts in bearing shall be of such lengths that no threaded portion shall be within the thickness of the parts joined.

At least one washer shall be placed under the bolt head or nut, whichever is to be rotated. Taper washers shall be used where the part under the bolt head or nut is not perpendicular to the centreline of the bolt.

Use a nickel base lubricant or nickel impregnated tape on the threads of all stainless steel bolts before assembly.

All stainless steel fasteners shall be fitted with a stainless steel ‘nyloc’ nut and lock nut and stainless steel washer under nut.

All dissimilar metals must be isolated with nylon, HDPE UHMW-PE, neoprene or other approved inert material.

Reinforcement can be adjusted locally to avoid contact with dissimilar material such as hand grip at the ladder location. If not possible, hand grip or reinforcement can be wrapped in denso tape to avoid bimetallic corrosion.

17.3.5 Commercial Grade Bolts

Where commercial grade bolts are called for in bolted joints these shall comply with AS 1111. Nuts shall comply with AS 1112 and shall have associated washers. All bolts shall be installed snug tight.

17.3.6 Submission of Quality Procedures

A steelwork fabrication Inspection and Test Plan (ITP) shall be provided along with the shop drawings, certificates and supporting quality documentation no later than 28 days prior to commencement of fabrication.

HOLD POINT

Submission of shop drawings and steelwork fabrication Inspection and Test Plan (ITP), no later than 28 days prior to commencement of fabrication.

17.3.7 Contractor Submission and Acceptance

No later than 28 days before delivery of materials and components to site, the Contractor shall supply all quality data for materials, manufacture and supply of materials and components, including a statement of compliance to specified codes and standards

All supplied materials and components shall be clearly marked to allow cross-matching to all of the quality documentation for that material or components.

HOLD POINT

Submission of all quality data for materials and components including statement of compliance to specified codes and standards. No later than 28 days before delivery to site.

17.4 Aluminium

The LV covers shall be folded and welded construction made from marine grade aluminium as a minimum, which shall be designed and fabricated to conform to best industrial practice for use in a marine environment. Covers shall be weather protected using a full perimeter seal from hollow neoprene. The top of the cabinet shall extend over the kerb to provide a drip seal. The hinges shall allow the covers to extend beyond the vertical and shall have a latch to prop them in the open state and sliding bolt to secure them shut. The covers shall permit easy access to all components and shall incorporate permanently fixed lifting lugs.

All welds are to be ground flush and any burrs shall be removed. Any surface aberrations or pitting shall be removed before bringing to site.

Except as specified, all nuts, bolts screws or washers shall be stainless steel grade 316 as a minimum requirement. All bolted or screwed components shall be fitted with stainless steel grade 316 washers. In exterior applications all stainless steel fasteners shall be isolated from aluminium components using nylon washers. Where sealing around the fasteners is required, neoprene washers shall be used.

Shop drawings and a fabrication Inspection and Test Plan (ITP) shall be provided no later than 28 days prior to commencement of fabrication.

HOLD POINT

Submission of shop drawings and fabrication Inspection and Test Plan (ITP) for aluminium LV covers, no later than 28 days prior to commencement of fabrication.

17.4.1 Contractor Submission and Acceptance

No later than 28 days before delivery of materials and components to site, the Contractor shall supply all quality data for materials, manufacture and supply of materials and components, including a statement of compliance to specified codes and standards

All supplied materials and components shall be clearly marked to allow cross-matching to all of the quality documentation for that material or components.

HOLD POINT

Submission of all quality data for materials and components including statement of compliance to specified codes and standards. No later than 28 days before delivery to site.

17.5 Summary of Hold/witness Points

All hold and witness points during metalworks are outlined in Table 17.1.

Table 17.1 Hold/Witness Point Schedule

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Procurement of materials	17.2	HOLD	Materials Inspection and Test Plans (ITPs), at least 28 days prior to procurement	Acceptance by Superintendent prior to authorising the release of the hold point
Fabrication of metalwork elements	17.3.6	HOLD	Shop Drawings and Fabrication ITP, at least 28 days prior to commencement of fabrication	Acceptance by Superintendent prior to authorising the release of the hold point
Delivery of elements to site	17.3.7	HOLD	Submission of all quality data for materials and components, at least 28 days before delivery to site	Acceptance by Superintendent prior to authorising the release of the hold point
Coating system application	17.4	HOLD	Shop drawings and fabrication Inspection and Test Plan (ITP) for aluminium LV covers, at least 2 weeks prior to coating system application	Acceptance by Superintendent prior to authorising the release of the hold point
Delivery of aluminium components to site	17.4.1	HOLD	Submission of all quality data for materials and components, at least 28 days before delivery to site	Acceptance by Superintendent prior to authorising the release of the hold point

18 Road Furniture, Signage and Line Marking

18.1 General

Generally, the road furniture, signage and line marking must be constructed to comply with the TfNSW standard specifications. Where necessary for the works, if changes have been made to these specifications, those and any additional requirements are documented in the following sections of this Specification.

18.2 Standards and Codes

The following standards and specifications must be followed and adhered to unless agreed with the Superintendent or their delegated representative, with reference to the noted sections within these documents relevant to the project:

- TfNSW Specification QA R132 – Safety Barrier Systems
 - Section 2.1: Standards - All supplied road safety barrier systems must be accepted by the list of TfNSW accepted safety barrier products. Where the requirements of the listed safety barrier systems is not able to be met and higher forms of delineation are required (other than line marking), temporary freestanding traffic barriers are to be resourced and placed every 3m along the alignment barriers would have otherwise been positioned.

HOLD POINT

Submission of product manual / safety data sheet of proposed road barrier system.

- Section 4.1.2: Construction Setout (Hold Point) - The Superintendent will inspect the set out of the safety barriers prior to authorising the release of the Hold Point.

HOLD POINT

Inspection of safety barriers.

- TfNSW Specification QA R143 – Signposting

HOLD POINT

Submission of proposed sign writing layout drawing.

- Section 2.3.1a): Sign support structure supply to be galvanised standard circular hollow section
- Section 3.2: Setting Out (Hold Point) - The Superintendent will inspect the proposed sign locations, prior to authorising the release of the Hold Point.

WITNESS POINT

Inspection of the proposed sign locations

- Submission of proposed sign location. Section 3.4: Foundations – Utility identification, excavation, placement of concrete.
- Section 3.5: Sign Support Structures Erection – Accurately position and support all components during erection, including meeting post height requirements of section 3.5.4.
- Section 3.6: Sign Panels Erection – During erection. Support and brace the sign panels and protect the sign face from damage.
- TfNSW Specification QA R145 – Pavement Marking (Performance Based)

- Section 2.1: Choice of Materials – Pavement marking material to be per NSW Ports ‘Design and User requirements’ Section 13.

HOLD POINT

Submission of product manual / safety data sheets of proposed pavement markings.

- Section 3.1: Surface Preparation – Assess the pavement surface for adhesion, prepare area per the surface condition requirements.
- Section 3.2: Position Markings (Hold Point) – Setout the work such that the markings are placed in accordance with the design drawings and line types E1, E5, TF and TB1 in Appendices 1 to 5. The Superintendent or representative may inspect the set out prior to authorising the release of the Hold Point.

WITNESS POINT

Inspection of position marking set out.

- Section 7.1: Positions, Dimensions and Tolerances – Installed pavement markings must comply with the tolerances shown in Table R145.1.

18.3 Summary of Hold/witness Points

All witness points during provision of road furniture, signage and line marking are outlined in Table 18.1.

Table 18.1 Hold Point Schedule

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Product Manual and Safety Data Sheets	18.2	HOLD	Relevant product manuals and safety data sheets, at least 2 weeks prior to installation.	Acceptance by Superintendent prior to authorising the release of the hold point
Inspection of safety barriers	18.2	HOLD	Inspection of set out of the safety barriers, at least 1 week prior to installation.	Acceptance by Superintendent prior to authorising the release of the hold point
Proposed sign writing layout	18.2	HOLD	Proposed sign writing layout drawings, at least 1 week prior to signwriting.	Acceptance by Superintendent prior to authorising the release of the hold point
Position marking	18.2	WITNESS	Inspection of sign proposed sign locations prior to installation	The Superintendent will inspect the proposed sign locations prior to authorising the release of the Witness Point.

PROCESS HELD	SECTION REFERENCE	HOLD OR WITNESS POINT	SUBMISSION DETAILS	RELEASE OF HOLD/WITNESS POINTS
Pavement marking	18.2	WITNESS	Inspection of pavement marking set out prior to marking	The Superintendent will inspect the pavement marking, prior to authorising the release of the Witness Point.
Safety barrier installation	18.2	WITNESS	Inspection of safety barriers prior to installation	The Superintendent will inspect the safety prior to authorising the release of the Hold Point.