

Hunter Water Corporation A.B.N. 46 228 513 446
Standard Technical Specification for:

<p style="text-align: center;">CONSTRUCTION OF WATER BOOSTER PUMPING STATIONS</p>
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AMENDMENTS

New Clause	Old Clause	Amendment
AMENDMENTS TO THE OCTOBER 2005 VERSION		
2	2	Drawings SCP 920 to 922 deleted
22	22	Requirements replaced with reference to STS903
23.1	23	Clause only to apply when information package not provided
23.2	-	New format for Operation and Maintenance information
28.1	28.1	Replaced with reference to Approved Products and Manufacturers on web site

AMENDMENTS TO THE AUGUST 2005 VERSION		
28.2.3	28.2.3	Address updated
AMENDMENTS TO THE AUGUST 2004 VERSION		
2.2	2.2	Drawings SCP 920 to 922 deleted
4.2	4.2	Reference to internet site added in lieu of appendices
23	23	Requirement for submission before commissioning addedd
24.4	24.4	Reference to appendices deleted
27.1	27.1	Reference to internet site added in lieu of drawings
27.1	27.1	Reference to internet site added in lieu of drawings
28.2.3	28.2.3	Address updated
-	App C	Appendix deleted
-	App D	Appendix deleted
-	App E	Appendix deleted
App C	App F	Appendix re-numbered
App D	App G	Appendix re-numbered
AMENDMENTS TO THE NOVEMBER 2002 VERSION		
25.5.1	25.4.1	Addition of requirements for degree of protection for switchboards
25.12.1	25.11.1	Deletion of personal protection requirements

1. GENERAL

1.1 Scope

This Standard Technical Specification details requirements for the construction of small water booster pumping stations.

The main items of work to be constructed include, but are not limited to the following:-

- (a) Excavation for all structures and pipework.
- (b) Construction of concrete pump pit.
- (c) Manufacture and installation of aluminium pump pit covers.
- (d) Manufacture and installation of miscellaneous metalwork items for the pumping station.
- (e) Supply and installation of suction pipework and valves from connection to watermain to pumps.
- (f) Supply and installation of discharge pipework and valves from pumps to connection to watermain.
- (g) Supply and installation of drainage pipework from pump pit.
- (h) Supply and installation of conduits for services.
- (i) Supply and installation of pumps and, if required, baseplates or pedestals.
- (j) Filling and compacting around structures and site.
- (k) Construction of access road and hardstand area.
- (l) Supply and installation of pressure gauges, switches and transmitters.
- (m) Manufacture, supply and installation of electrical switchboard.
- (n) Supply, install and commission telemetry system and configure SCADA database
- (o) Supply and installation of incoming power supply from substations to switchboard including conduit.
- (p) Environmental protection measures including establishment and regular maintenance of all necessary environmental protection works.
- (q) Landscaping.
- (r) Restoration of all disturbed areas.
- (s) Acceptance testing of pipework.
- (t) Testing of pumps and electrical equipment.

1.2 Interpretation

Unless specifically stated otherwise, construction of water booster pumping stations includes ALL functions described in this Standard Technical Specification and the provision of any minor materials or services which are not described but are reasonably necessary to produce a fully functional water booster pumping station.

For the purposes of this Standard Technical Specification, except where the context requires otherwise:

'Drawings' means the drawings detailing the work involved in the particular project in hand.

'Specification' means the Specification detailing the work involved in the particular project in hand.

'Standard Drawings' means the Hunter Water Corporation Limited drawings, including those listed in clause 2.2, which detail general requirements for a class of work.

'Standard Technical Specifications' means the Hunter Water Corporation Limited technical specifications, including those listed in clause 2.1, which detail general requirements for a class of work.

Headings are for the convenience of the reader and shall not be used in the interpretation of this Standard Technical Specification.

Specific requirements, including those in the Specification or Drawings, take precedence over general requirements.

Unless the context requires otherwise any expression such as "give notice", "submit", "approval", or "directed" means give notice to, submit to, approval by, or directed by the person nominated by the Principal or Purchaser.

2. REFERENCED DOCUMENTS

2.1 Hunter Water Corporation Standard Documents

The following Hunter Water Corporation standard documents are deemed to form part of this Standard Technical Specification to the extent and for the purposes referred to in the text:

- STS100 Passivation of Stainless Steel
- STS101 Construction and Pipe Bedding Materials
- STS102 Natural Gravel and Crushed Rock Pavements
- STS103 Valves, Hydrants and Associated Components
- STS401 Standard Technical Specification for Construction of Watermains
- STS900 Environmental Protection Measures for Construction Sites
- EIS-91 HWC General Requirements for Electrical Installations
- EIS-91/A2 HWC Special Requirements for Water Booster Pumping Stations

2.2 Hunter Water Corporation Standard Drawings

The following Hunter Water Corporation standard drawings are deemed to form part of this Standard Technical Specification:

- WCP-100 Symbols for Construction of Watermains
- WCP-200 Mainlaying - DICL Mains - Typical Installation of Pipes and Fittings for DN 100 to 750 Mains
- WCP-201 Mainlaying - UPVC Pipes - Typical Installation of Pipes and Fittings for DN 100 to 250 Mains
- WCP-202 Mainlaying - Pipe Support and Trench Fill for DN 100 to 750 Mains
- WCP-203 Mainlaying - Trenchstops and Bulkheads for DN 100 to 750 Mains
- WCP-204 Mainlaying - Trench Drainage for DN 100 to 750 Mains
- WCP-205 Mainlaying - Pipe Support and Trench Fill in Bad Ground for DN 100 to 750 Mains
- WCP-206 Mainlaying - Construction Work As Executed Information

- WCP-300 Installation - Hydrants for DN 100 to 750 Mains
- WCP-301 Installation - Stop-Valve for DN 100 to 375 Mains
- WCP-302 Installation - Air Valves for DN 100 to 750 Mains
- WCP-304 Installation - Driveway/Roadway Crossings for DN 100 to 750 Mains
- 13521 Flange Welding Details
- 13741-07 Standard 2400 x 1500 Pit - Cover - Arrangement
- 13741-08 Standard 2400 x 1500 Pit - Cover - Details
- 13741-11 3.2 x 2.1 & 2.7 x 2.1 Rectangular Valve Pits - Cover Marking Plan
- 13741-12 3.2 x 2.1 & 2.7 x 2.1 Valve Pits - Cover Details
- 13751-01 Concrete Supports for Stop Valves and Reflux Valves
- 13752-00A Circular and Rectangular Valve Pits - Monorail Ladder Details

2.3 Standards Australia Documents

The following Australian Standards are deemed to form part of this Standard Technical Specification to the extent and for the purposes referred to in the text:

- AS 1023.1-1985 Built-in thermal detectors and associated control units.
- AS/NZS 1111-1996 ISO metric commercial hexagon bolts and screws.
- AS/NZS 1112-1996 ISO metric hexagon nuts, including thin nuts, slotted nuts and castle nuts
- AS 1202 AC motor starters (up to and including 1000V).
- AS 1214-1983 Hot-dip galvanised coatings on threaded fasteners.
- AS/NZS 1252-1996 High strength steel bolts with associated nuts and washers for structural engineering
- AS 1289 Methods of Testing Soils for Engineering Purposes.
- AS 1302-1991 Steel reinforcing bars for concrete
- AS 1303-1991 Steel reinforcing wire for concrete
- AS 1304-1991 Welded wire reinforcing fabric for concrete
- AS 1349-1986 Bourdon tube pressure and vacuum gauges.
- AS 1359.41-1986 Rotating electrical machines - General characteristics
- AS 1359.60-1986 Rotating electrical machines - Tests
- AS/NZS 1477-1996 PVC pipes and fittings for pressure applications
- AS/NZS 1580.405.1
 - 1996 Determination of pencil hardness of paint film
- AS 1604-1997 Timber - Preservative-treated - Sawn and round
- AS 1627.4-1989 Metal finishing - Preparation and pre-treatment of surfaces - Abrasive blast cleaning
- AS 1627.5-1994 Metal finishing - Preparation and pre-treatment of surfaces - Pickling, descaling and oxide removal
- AS 1650-1989 Hot dipped galvanised coatings on ferrous articles
- AS 1664-1979 Aluminium Structures Code.

AS 1665-1992	Welding of aluminium structures.
AS 1939-1990	Degrees of protection provided by enclosures for electrical equipment (IP Code).
AS 2008-1997	Residual bitumen for pavements
AS/NZS 2053-1995	Conduits and fittings for electrical installations
AS/NZS 2053.2-1995	Conduits and fittings for electrical installations - Part 2: Rigid plain conduits and fittings of insulating material
AS/NZS 2053.7-1995	Conduits and fittings for electrical installations - Part 7: Rigid metal conduits and fittings
AS/NZS 2064-1997	Limits and methods of measurement of electronic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment
AS 2279	Disturbances in mains supply networks.
AS 2417.2-1980	Pumps - The international acceptance test codes - ISO 2548-Class C tests
AS 2528-1982	Bolts, studbolts and nuts for flanges and other high and low temperature applications
AS 2700-1996	Colour standards for general purposes
AS 2837-1986	Wrought alloy steels - Stainless steel bars and semi-finished products
AS 3000-1991	Electrical installations - Buildings, structures and premises (known as the SAA Wiring Rules).
AS 3147-1992	Approval and test specification - Electric cables - Thermoplastic insulated - For working voltages up to and including 0.6/1 kV
AS 3500.1-1992	National Plumbing and Drainage Code - Water Supply
AS 3582.1-1991	Supplementary cementitious materials for use with portland cement Part 1 Fly ash
AS/NZS 3678-1996	Structural Steels - Hot rolled plates, floorplates and slabs.
AS/NZS 3679-1996	Structural Steels - Hot rolled bars and sections / Welded I sections.
AS 3680-1989	Polyethylene sleeving for ductile iron pipelines
AS 3876-1991	Information processing - Guidelines for the documentation of computer-based application systems
AS/NZS 3879-1995	Solvent cements and priming fluids for use with unplasticised PVC (uPVC) pipes and fittings
AS 3972-1997	Portland and Blended Cements
AS 4087-1986	Metallic flanges for waterworks purposes
AS 4100-1990	Steel Structures.

References in the text giving just the number of the Standard mean the above editions.

2.4 Water Services Specification (WS-Spec)

The following sections of the water Services Specification (WS-Spec) are deemed to form part of this Standard Technical Specification to the extent and for the purposes referred to in the text. WS-Spec can be obtained through Standards Australia.

SP2	Ductile Iron Pipes and Fittings
SP3	Grey (Cast) Iron Fittings
SP4	PVC Pipes and Fittings
SP15	Elastomeric Seals
SP30	Protective Coatings for Valves
SP45	Concrete Supply Special Class
TR10	Concrete (Civil Works)

Use materials and components as specified for Hunter Water Corporation in the Table(s) of Water Agency Practices in each SP section.

2.5 Roads and Traffic Authority NSW Documents

The following Roads and Traffic Authority NSW documents are deemed to form part of this Standard Technical Specification to the extent and for the purposes referred to in the text:

- Sprayed Bituminous Surfacing (MR Form No 93)
- Residual Bitumen (MR Form No 337)
- Supply and Delivery of Cover Aggregate (MR Form No 351).
- Supplying and Laying Asphaltic Concrete (MR Form No 612):
- The Construction of Natural Gravel or Crushed Rock Road Pavement (Bitumen Surfaced) (MR Form No 743)
- The Construction or Resheeting of Natural Gravel or Crushed Rock Road Pavement (Not Bitumen Surfaced) (MR Form No 800).

2.6 Other Referenced Documents

The following documents are deemed to form part of this Standard Technical Specification to the extent and for the purposes referred to in the text:

- Construction Safety Act
- New South Wales Occupational Health and Safety Act
- Building Services Corporation Regulations

3. GENERAL CONSTRUCTION

3.1 General

Construct the water booster pumping station and associated works to the lines, levels, grades and in the locations and using the materials and methods shown on the Drawings and in the Specification and to the details shown on the relevant Hunter Water Corporation Standard drawings listed in clause 2.2.

3.2 Order of Construction

Undertake and complete all work including fittings before connection is made to the existing water supply system.

3.3 Environmental Protection Measures

Implement and maintain environmental protection measures and before disturbing the natural surface on Site submit an Erosion and Sediment Control Plan all in accordance with STS900.

3.4 Work in Roadways

Obtain and comply with the requirements of the Local Council and the Roads and Traffic Authority whenever work is to be undertaken in a roadway.

4. SELECTED SUBCONTRACTORS

4.1 Works

The Contract includes the following Selected Subcontract work:-

Selected Subcontract No 1 Manufacture and Supply of Electrical Equipment.

Selected Subcontract No 2 Installation of Electrical Equipment.

Selected Subcontract No 3 Design and Installation of Telemetry System.

Selected Subcontract No 4 Supply of Submersible Sewage Pumps.

4.2 Subcontractors

Select subcontractors from Hunter Water Corporation preferred contractor lists which can be accessed on their website at www.hunterwater.com.au/standardssuppliers.asp.

See clause 28.2.3 in relation to Selected Subcontract No 4.

4.3 Secondary Selected Subcontract

Selected Subcontractors No 1, 2 and 3 may enter secondary subcontracts with other approved Subcontractors from Appendices C, D and E.

5. MATERIALS

5.1 General

Obtain all materials necessary for construction of the Works from approved sources. Comply with all recommendations of the manufacturers regarding the storage and handling of the materials. Undertake all handling, transport and storage such that no damage occurs to the materials including coatings and linings.

Any damaged material is liable to be rejected. Do not use any rejected material in the Works and remove it from the Site at the earliest opportunity.

5.2 On-site Stockpiles

Only store sufficient materials on site as are necessary to allow timely and efficient progress of the work. Locate stockpiles of excavated or imported material where they cause no interference to the public, drainage routes or vehicular or pedestrian traffic. Clear lines of sight for drivers must not be obstructed. Do not stack materials against structures, fences, trees or other property improvements. Leave a clear path at least 600 mm wide between the edge of any excavation and the inner toe of any stockpile or spoil banks.

5.3 Bedding Sand

Supply bedding sand embedment material in accordance with Standard Technical Specification STS101.

5.4 High Grade Compaction Sand

Supply high grade compaction sand embedment material in accordance with Standard Technical Specification STS101.

5.5 Select Fill

For select fill use excavated material, free from organic matter and having a particle size no larger than 20 mm. The material shall be suitable to allow compaction as specified without causing damage to the pipeline. If material excavated during excavation does not comply, import non-cohesive material.

5.6 Trench Fill

Where the trench is not subject to traffic loading use excavated material for fill in the trench fill zone provided it has a particle size no greater than 75 mm across the largest dimension, is free from organic matter and can be placed into a dense mass free of voids and cavities.

For trafficable areas use:

- cement stabilised trench fill in accordance with clause 5.7 for all existing roads; or
- crushed rock dust in accordance with Standard Technical Specification STS101; or
- crushed rock in accordance with Standard Technical Specification STS102; or
- as directed by the authority responsible for the trafficable area.

5.7 Cement Stabilised Trench Fill

Cement stabilised trench fill shall comprise a 14:1 sand : cement mix.

5.8 UPVC Pressure Pipes and Fittings

Supply UPVC pressure pipes manufactured in compliance with Section SP4 of WS-Spec. Unless specified otherwise, use Series 2 (Cast Iron Outside Diameters) flexible jointed pipes to the class nominated in the Drawings. Do not use UPVC pressure pipes exceeding 6 months of age from the date of manufacture. All fittings for UPVC pressure pipelines DN 100 and greater are to be ductile iron to clause 5.9 and internally and externally coated with a thermal bonded coating in accordance with Section SP30 of WS-Spec.

5.9 Ductile Iron Pipes and Fittings

Supply ductile iron pipes and fittings manufactured in compliance with Section SP2 of WS-Spec. Use flexible jointed pipes to Class K9, flanged pipes to Class K12 and fittings to Class 14 or Class 16.

5.10 Grey (cast) Iron Fittings

Supply cast iron fittings manufactured in compliance with Section SP3 of WS-Spec. Use fittings to Class C. Do not use grey cast iron fittings if ductile iron fittings to clause 5.9 are manufactured.

5.11 Joint Seals

Supply elastomeric seals manufactured in compliance with Section SP15 of WS-Spec. Use seals of either ethyl propylene-diene (EPDM) or nitrile-butadiene rubber (NBR).

5.12 Polyethylene Sleeving

Use cream coloured polyethylene sleeving, adhesive tape, strap and buckle in accordance with AS 3680. Supply rolls with protective end flanges and perforated at 6.1 metre intervals.

5.13 Geotextile Filter Fabric

Geotextile filter fabric shall be approved inert material, BIDIM A14, manufactured by Geofabric Australia Pty Limited.

5.14 Timber Piles

All piles are to be treated hardwood, strength group F14, and in accordance with "Koppers - Standard Specification, Hardwood Foundation Piling". The CCA treatment shall be to the requirements of AS 1604 Hazard Level 5 protection and the further requirements of the NSW Timber Market Act.

5.15 Cement

Use only cements and supplementary cementitious products registered under the NSW Government Cement Quality Assurance Scheme. Do not use any admixtures in the concrete. Use only one of the following cements:

- Fly Ash Blended Cement conforming to the requirements of Type SR to AS 3972 and containing 20% fly ash to AS 3582 Part 1, "fine grade" only, or
- Blended Cement, other than fly ash, conforming to the requirements of Type SR to AS 3972.

5.16 Concrete

Supply concrete manufactured in compliance with Section SP45 of WS-Spec.

Supply concrete from plant(s) accredited under the Hunter Water Corporation Concrete Quality Assurance Scheme to the grade shown on the Drawings or Standard Drawings.

Unless specified otherwise, the following requirements shall apply. See Clause 6.2 of Section SP45 of WS-Spec.

		CLAUSE OF SP45	CLASS AND GRADE			
			S40	S32	S25	N20
MATERIALS AND MIX	Cement Type	3.1	*	*	*	SR
	Minimum Cement (kg/m ³)		390	330	280	
	Maximum Cement (kg/m ³)		410	370	340	
	W/C Ratio Maximum		0.45	0.50	0.55	
	Laboratory Trial Mix Required	3.4	Yes	Yes	Yes	No
STRENGTH GRADE	F'c at 28 days (Mpa)	2.3	40	32	25	20
OTHER	Nominal Slump (mm)	2.3	80	80	80	80
	Drying Shrinkage (strain x 10 ⁻⁶) at 3 weeks or {8 weeks}	2.3	500 {3}	500 {3}	500 {3}	
	Air Content (%)	2.3				
	Pumped Concrete Accepted		Yes	Yes	Yes	Yes

Note: * Cement Type is to be selected from Clause 5.15 of STS405

5.17 Reinforcement

Supply reinforcement as shown on the Drawings or the Standard Drawings and manufactured in compliance with the relevant Australian Standards listed below:

- AS 1302 Steel reinforcing bars for concrete
- AS 1303 Steel reinforcing wire for concrete
- AS 1304 Welded wire reinforcing fabric for concrete

5.18 Fasteners

Supply all nuts, bolts and washers in accordance with AS 2528. All exposed boltheads and nuts shall be hexagonal and the length of all bolts shall be such that tightened bolted connections shall have a minimum of 2.5 threads and a maximum of 5 threads protruding from the nut.

All anchors, bolts, nuts and washers either embedded in concrete, installed within the wet well and/or used in the fabrication and/or installation of stainless steel items shall be of Grade 316 stainless steel to AS 2837. All other steel anchors, bolts, washers and nuts shall be hot dip galvanised in accordance with AS 1650. Grade 316 stainless steel to AS 2837 is an acceptable alternative to hot dip galvanised steel. Passivate all stainless steel components in accordance with STS100.

5.19 Valves

Supply valves in accordance with Standard Technical Specification STS103.

5.20 Asset and Equipment Number Labels

Manufacture Asset and Equipment Number Labels from:

- (a) Electrical components - 1.6 mm thick silver anodised aluminium sheet filled with black enamel. Fix using four (4) aluminium pop rivets.
- (b) For pumps and valves - 1.6 mm thick stamped or embossed stainless steel. Do not paint. Fix using stainless steel drive screws.

The asset number is listed in Appendix C. Lettering is to be 9 mm high.

5.21 Metering Equipment

Obtain Metering Equipment for the electrical switchboard from the Supply Authority.

5.22 Telemetry Hardware

Obtain the PLC (Square D Model 50) and Telemetry Unit (Square D Model PDS500) to be installed by selected subcontractor No. 1 in the electrical switchboard from Hunter Watertech Pty. Ltd.

5.23 Lock Barrels

Obtain lock barrels for the pumping station switchboard from the Hunter Water Corporation. Contact the Superintendent regarding supply of lock barrels, refer clause 25.12.4.

6. EXISTING SERVICES

6.1 Location of Services

Any details of services shown on the Drawings are not to be taken as indicating all existing services or exact locations. Irrespective of any information on the Drawings, verify the exact location of all services which may be affected by construction activities. If services are located which are not shown on the Drawings or are not in the location shown on the Drawings, give

notice at least three (3) working days prior to commencement of any construction activity that may affect the service.

6.2 Protection and Maintenance of Services

Take all actions and provide all things necessary to protect and maintain existing services to the satisfaction of the relevant authority or owner. This may include arranging or performing relocation, temporary diversion or support of the service.

6.3 Repair of Services

If a service is damaged during construction, arrange or perform repair to the satisfaction of the controlling authority or owner. Obtain from the authority or owner, a certificate stating that the repair has been carried out to their satisfaction.

If the service is not under the control of an authority and the owner cannot be located within a reasonable time, report the damage, and arrange or perform repair to an approved standard. Do not backfill, cover up or make the repair inaccessible prior to obtaining approval.

7. CLEARING

Do not destroy, remove or clear vegetation or surface improvements to an extent greater than necessary for the execution of works. Keep clearing along any pipelines to a maximum width of four (4) metres.

Obtain the approval of the Council for the removal of any trees. Take any steps necessary to prevent damage to trees that are not to be removed.

Dispose of all rubbish and surplus material within 24 hours of clearing.

Stockpile topsoil separate from other excavated material and use it to make good the surface after backfilling.

8. EXCAVATION

8.1 Safety

Do not commence any excavation until all materials necessary to make the excavation safe are on Site and available for use. This includes any necessary fencing and barriers as well as excavation support systems.

8.2 Limits of Excavation

Keep the extent of excavation to the minimum possible to allow efficient construction of the Works while meeting the minimum requirements shown on the Drawings and the relevant Standard Drawings. Keep pipe trench widths within the maximum widths recommended by the pipe manufacturer.

Unless approved otherwise, keep the sides of excavations for pipework vertical to at least 150 mm above the pipe.

Ensure that the minimum cover requirements will be satisfied following any earthworks which may occur in the area of the pipelines and services to the pumping station. This is particularly relevant in new subdivisions or developments where earthworks are to be expected to form roads, driveways, footpaths and for general shaping of the surfaces. Preferably lay services after formation of surfaces to finished levels. If minimum cover requirements cannot be achieved submit a proposal to overcome the problem.

8.3 Improved Surfaces

Where excavation is required under improved surfaces such as pavements, driveways and kerb and gutter, use tunnelling or boring where the surfaces cannot be satisfactorily reproduced and under existing concrete footway areas and concrete driveways. Ensure backfilling is to a standard to fully support the surface and any likely applied load.

If open excavations are used in improved surfaces, keep the excavation width to the minimum allowed. Saw cut neat straight lines at the outer limits of the excavation through bitumen, asphalt and concrete. Remove pavers, blocks or brick pavements by hand, clean them and set them aside for later replacement.

8.4 Explosives

Use of explosives is not permitted.

8.5 Support of Excavations

Adequately support all excavations as the work proceeds to meet the requirements of the Workcover Authority of NSW. Comply with Regulations 95 and 97 of the Construction Safety Act. Ensure that adjacent structures and services are not subject to disturbance by the excavation support system.

When removing, raising or withdrawing supports, exercise every precaution necessary to prevent slips or falls and ensure that no damage, disturbance or displacement occurs to the installations. Backfill simultaneously with the raising or withdrawal of supports. Ensure that compaction of pipe embedment and backfill material occurs below such excavation support and against native ground.

When directed or specified, leave the excavation support system in place as permanent support. Cut off the support system at a depth below ground surface that will satisfy the structural requirements of the site.

8.6 Drainage and Dewatering

Keep all excavations free of water. Provide, maintain and operate intercepting works to prevent surface water from entering the excavations; and all equipment necessary for dewatering the excavations and keeping the Works free from water.

Lowering of the water table by well points or other external dewatering methods may only be used if no damage is likely to be caused to adjacent structures and services.

Ensure that all downstream works that are under construction, completed or in use are protected at all times against the effects of any drainage which is discharged or likely to be discharged from the work.

8.7 Extra Depth Excavation

If extra excavation is required to reach a firm foundation or if excavation has extended deeper than necessary to meet the requirements of this Standard Technical Specification, refill to the required level with an approved non-cohesive material complying with STS101. Place and compact the material in accordance with clause 10.1.

Where material has been disturbed to a level deeper than necessary under this Standard Technical Specification, compact the disturbed material to density index not less than 70% for granular (non-cohesive) material or to dry density ratio not less than 95% for non-granular (cohesive) material. If satisfactory compaction of the disturbed material cannot be achieved, remove the material and refill to the required level with an approved non-cohesive material complying with STS101. Place and compact the material in accordance with clause 10.1.

8.8 Foundations and Foundation Stabilisation

Where the bottom of an excavation is soft or considered to provide an unacceptable foundation produce a stable foundation by one of the following:

- (a) Use of geotextile surround as shown on Standard Drawing WCP-205 for pipework. For other structures place geotextile fabric across the full excavation width and extending up the sides to minimum level of 600 above the base of the excavation.
- (b) Extra depth excavation in accordance with clause 8.7.
- (c) Ram ballast into the soft ground until an approved firm foundation is obtained at the design depth. Use ballast comprising clean hard rock of 150 mm nominal size having no less than 85% retained by a 150 mm sieve and no less than 95% retained by a 100 mm sieve, Remove and dispose of any excess material.
- (d) Timber piles as shown on Standard Drawing WCP-205. Piles spaced, unless specified otherwise, at 1.2 metre centres for Type L and Type M or 5.5 metre centres for Type K along the centre line of pipe, shall be driven to nominal refusal. Only use piling, where ballast, geotextile and / or extra depth excavation are considered unsuitable. Do not use piling unless approved in writing by the Superintendent. Use only DICL or steel pipes with piling support.

Give notice prior to commencing any foundation stabilisation.

8.9 Surplus Excavated Material

Promptly remove and dispose of excavated material which is not required for reuse. Surplus material is the property of the controlling authority or owner of the excavation site. Do not dispose of the surplus material without the prior written consent of the dump site's owner, owner's agent, lessee or controlling authority.

9. PIPE BEDDING, LAYING, JOINTING AND BACKFILLING

9.1 General

Bed, lay, joint and backfill the suction and discharge pipework in accordance with clauses 8, 9 and 11 of Standard Technical Specification STS401.

See clause 5 for materials requirements.

10. BACKFILLING OF STRUCTURES

10.1 General

Place and compact backfill in even layers on either side of structures to avoid differential loading.

See clause 5 for materials requirements. Backfill containing boulders, large rocks, logs, stumps, tree loppings, builders refuse, broken concrete and other like material is expressly forbidden.

Keep all dewatering systems operating during backfilling so that no fill material is placed or compacted under water. At all times ensure that the pipelines and structures are not damaged or moved during placement and compaction of fill.

Place and compact backfill in layers not greater than 300 mm thick except in roadways use layers not greater than 150 mm thick. Compact cohesive (non-granular) backfill to a dry density ratio of 98% standard and cohesionless (granular) backfill to a density index of 70%.

Measure the degree of compaction in accordance with;

- for cohesionless (granular) fill - the density index determined in accordance with AS 1289.E6.1 based on the field dry density determined in accordance with AS 1289.5.3.1 or AS 1289.E3.5 and the maximum and minimum dry densities in accordance with AS 1289.E5.1
- for cohesive (non-granular) fill - the dry density ratio determined in accordance with AS 1289.5.4.1 based on the field dry density in accordance with AS 1289.5.3.1 and the maximum dry density in accordance with AS 1289.5.1.1.

Compact fill material by manual or mechanical tampers. Compact non-granular fill at a moisture content within plus or minus 2% of optimum and granular fill at a moisture content within plus or minus 3% of optimum. Flooding of the fill is not permitted.

10.2 Compaction and Density Testing

Undertake testing of fill compaction and/or density in accordance with AS 1289 Part E. Engage an approved body registered by NATA for the particular tests to be undertaken. Submit test results.

The minimum number of tests shall be:

AREA	ZONE	NUMBER OF TESTS
Hardstand	Pavement	Two
	Backfill and subgrade	Two for each 900mm layer
Access Road	Pavement	Two tests for every 50 m length of access road but not less than two.
	Backfill and subgrade	Two tests for each 900 mm layer for every 50m length of access road but not less than two tests per 900 mm layer.

Tests shall be considered to apply to a section of work being either the hardstand area or fifty (50) lineal metres of the access road. If a test fails, the relevant section of work shall be considered to be defective. Elect to either rectify the work or undertake two further tests in the section deemed to have failed within one week of the failed test. The locations of the additional tests shall be where directed. If both additional tests pass, the section shall be accepted. If one or both of the additional tests fail, rectify the work.

Within two weeks of the completion of any rectification work, perform two more tests where directed. If one or both of the tests fail, rectify the work and continue to retest and rework until all test results are satisfactory.

11. CONCRETE

11.1 General

Construct concrete civil engineering works to the requirements of Section TR10 - Concrete (Civil Works) of WS-Spec.

Unless noted otherwise on the Drawings use concrete strengths nominated below:

ITEM OF WORK	Minimum Crushing Strength at 28 Days (Mpa)
Water Structures eg. Valve and Pump Pits, Tanks, Reservoirs, etc.	32
Stormwater structures eg. Pits, Headwalls Channels, etc.	25
Accessway, dish crossing,	25

Reinforced concrete pipe bedding and surround	25
Thrust Blocks	25
Pathways, Footpaving, Kerb and Gutter	20
Unreinforced concrete pipe bedding, surround, bulkheads and other mass concrete	20

11.2 Identification Certificate

The Identification Certificate accompanying each load delivered to site shall include the following further details:-

- (a) time at which the concrete was batched
- (b) size of the load in cubic metres.
- (c) type of concrete eg. Grade 20.
- (d) total cement content of the load in kilograms (kg).
- (e) amount of free water batched in litres (L).
- (f) slump at time of batching in millimetres (mm).
- (g) type of cement used.

Do not use concrete supplied without a completed Identification Certificate.

11.3 Expansion and Contraction Joints

11.3.1 Kerbing

Weakened plane (contraction) joints shall be 3 mm wide, clean cut and made vertically through the concrete at right-angles to the direction of the work. Normally they shall be spaced at 3 m intervals with minor adjustments to avoid short closing lengths.

Form expansion joints adjacent to other structures. Expansion joints shall be sealed with 15 mm wide preformed, self-expanding cork joint sealer cut to the full profile of the kerb section. Remove tape from top of sealer at about the time of final set of the concrete.

Joint arrises abutting cork joint sealer shall not be tooled off.

11.3.2 Footpaths and Minor Paving

Joints shall be straight, continuous and normal to the surface of the pavement.

Weakened plane joints shall be formed by making a cut 3 mm wide for at least one quarter of the depth of the paving. Arrises shall be tooled to a suitable radius. Space weakened plane joints at 2 metre intervals with minor adjustments to avoid short closing lengths.

Expansion joints shall be constructed for the full depth of the paving using 15 mm wide preformed self-expanding cork joint sealer. They shall be provided where ever the paving abuts fixed structures, such as buildings and pits, transversely at maximum intervals of 15 m along path and at path intersections. Joint sealer shall be bonded to the first placed concrete using a suitable contact adhesive. Remove tape from top of sealer at about the time of final set of the concrete. Joint arrises abutting cork joint sealer shall not be tooled off.

11.3.3 Accessways and other structures

All joints to the details shown on the Drawings.

11.4 Blockouts and Cored Holes

- (a) Unless blockouts or cored holes are shown on the Drawings all pipes and fittings shall be cast into the structure when the structure itself is poured. Where this is not possible submit details of blockouts or alternative methods for approval. Details should conform to details shown on Drawing SCP-901;
- (b) All pipes which are cast into the concrete shall be thoroughly cleaned to remove all traces of dust, grease, rust and paint prior to the placement of concrete to secure a tight bond with the concrete;
- (c) Where cored holes or blockouts are to be grouted to hold pipework, bolts and other fittings, the cored holes or blockout shall be scabbled and treated with an epoxy compound, such as Hilti CA80 ,Epirez 133 or Epirez 633, strictly in accordance with the Manufacturer's instructions;
- (d) Openings shall be constructed so as to leave a minimum clearance of 100 mm between finished concrete and the location of the item to be cast-in. Reinforcement shall be constructed continuously through openings as detailed on the reinforcement Drawings and shall be trimmed around the item to be cast-in at a maximum distance of 50 mm from the item;
- (e) After placing the pipe and fitting, the remaining void shall be carefully filled with epoxy mortar, such as Hilti CA80 or Epirez 633 mixed , using appropriate sand (either Epirez No 2 Quartzite Aggregate or Hilti CTS 99 Graded Sand), to the Manufacturer's written instructions, to produce a watertight joint. The epoxy mortar shall be retained by a form which shall be built up as filling proceeds;
- (f) Where fixing bolts to be cast-in are positioned by means of a template they shall be supplied with a backing nut and a face nut for secure fixing of the bolt. The backing nut shall be cast into the concrete;
- (g) Aluminium or ferrous structural members built into brick or concrete shall have their contact surfaces first painted with two (2) coats of bituminous paint.

11.5 Cast In Items

All anchor bolts and fastenings cast in concrete shall be Stainless Steel Grade 316 to AS 2837 unless otherwise shown on the Drawings.

11.6 Specific Requirements

Unless specified otherwise, the following requirements shall apply. See Clause 9.2 of Section TR10 of WS-Spec.

		CLAUSE (TR10)	CLASS AND GRADE			
			S40	S32	S25	N20
OTHER	Curing Compound Accepted Yes/No	6.9	No	No	No	No
	Minimum Period Between Adjacent Pours (Days)	6.1	2	2	2	2
SURFACE FINISH - FORMED	Surfaces exposed to sewage, effluent, or sewage gases.	6.7	F3	F3	F3	
	Surfaces of water retaining structures exposed to water.		F3	F3	F3	

	Internal surfaces and all exposed surfaces, except trafficable surfaces.		F2	F2	F2	F2
	Internal trafficable surfaces.		F2	F2	F2	F2
	External trafficable surfaces.		F2	F2	F2	F2
	Concealed surfaces.		F1	F1	F1	F1
SURFACE FINISH - UNFORMED	Surfaces exposed to sewage, effluent, or sewage gases.	6.8	U3	U3	U3	
	Surfaces of water retaining structures exposed to water.		U3	U3	U3	
	Internal surfaces and all exposed surfaces, except trafficable surfaces.		U2	U2	U2	U2
	Internal trafficable surfaces.		U5*	U5*	U5*	U5*
	External trafficable surfaces.		U4*	U4*	U4*	U4*
	Concealed surfaces		U1	U1	U1	U1

Refer to clause 11.7 of STS405 for requirements for Class U4 and Class U5.

11.7 Unformed Surfaces Finish

Requirement: Additional to finishes specified in Clause 5.8 of Section TR10 of WS-Spec, provide one of the following classes as specified:

Class U4 - (Broom finish)

Wood float finish Class U2 to be lightly broomed at right angles to the alignment of the pavement.

Acceptance criteria

- Abrupt irregularities less than 5 mm
- Gradual irregularities less than 5 mm

Class U5 - (Sponge Float - Trafficable)

Steel trowelled finish Class U3 to be sponge floated.

Acceptance criteria

- Abrupt irregularities less than 2 mm
- Gradual irregularities less than 5 mm

11.8 Topping

Topping shall have a minimum thickness of 25 mm. Cement content of the topping mix shall be the same as that of the structural concrete being topped. Prior to placing topping concrete and the grout beneath the pump baseplate or pedestal, scabble the concrete surface and apply Hilti CA80 or Epirez 133 epoxy.

Place topping concrete to the dimensions as shown on the Drawings. Ensure the topping is dense, uniform and the surface free from blemishes. Remove any splatter or solids lodged in or upon the pump baseplate or pipework.

11.9 Concrete Repairs

Repair air voids, bolt holes and honeycombing using an epoxy paste such as Hilti CA273. Repairs by bagging and cement mortar are not permitted.

For thin bed bonding use Hilti CA80 or Epirez 133.

11.10 Testing

The Contractor shall arrange for concrete sampling and testing, including transportation of cylinders. A minimum of 2 cylinders shall be taken for all concrete supplies over one cubic metre. A Slump Test shall also be carried out at the time that the cylinders are taken. Sampling and Testing shall be in accordance with relevant Australian Standards, using NATA certified tests. The cost for all these works shall be borne by the Contractor.

Minimum crushing strength and slump when tested in accordance with SP45, cement content and water / cement ratio shall be in accordance with clause 11.1 and 5.16.

12. PUMPING STATION PIT

12.1 Flotation

Ensure that any partly or fully completed structures do not move due to hydrostatic pressures.

12.2 Blockouts

On completion of pipework installation, epoxy mortar fill all blockouts in concrete structures in accordance with clause 11.4. Finish surfaces flush with the internal surface of all structures.

13. INSTALLATION OF ELECTRICAL CONDUITS

13.1 General

Install electrical conduits in accordance with EIS-91, the SAA Wiring Rules, Local Supply Authority's requirements and clause 26.8.3.

All electrical conduits except where specifically noted on the Drawings shall be heavy duty (HD) orange coloured UPVC conduits which comply with AS/NZS 2053.2. Mark all electrical conduits according to AS/NZS 2053 except that either embossing or moulding will be the only acceptable means of marking and that the distance between markings shall not exceed one (1) metre.

Where proprietary conduit bends are used, they shall be large radius sweep bends such as Clipsal 247L series.

Where conduits terminate above or underground, fit and seal the ends with proprietary conduit caps.

Provide bellmouths free from sharp edges and burrs on conduits terminated in cable pits and switchroom subfloors.

Install a continuous 2 mm diameter galvanised mild steel draw wire inside each conduit run. The draw wire shall be of sufficient length to allow one (1) metre to be folded back into each end of the conduit run.

13.2 Joints

Join UPVC conduits by solvent welding strictly in accordance with the Manufacturer's instructions using interference fit joints to AS/NZS 1477 with the solvent cement in accordance with AS/NZS 3879. The solvent cement shall be of a contrasting colour to the conduit.

13.3 Conduits between Switchboard Upstand and Pump Pit

The switchboard concrete upstand shall be joined to the pump pit by a series of UPVC conduits, as shown on the respective Drawings.

Provide a 2 mm diameter stainless steel draw wire in each UPVC conduit between the concrete upstand and the pump pit. Fit a suitable shackle or pulling eye to each end of each stainless steel draw wire to facilitate the pulling of cables in/out of the conduit. Permanently fix each draw wire to the base of the concrete upstand adjacent to each conduit.

14. MECHANICAL INSTALLATION OF PUMPS, VALVES AND FITTINGS

14.1 General

Lengths are to be determined accurately and items installed in such a manner as to ensure no undue loading on pumping units or pipework.

Prevent damage to or deterioration of pumps, electrical cables and ancillary equipment prior to putting into service and comply with manufacturer's recommendations for storage.

14.2 Flanged Joints

Select bolting in accordance with AS 4087 Appendix C for flanges to AS 4087 Class 14 or 16.

Assemble flanged joints in accordance with AS 4087 Appendix D and the following requirements.

Fit 3 mm thick insertion rubber gaskets to all flanged joints except where 'O' rings are fitted.

Use washers under all nuts. In addition, use washers under bolt heads for connection to items with protective coatings.

Where stainless steel fasteners are used to fasten galvanised items, install high strength fibre or phenolic insulating washers and sleeves between the stainless steel washers / bolts and the galvanised item being fixed or jointed.

All bolts, nuts, washers and locking devices in the flanges of the pumps and pipework and accessories in the pump pit shall be stainless steel to AS 2837 Grade 316. Apply "Loctite" nickel anti seize thread lubricant to all stainless steel fasteners prior to fitting nuts.

Where use of dismantling joints is indicated on Drawings they shall be of the thrust bearing type equivalent to the Sydney Water Standard for Dismantling Joints for Cast Iron Pipes. Connect puddle and thrust flanges with a metal to metal epoxy. Prior to connection of puddle or thrust flanges, remove surface coatings on flanges and the pipe at the location of connection.

14.3 Installation of Pump Units

Install pumping units, pump baseplates or pedestals, holding down bolts and associated items in accordance with written instructions and approved Drawings supplied by the pump manufacturer. Set the pumping units true and square by means of steel levelling wedges. Check alignment with suction and discharge pipework before final positioning.

The pumping units and associated equipment shall be installed free of any undue stresses, strains or vibrations and be accessible for maintenance.

Set all foundation bolts to their maximum depth using an epoxy grout Epirez 133 with Epirez No 2 Quartzite Aggregate to a maximum ratio of 1:2 by volume or Hilti CA80 with Hilti CTS 99 Graded Sand to a maximum ratio of 1:2 by volume.

14.4 Pump Numbers

Supply 100 mm high pump numbers cut from 2.5 mm thick marine grade C5251-H34 aluminium or grade 316 stainless steel. The numbers shall be the pump and starter number ie. "1", "2", "3".

Fix the pump numbers, using grade 316 stainless steel expanding metal sleeve masonry anchors, to the wall of the pit adjacent to the respective pumpset and such that they are clearly visible from the top of the pit.

The pump with the lowest serial number shall be the No 1 pump and shall be installed closest to the electrical switchboard, or in the case where pumps are equidistant from the switchboard, Pump Number 1 shall be the pump on the right hand side of the pit when viewed from the switchboard location.

14.5 Pressure Gauges and Tapping Points

Supply, per station, two (2) glycerine oil filled, direct mounting, bottom connection pressure gauges complying with AS 1349 and with 3/8" (DN 10) BSPM connections.

The gauge face shall be 100 mm in diameter and calibrated in metres head of water. The gauge range is shown on the electrical drawing titled "Station Control Schematic".

Install two (2) tappings, one (1) in a suction pipe and one (1) in a delivery pipe. Fit each tapping with a 3/8" (DN 10) BSP bronze, brass or stainless steel tee. In accordance with the Drawings, provide and install isolating 3/8" BSP stainless steel or bronze ball valves together with bronze, brass or stainless steel fittings as required to complete installation and connect each tee branch to the respective suction and delivery pressure switch and pressure transmitter using 10 mm black flexible pressure tubing (Nylex Nylon II or similar).

Install the appropriate pressure gauge on the respective suction and delivery tees.

15. METALWORK

15.1 Steelwork

Use Grade 250 steel in accordance with AS/NZS 3678, and AS/NZS 3679. Fabricate in accordance with AS 4100. Round all cut edges to 2 mm radius.

Except where otherwise noted on the Drawings, hot dip galvanise all steelwork after fabrication, all in accordance with AS 1650. Do not weld galvanised components after galvanising.

Prior to galvanising, clean the steelwork surface of all dirt, weld spatter, grease, slag, oil, paint or other deleterious matter and chemically descale in accordance with AS 1627 Part 5, or abrasive blast clean in accordance with AS 1627 Part 4 to Class 3 standard.

The zinc coating shall consist of a uniform layer of commercially pure zinc free from abrasion, cracks, blisters, chemical spots or other imperfections and shall adhere firmly to the surface of the steel. The thickness of zinc coating shall not be less than 100 microns at any point.

Any surface damage to the galvanising shall be shot or grit blasted clean and given two coats of Amercoat No 62 primer. Apply the second coat after the first coat is touch dry and within twenty-four hours of application of the first coat.

Where site welding of galvanised steelwork has been approved, the resulting weldment is to be chipped and cleaned to bare metal and painted with Galment zinc enriched paint.

15.2 Aluminium Components

Aluminium components shall be grade 6061, 6063, 6351, 5083 or 5251. Fabricate in accordance with AS 1664 and AS 1665. Apply two coats of bituminous paint to surfaces of aluminium components in contact with concrete.

15.3 Stainless Steel Components

Stainless steel shall conform to AS 2837 type 302, 304, 304L, 316, 321 or SAF2304.. The free machining type 303 is not acceptable.

Passivate all stainless steel components in accordance with Standard Technical Specification STS100.

15.4 Fasteners

All nuts, bolts and washers shall be in accordance with AS/NZS 1111 and AS/NZS 1112 or AS/NZS 1252. All exposed boltheads and nuts shall be hexagonal and the length of all bolts shall be such that bolted connections shall have a minimum of 2.5 threads and a maximum of 5 threads protruding from the nut.

Use washers under all nuts. In addition, use washers under bolt heads for connection to items with protective coatings.

Where stainless steel fasteners are used to fasten galvanised items, install high strength fibre or phenolic insulating washers and sleeves between the stainless steel washers / bolts and the galvanised item being fixed or jointed.

All anchors, bolts, nuts and washers either embedded in concrete or within the pump pit shall be of Grade 316 stainless steel to AS 2837.

All bolts, nuts and washers used in the fabrication and/or installation of stainless steel items shall be of stainless steel and of similar grades to the items being fixed or jointed. All other steel anchors, bolts, washers and nuts shall be hot dip galvanised in accordance with AS 1650. In addition, coat all nuts and bolts which are to be installed in ground, except Grade 316 stainless steel, with Denso 300 Primer and 400 Mastic/440 Cord, then wrap the entire joint in Denso 600 Tape (double thickness) and over wrap with Denso 931 Overwrap (minimum 55% overlap), all in accordance with the Manufacturer's recommendations. Grade 316 stainless steel to AS 2837 is an acceptable alternative to hot dip galvanised steel.

Apply loctite nickel anti-seize thread lubricant to the threads of all stainless steel nuts and bolts prior to assembly.

16. ACCESS ROAD AND HARDSTAND AREA

16.1 General

Provide a minimum 200 mm compacted pavement constructed to grade and levels as shown on the Drawings.

If shown on the Drawings provide a bituminous seal or asphaltic concrete seal in accordance with clause 16.4 or 16.5.

16.2 Subgrade

The subgrade is defined as the top 300 mm of the earth formation immediately below the paved area and extending 150 mm beyond the defined access road or hardstand dimensions.

Consolidate the subgrade, at optimum moisture content, to give a dry density ratio according to AS 1289.5.4.1 of not less than 98% standard based on the field dry density determined in accordance with AS 1289.5.3.1 and the compaction test in accordance with AS 1289.5.1.1 (Standard).

16.3 Basecourse

Construct the 200 mm basecourse layer for the access road and hardstand area in accordance with Roads and Traffic Authority NSW Specifications for The Construction of Natural Gravel or

Crushed Rock Road Pavement (Bitumen Surfaced) (MR Form No 743) or The Construction or Resheeting of Natural Gravel or Crushed Rock Road Pavement (Not Bitumen Surfaced) (MR Form No 800).

For bitumen surfaced pavements the material shall meet the requirements of MR Form No 743 Table 2 Class A nominal size 20 mm. For unsealed pavements the material shall meet the requirements of MR Form No 800 Appendix 1.

Supply a test certificate from a NATA registered laboratory certifying the proposed material complies with the requirements of clause 16.3.

The basecourse shall be compacted at a moisture content within plus or minus 2 % of optimum in layers not exceeding 150 mm loose thickness to obtain a dry density ratio according to AS 1289.5.4.1 of not less than 100% standard based on the field dry density determined in accordance with AS 1289.5.3.1 and the compaction test in accordance with AS 1289.5.1.1 (Standard) to a finished pavement thickness of 200 mm.

16.4 Sprayed Bituminous Sealing

If required apply a two coat hot bitumen and aggregate seal to the prepared surface of the pavement after the application of a prime coat. The work shall be carried out in accordance with the Roads and Traffic Authority of NSW Specification for Sprayed Bituminous Surfacing (MR Form No 93) and as specified below.

The work shall consist of

- Spraying of primer at 1.00 Litres per square metre of pavement surface.
- Precoating of aggregate at 8.5 litres per cubic metre.
- The spraying of hot bitumen at a uniform rate of 1.36 litres per square metre of pavement surface followed by the application of 14 mm precoated aggregate at a uniform rate of 1 cubic metre to 75 square metres of pavement surface.
- The spraying of hot bitumen at a uniform rate of 1.1 litres per square metre of pavement surface followed by the application of 10 mm precoated aggregate at a uniform rate of 1 cubic metre to 110 square metres of pavement surface.
- The rolling and incorporation of the aggregate.

The application of the second coat of bitumen and the subsequent placement of 10 mm precoated metal shall take place immediately after incorporation of the first coat of aggregate.

Materials shall comply with the following :

- Bitumen shall conform to the Roads and Traffic Authority of NSW Specification for Residual Bitumen (MR Form No 337) for Class 170 Bitumen and AS 2008.
- Cover aggregate shall conform to the Roads and Traffic Authority NSW Specification for Supply and Delivery of Cover Aggregate (MR Form No 351).

16.5 Asphaltic Concrete

If required, or as an alternative to sprayed bituminous seal to clause 16.4, apply an asphaltic concrete seal to the prepared surface of the pavement in accordance with Roads and Traffic Authority NSW Specification for Supplying and Laying Asphaltic Concrete (MR Form No 612) with the following requirements :

- | | |
|---------------------------------|-------|
| (a) Class of Bitumen | 170 |
| (b) Nominal size mix | 10 mm |
| (c) Minimum Compacted thickness | 25 mm |
| (d) Pavement Category | A |

16.6 Timber Guardrail

Construct timber guardrails from Koppers Tanalith logs to AS 1604 with post spacing, post diameter, post embedment and rail diameter as shown on the drawings. Use Brand No. H5 logs to the requirements of AS 1604 Hazard Level 5 protection. The rails shall be suitably scarfed and fixed by a 16 mm galvanised bolt at each post.

Where details are not shown on the Drawings dimensions shall be in accordance with the following table.

Post Diameter (mm)	Post Spacing (mm)	Post Hole Diameter (mm)	Post Embedment (mm)	Top of Rail above Finished Ground Level (mm)	Rail Diameter (mm)
150	1800	400	900	700	125

Backfill the post hole with concrete of Grade N20.

Protect all treated timber surfaces which have been cut or machined including scarfed and drilled surfaces by applying, in accordance with Manufacturer's instructions:

- (a) above ground - Koppers Reseal
- (b) below ground - Koppers CN Emulsion

17. RETAINING WALLS

17.1 Retaining Walls - Timber Cantilever

17.1.1 General

Construct timber walls from Koppers Tanalith logs to AS 1604 with post spacing, post diameter, post embedment and waling size as shown on the drawings. Use Brand No. H5 logs to the requirements of AS 1604 Hazard Level 5 protection.

Where details are not shown on the Drawings dimensions shall be in accordance with the following table:

Retained Height (m)	Post Diameter (mm)	Post Spacing (m)	Post Hole Diameter (mm)	Post Embedment (m)	Waling Slabs (mm)
0.3	75	1.8	200	0.7	100
0.6	125	1.8	400	1.0	100
0.9	175	1.8	400	1.4	100
1.2	225	1.5	400	1.8	100
1.5	250	1.2	450	2.0	100

Rake the posts back towards the retained material at an angle of 5 degrees from vertical.

Backfill the post hole with concrete of Grade N20. Where posts are embedded in sound unfractured rock the minimum embedment may be reduced to 500 mm.

Use 100 mm high slab walings. Scarf walings at either end to ensure even bearing on the posts. Fix the top row of walings with 100 mm long galvanised bridge spikes.

Backfill the post hole with concrete of Grade N20.

Protect all treated timber surfaces which have been cut or machined including scarfed and drilled surfaces by applying, in accordance with Manufacturer's instructions:

- (a) above ground - Koppers Reseal
- (b) below ground - Koppers CN Emulsion

Line the internal or loaded face of the retaining wall with a geotextile membrane, Terra Firma Grade 1000, from the top waling to a minimum depth of 150 mm below the bottom waling.

17.1.2 Handrails

Provide a handrail 900 mm above ground level along the full length of all retaining walls higher than 600 mm. Use a 125 mm diameter log, suitably scarfed and fixed by a 16 mm galvanised bolt at each post.

17.2 Retaining Walls - Concrete - Crib Wall

17.2.1 General

Construct from Humes Crib Wall components (or approved equivalent) in accordance with the Manufacturer's guidelines.

Course height shall be 250 mm, header spacing shall be 1000 mm, header length shall be 900 mm unless detailed otherwise on the Drawings and batter shall be 1 in 4.

17.2.2 Foundations

Where the wall is to be founded on bedrock remove all vegetation, loose rock, soil, clay and friable weathered rock. Fill any irregularities with mass concrete.. Ensure that the wall is founded on intact bedrock and not on a foundation of floaters. Do not support a wall on undercut material.

Where the wall will be founded on soil, any material containing a high proportion of organic material shall be stripped, the exposed foundation shall be scarified to a minimum depth of 200 mm, brought to near the Standard Optimum Moisture Content (AS 1289.5.1.1) and compacted to a minimum dry density ratio (AS 1289.5.4.1) of 95% Standard (AS 1289.5.1.1). All fill should be placed in layers with a maximum loose thickness of 250 mm and compacted in the manner described above.

Slope the foundation surface to ensure the required batter.

Approval of the foundation shall be required prior to placement of the wall materials.

Where the wall is to be founded on bedrock, the base of the wall shall be at a level which is a minimum depth of 250 mm below the finished surface level at the toe of the wall.

Where a wall, is to be founded on soil, the base of the wall shall be at a level which is a minimum depth of 450 mm below the finished surface level at the toe of the wall.

Provide a continuous base of 250 mm thick S32 concrete reinforced with 2 layers of F81 fabric. Step the base where required in increments of 250 mm.

Where pipes are to pass beneath the wall they shall be encased in concrete.

17.2.3 Cribfill and Backfill

Use crushed rock with maximum particle size 75 mm for fill material in the wall (Cribfill).

Use granular material consisting of sand, crushed rock, slag, skulls, ripped sandstone for backfilling behind the wall.

Do not use clay material as fill material in the wall or backfill material within 500 mm of the rear of the wall.

Compaction of fill placed behind the wall shall be carefully carried out to minimise the induced lateral stress against the wall.

Place fill in layers with a maximum loose thickness of 250 mm and compact to a dry density ratio (AS 1289.5.4.1) of not less than 95% Standard Compaction (AS 1289.5.1.1).

Where pavement construction is to take place using the backfill as subgrade material, compact in accordance with the requirements of clause 16.2.

17.2.4 Drainage

Install a 160 mm diameter subsoil drain with filter sock at the rear of the wall foundation.

Direct all surface runoff away from the back of the wall so as to prevent infiltration of such surface runoff into the granular backfill. Direct the surface runoff so as to prevent erosion and possible undercutting along the toe of the wall. Ensure that water does not pond at the toe of the finished wall.

17.2.5 Handrail

Provide a handrail 900 mm above ground level along the full length of all retaining walls higher than 600 mm. Construct the handrail from Koppers Tanalith logs to AS 1604 with post spacing, post diameter, post embedment and rail diameter as shown on the Drawings. Use Brand No. H5 logs to the requirements of AS 1604 Hazard Level 5 protection. Suitably scarf the rails and fix at each post with a 16 mm galvanised bolt.

Where details are not shown on the Drawings dimensions shall be in accordance with the following table.

Post Diameter (mm)	Post Spacing (mm)	Post Hole Diameter (mm)	Post Embedment (mm)	Rail Diameter (mm)
125	1800	400	1000	125

Backfill the post hole with concrete of Grade N20.

Protect all treated timber surfaces which have been cut or machined including scarfed and drilled surfaces by applying, in accordance with Manufacturer’s instructions:

- (a) above ground - Koppers Reseal
- (b) below ground - Koppers CN Emulsion

18. RESTORATION

18.1 General

Restore as near as practicable to their pre-existing condition, all surfaces, services and/or improvements disturbed, destroyed, removed or damaged during construction of the Works and during installation of temporary works such as access roads. Improvements shall be deemed to include trees and shrubs, mulched areas, gardens, paving, flagging, proprietary finished areas such as 'pebble crete' and the like, retaining walls, fences and all other structures.

When necessary for the restoration of surfaces, stockpile existing topsoil separately and replace it over the areas where it was previously located when completing backfilling operations. Where there is a shortfall of existing topsoil use approved imported topsoil.

18.2 Timing of Restoration

Undertake restoration to surfaces, services and improvements progressively as the work proceeds. At all times ensure that services are maintained. Complete restoration and repair work within five calendar days after completion of backfilling of each section of the Works unless specifically stated otherwise elsewhere.

Undertake any maintenance of the restoration within two calendar days of the need for such maintenance becoming apparent.

18.3 Pavements

Immediately after backfilling of a trench excavated through a pavement, temporarily restore the surface and maintain it in a trafficable condition until final restoration is completed. Where the original pavement was bitumen or asphalt use a pre-mixed asphaltic material for the temporary restoration. Otherwise use crushed metal or gravel. Complete final restoration of pavements within one month of temporary restoration.

18.4 Turf

Restore areas of established well maintained lawns to the full limits of the disturbed area with approved imported turf. Restoration using sods removed prior to construction will only be approved if the sods are of equivalent standard to imported turf. Also use turf to restore areas where there is significant risk of erosion such as on steep or long slopes.

Following backfilling and initial settlement spread and grade topsoil to achieve a smooth surface free from lumps, stones or other debris and blending into the levels and shapes of the adjoining undisturbed ground allowing for the turf. Mix an approved fertiliser of N:P:K ratio of 10:4:6 (equivalent to "Mulitgro") into the topsoil at a rate of 40g/m².

Lay the turf without gaps on the prepared topsoil surface and lightly top dress and compact. Water regularly until regrowth is established.

18.5 Grassed Areas

For grassed areas not requiring restoration with turf, restore by replacing the pre-existing topsoil or approved imported topsoil, to a minimum thickness of 50 mm. Seed the affected area with grass seeds of the varieties prevalent in the immediate area. Water and maintain the disturbed area until regrowth is established.

If regrowth fails to occur within six weeks of restoration, reseed and maintain until regrowth is established.

18.6 Trees

Where Council or private landowners require replacement trees to be planted, provide suitable trees. Where such replacement trees will be adjacent to a sewer, provide trees suitable for planting adjacent to the sewer as detailed in Hunter Water Corporation's publication entitled "Tree Roots".

18.7 Provision for Settlement

Make good any settlement of the trench during the Defects Liability Period by placing additional approved fill such that the finished surface level conforms with the adjacent surface.

For trenches through other than pavements, turf areas, grassed areas or other improved surfaces, backfill may be placed sufficiently high to compensate for expected settlement unless it would create a hazard or inconvenience to the public. At the end of the Defects Liability Period, trim back such excess material to conform with the adjacent surface and dispose of the surplus.

18.8 Tunnelling

Where tunnelling has been used in lieu of trenching to avoid improved surfaces, backfill such as to restore full support to the surface. Repair any damage to the improved surface which occurs at anytime due to subsidence of the backfill.

18.9 Maintenance of Restored Surfaces

Maintain all restored surfaces and improvements in a satisfactory condition until expiry of the Defects Liability period notwithstanding that any deterioration, and the need for their maintenance, may or may not be due to defects which become apparent or arise from events which occur during that period.

18.10 Certification

Submit certificates issued by the relevant public authorities certifying that all roads, footpaths and surfaces in public places under their control have been satisfactorily restored. Notwithstanding any other provision, the Defects Liability Period shall not be completed until such certification is submitted unless it is agreed that the public authority has unreasonably withheld issue of the certificate. The issue of such certificates shall not relieve any responsibility for any defect.

19. CONNECTION TO EXISTING WATERMANS

Only undertake connection to existing live watermains on completion of all other Works. Give written notice, including full details of the proposed connection procedures, 10 working days prior to making the connection and comply with any directions regarding the method and timing of the connection which are necessary to meet operational needs of the existing water supply system.

Perform the connection on the approved date and at the approved time. Do not commence the connection work unless all necessary materials and equipment are available on site. Undertake all work so as to minimise interruption to the operation of the existing water supply system.

Arrange for the Corporation to shutdown the existing watermains to allow connection. Shutdown of the Corporation's existing mains may not completely prevent the inflow of water into the sections isolated.

20. ACCEPTANCE TESTING

20.1 General

Undertake acceptance testing of the pumping station pit and all pipelines constructed. Acceptance testing may be done progressively, but must be no earlier than 7 days after completion of the structure or pipeline section to be tested. Give 48 hours notice before commencement of acceptance testing. Ensure that structures and pipes are clean before any test is performed. Do not pressure test during wet weather.

If any of the tests prove to be unsatisfactory, detect and repair the fault and then re-test. Continue to repair and re-test until a satisfactory test is obtained. Even if testing produces satisfactory test results, repair any structure, pipeline or conduit in which there is a visible or detectable leak or blockage.

20.2 Acceptance Testing of Pressure Pipelines

Test all pressure pipelines constructed in accordance with clause 13 of STS401.

21. COMMISSIONING OF PUMPING STATION

21.1 Requirements

All materials, equipment, installation and workmanship included in the Works covered by this Specification shall be tested and/or inspected to prove compliance with the Specification requirements.

Tests and inspections shall comply with current relevant Australian Standards.

Testing shall include pre-commissioning, field testing and performance testing of each part of the whole installation.

21.2 Pre-commissioning

Pre-commissioning is the preparation of plant or equipment so that it is in a safe and proper condition and ready for commissioning and operation. It includes all aspects of plant operation such as safety, electrical, mechanical and instrumentation.

Pre-commissioning shall be conducted in a logical sequence in accordance with an approved program.

The Contractor shall prepare pre-commissioning record sheets for each item of equipment to ensure results of tests are satisfactorily recorded and that all necessary checks or tests have been performed.

Specific requirements for pre-commissioning shall include but are not limited to:-

- (a) Initial charges of lubricant in addition to any special lubricant requirements for initial flushing or treatment of the system or for "running in".
- (b) Physical checks and tests such as completeness of assembly, rotational tests (including checking that the rotation of electrical motors is in the correct direction), alignment checks, balancing and vibration checks, temperature, pressure and flow measurements, clearances, belt alignment and tension, etc., depending on the type of equipment.
- (c) Electrical and instrument installation tests, including motor insulation tests and checking instruments against certified instruments and correcting as necessary.
- (d) Tests of the correct functioning of automatic and manual control and protection equipment, including simulating danger conditions, mal-operations or failures, to check that all instruments and controls function correctly.
- (e) These tests shall also include adjusting instrument set points and alarm settings and proving correct operation of alarms.
- (f) Equipment and system operating tests and scheduled items in Appendix A. Certify compliance of each item in Appendix A and submit a signed copy prior to commissioning.

Pre-commissioning tests shall be carried out under the Supervision and to the satisfaction of the Hunter Water Corporation and shall be recorded on the appropriate Pre-commissioning Record Sheet.

Submit one signed copy of each completed Pre-commissioning Record Sheet countersigned by the Hunter Water Corporation's Representative who witnessed the test.

21.3 Commissioning

Commissioning is the running of the plant and equipment to ensure flow through the pumping system, carrying out any necessary testing and adjustments until it is ready and suitable for normal starting and running under service conditions.

Representatives of the Hunter Water Corporation will participate in the tests and may elect to record an independent set of test results for evaluation. The Hunter Water Corporation shall require a period of five (5) working days notice to undertake testing.

Commissioning shall be conducted in a logical sequence in accordance with an approved program based on Appendix B, Commissioning Schedule.

Throughout commissioning the Contractor shall be responsible for the test program.

Provide continuous supervision by personnel experienced in the operation of the equipment and have qualified personnel in attendance to carry out all necessary adjustments and/or remedial work during the commissioning tests.

21.4 Testing and Commission Documentation

Prepare schedules, test record sheets and programmes for acceptance by the Superintendent prior to each stage of the overall commissioning.

These documents are required to satisfy the Superintendent that a properly recorded logical comprehensive test programme has been carried out.

22. WORK-AS-EXECUTED DETAILS

Provide Work-As-Executed details in accordance with STS903 at least ten (10) working days prior to the date of commissioning.

23. OPERATION AND MAINTENANCE INFORMATION

23.1 Manuals

Clause 23.1 applies if no Operation and Information Package has been provided by Hunter Water Corporation.

Provide four (4) copies of Operations and Maintenance Manuals including lubrication charts and trouble-shooting instructions for the whole of the equipment including soft starters if used. Submit Operations and Maintenance Manuals to the Superintendent at least ten (10) working days prior to the date of commissioning.

The installation, operation and maintenance instructions must be relevant to the actual machinery supplied under this Contract. Identify all parts requiring maintenance and clearly state the type and frequency of recommended maintenance. Installation, operation and maintenance instructions that are of a general nature are not acceptable.

Each copy must be assembled between a set of durable hardcovers suitably labelled and securely fastened. The method of binding must provide a secure system of fastening pages and allow manuals to lay open whilst in use and permit pages to be easily replaced and / or added.

In addition to the requirements set out above the manuals shall include:-

(a) General

Contractors name, address and telephone number

Client contract number

Job name

Pumping station general arrangement drawing of pumps, motors and pipework.

Work as executed electrical installation drawings prepared in accordance with clause 27.19.

(b) Pumps

Manufacturer

Type and model number

Serial numbers

Typical performance curves

General arrangement drawing of pump and discharge bend assembly (dimensioned)

Section arrangement drawing with parts and material list.

(c) Motors

Manufacturer

Type and model number

Serial numbers

Dimensioned arrangement drawing

Sectional arrangement drawing with parts and material list

(d) Test Curves (where applicable)

Pump certified test curves

Test result log sheet

Motor test curves

Motor torque/speed/efficiency characteristics curves

(e) A Description of Operation

(f) Installation Instructions

(g) Start Up/Shut Down Procedures

(h) Maintenance Information

Trouble shooting instructions for pump and motors.

Step by step procedures for dismantling and reassembly of pumps and motors using any special tools shall be detailed together with step by step procedures for replacement of wearing parts such as bearings, seals, wear rings, etc.

Drawings as scheduled and any other drawing necessary for complete understanding of installation, operation and maintenance.

Log sheets and maintenance inspection sheets for use by operations and maintenance staff detailing routine monitoring, inspection and maintenance requirements and frequency thereof.

23.2 Information Package

Clause 23.2 applies if an Operation and Information Package has been provided by Hunter Water Corporation.

The electronic Operation and Information Package provided lists all of the information required to allow the ongoing operation and maintenance of the Works. Some of the required information has been prepared by the designers and is included in the package.

Prepare all of the information indicated in the package to be provided by the 'Installation Contractor', append it to the package in the form indicated, and submit the complete package at least ten (10) working days prior to the date of commissioning.

24. ELECTRICAL WORKS - GENERAL

24.1 General

This Electrical Specification comprises four (4) sections:-

- Clause 24 - Electrical Works - General
- Clause 24 - Electrical Equipment Manufacture and Supply
- Clause 26 - Electrical Equipment Installation
- Clause 27 - Telemetry Design and Installation

24.2 Extent of Work

Clauses 24, 25, 26 and 27 detail requirements for design, manufacture, works testing, supply, delivery to site, installation, pre-commissioning of electrical switchboards and associated electrical and telemetry equipment and rectification of defects during defects liability period.

Provide everything necessary or usually supplied so that the installation will be satisfactory for the service conditions specified and for its safe operation.

24.3 Design Approval

All switchboard design and electrical installation design drawings and material lists shall be approved by Hunter Water Corporation prior to calling of tenders.

24.4 Selected Subcontracts

The electrical works are in three (3) parts, all parts are to be by Selected Subcontract.

Only firms on the "approved" lists should be invited to submit quotations for the separable portions.

The names of each of the Selected Subcontractors shall be submitted to the Superintendent 28 days prior to the commencement of any work by the Selected Subcontractors.

The three (3) Parts are detailed in clauses 24.5, 24.6 and 24.7 below:

24.5 Part A - Work to be carried out by Selected Subcontract No. 1 - Manufacture and Supply of Electrical Equipment

Manufacture of Electrical Switchboard for the pumping station in accordance with the approved detailed design Drawings and the specification.

Provide pressure monitoring and control equipment for each pumping station.

Provide works testing for Electrical Switchboards.

Carry out all other work as detailed in clause 25.

24.6 Part B - Work to be carried out by Selected Subcontract No. 2 - Installation of Electrical Equipment

Advise Supply Authority of all wiring, load requirements and submit all test requests.

Take delivery and install the Electrical Switchboard.

Determine final size of consumer mains.

Supply and install consumers mains including consumers poles if required and earthing system.

Install pressure monitoring and control equipment.

Supply install and terminate the pump cables and control cables.

Install electricity metering equipment as provided to the requirements of the Supply Authority.

Carry out all other work detailed in clause 26.

24.7 Part C - Work to be carried out by Selected Subcontract No. 3 - Design and Installation of Telemetry System

Install telemetry radio, antenna, surge protection and all associated cabling between the RTU within the switchboard and the antenna.

Design, install, commission and document the PLC program.

Configure Hunter Water Corporation's SCADA database.

Commission the station telemetry system and calibrate pressure switches and pressure transmitters.

The range and settings for the pressure switches and pressure transmitters is shown on the electrical drawing titled "Station Control Schematic".

Carry out all other work detailed in clause 27.

24.8 General Technical Requirements

The Hunter Water Corporation's General Requirements for Electrical Installations EIS-91 as amended hereinafter and elsewhere in this Specification, forms part of this Specification.

The Hunter Water Corporation's Special Requirements for Water Booster Pumping Stations EIS-91/A2 as amended hereinafter and elsewhere in this Specification, forms part of this Specification.

Where EIS-91 or EIS-91/A2 describes more than one material or method of installation, that which is indicated in this specification or on the drawings shall apply.

Should any part of this specification or the Drawings conflict with EIS-91 or EIS-91/A2 then the requirements of this specification or the drawings shall take precedence over the corresponding requirement of EIS-91 or EIS-91/A2.

24.9 Compliance with Authorities, Statutes, Regulations and Standards

24.9.1 General

Except where EIS-91, EIS-91/A2 or this specification requires a higher standard, carry out the Works in accordance with the current edition of AS 3000, the Service Rules of the Supply Authority, the requirements of the Australian Communications Authority and the requirements of all relevant Statutory Authorities.

Where reference is made to standard specifications, use the current edition (as amended) of the specification at the date of tendering.

References throughout this specification to particular clauses of any standard shall not relieve the Contractor of responsibility to comply with all clauses, where applicable.

Proof of compliance with a standard or specified test may be required. Where requested, such proof shall comprise a test certificate from an approved independent testing authority.

Arrange for each Authority having jurisdiction to inspect and check the works. Advise the Superintendent at least five (5) working days in advance of the date any inspection is to take place.

All electrical installation work shall be carried out by or under the constant personal supervision of a person holding a Qualified Supervisor Certificate - Electrician issued under Building Services Corporation Regulations, 1990.

24.9.2 Safety in Work

All moving, dangerous or hazardous parts of machinery and all excavations shall be guarded, fenced or otherwise enclosed to the requirements of the Workcover Authority of NSW.

Ensure that all work is carried out in accordance with the requirements of the Occupational Health and Safety Act 1983.

24.9.3 Notification of Electrical Work

One copy of each "Notification of Electrical Work" shall be forwarded to the Superintendent at the time of submission to the Supply Authority.

24.10 Supply Authority

The Supply Authority for electrical work in this area is Energy Australia. Enquires may be referred to the Wallsend office on (049) 519555.

25. PART A - SELECTED SUBCONTRACT No 1 - MANUFACTURE AND SUPPLY OF ELECTRICAL EQUIPMENT

25.1 General Requirements

Comply with the requirements of clause 24.

Do not make any amendments during construction without obtaining prior written approval from the Hunter Water Corporation. On completion of the Contract, include any such amendments on "Work as Executed Drawings".

Ambient conditions will be within the limits of 0°C to 45°C.

The switchboards will be connected to the Supply Authority Supply System.

Nominal system parameters: 415 Volt, 3-phase, 4-wire, 50 Hz, multiple earthed neutral (MEN) system.

Prospective Fault Current for each installation is to be shown on the respective power circuit diagrams. Confirm these fault levels with the Supply Authority.

25.2 Equipment Rating

Any equipment ratings shown on equipment schedules or drawings are based on estimated kW ratings of the water booster pumps or other mechanical equipment.

Confirm and use the actual kW ratings to size equipment including motor starters and cabling, with the equipment schedules and drawings modified accordingly where ratings are different.

Where future upgrading of the pumps is nominated in the Specification, the switchgear shall be suitable for the final pump ratings with motor protection devices installed or set for the initial lower ratings.

Confirm the ultimate number of pumps, the actual kilowatt rating and starting method and determine the rating of the electrical switchboard and switchgear required, prior to manufacture of switchgear or commencing installation.

For Duplex pumping stations the equipment is to be sized to enable both water booster pumps to operate together.

For pumping stations other than Duplex the equipment is to be sized to enable one (1) less than the installed number of water booster pumps to operate together.

25.3 Scope of Supply

Supply all switchboards, control panels, pressure monitoring and control devices required for each station. The range and settings for the pressure switches and pressure transmitters is shown on the electrical drawing titled “Station Control Schematic”.

The switchboard(s) shall be complete with circuit breakers, contactors, fuses, soft starters, relays, timers, instruments and accessories as detailed in this specification and associated drawings. Include those items usually required with switchgear of this type and which may not be specifically defined.

25.4 Provision of Plinths

Liaise with civil designer to ensure that the civil works will be adequate for the switchboards.

Construct the cabinet base 25 mm smaller than the concrete plinth on all sides.

25.5 Switchboard Details

25.5.1 General

In addition to the requirements of AS/NZS 3000:2000, live parts within the switchboard including equipment mounted on the doors shall be behind barriers that provide a degree of protection of at least:

- (a) IPXXB or IP2X, and
- (b) IPXXD or IP4X for horizontal top surfaces that are readily accessible.

Barriers are to be designed to facilitate safe testing within the switchboard. Removal of a barrier to facilitate a test should not unnecessarily expose the tester to live parts.

For circuit breakers shrouding should also incorporate interpole barriers to prevent arcing between phases.

Manufacture cabinets, covers and doors from marine grade aluminium not less than 2.5 mm thick and of grade as shown on the Drawings. Alternatively manufacture from 2.0 mm thick grade 316 stainless steel sheet

Do not exceed overall dimensions shown on the Drawings.

Cabinets shall be all-welded construction with sheets bent to minimise the number of welded joints. Bends in aluminium sheets shall be of adequate radius to prevent cracking. Round all edges to remove sharp or irregular projections. All welds shall be ground smooth.

Passivate all stainless steel components in accordance with STS100.

Seal the switchboard to protection class IP 55. Dust seals shall consist of neoprene extrusion with internal gripping device to hold the seal onto the metal edge.

The metering compartment shall comply with the standard requirements of the Supply Authority particularly in regard to current transformers, potential fuses, test links, spacing, etc. Submit the general arrangement drawing, together with metering component details to the Supply Authority for approval, prior to construction.

The switchboard shall be suitable for bottom cable entry. Provide gland plates, manufactured from aluminium or other non-magnetic material, in the bottom on each section for cable entry. The gland plates are required to provide access to both sides of the cable glands and to provide a means to facilitate pulling cables into cubicles. Access for all cabling and routine maintenance shall be from the front only.

Fix surface mounted equipment, installed within the cubicle, on 3 mm sheet steel mounting plates, metal mounting rails or insulated panels as shown on the switchboard layout drawing and ensure

equipment is suitable for front connection. Paint steel mounting plates in accordance with clause 25.11.

Bolt all equipment mounting plates to heavy duty angle supports or plates welded to the cabinet sides.

Flush mounted equipment mounted on the inner hinged door is to be arranged so that it does not foul on the door openings when the door or panels are swung fully open.

25.5.2 Locks and Hinges

Fit all external doors exceeding 1.2 metres in height with 3 hinges and 3 point locking mechanisms with suitable operating handle. The rods shall be held securely in the handle mechanism. Provide suitable guides on the door near the end of each locking rod.

Fit external doors of outdoor cabinets with padlockable vandal proof handles.

Where nominated, fit internal doors with nightlatch and provision for "81/3" key cylinder.

25.6 Main Circuits

All main circuit wiring and busbars shall be arranged and colour coded Red, White, Blue, Black from left to right, top to bottom or front to rear as viewed from the front of the switchboard.

All connections on the line side of the protective device in each incoming and outgoing functional unit shall be shrouded or insulated so as to prevent the possibility of a line side fault developing and to provide personnel protection.

Main power cables shall be coloured red, white, blue, black over their full length, or where such colouring is not available, shall be coded at each end by coloured heatshrink.

Number each power cable by the same method as control wiring.

Terminate all power cables with crimp lugs.

Where parallel cables may be installed on site, (ie, pump motors and large consumer mains), make provision to ensure only one cable lug needs to be installed on each side of each terminal lug.

Where required, provide busbar flags of sufficient rating and clearance, at the termination point, to terminate the required number of cables.

Inspect and test all circuit connections in accordance with AS/NZS3000:2000, Clause 1.11.2.5, to ensure that there is no interconnection of conductors between different circuits. In particular, a separate neutral conductor is required for each active circuit, ie common neutrals are not permitted.

25.7 Control Circuit Wiring

Control circuit wiring shall be flexible PVC coated, of minimum size 1.5 sq mm copper conductors with 250 V grade insulation.

Bush all holes through partitions where wiring passes through. Cable looms to hinged panels and doors to be effectively bushed where loom passes over mullion and door edges.

Bush all metal edges in contact with cables.

Cable primary insulation shall be coloured in accordance with the following:

Phase wiring (A, B and C) - red, white, blue & black

Voltmeter and current transformer primary connections - red, white, blue & black

240 V and 110 V ac control active (controlled by isolator or fuse in the immediate compartment) - white

240V and 110V ac control active (not controlled by isolator or fuse in the immediate compartment) - orange

240V and 110V ac control neutral - black

Extra Low Voltage dc positive and Analog (4-20mA dc) positive - brown

Extra Low Voltage dc negative and Analog (4-20mA dc) negative - grey

Extra Low Voltage devices (eg. thermistor, seal failure probe, flood level regulator) - blue

Earth - green/yellow

For Analog loop wiring, the wire connecting the dc supply negative or the transmitter source negative to the last load device, shall be classified as 'negative'. Classify all other wires as 'positive'.

Colour coding for voltages other than the above shall be referred to the Superintendent for a determination prior to installation.

Do not install data cables in wiring ducts or channels with wiring operating at voltages in excess of Extra Low Voltage except where the data cables are double insulated. Data cables shall comply with the requirements of the Australian Communications Authority.

25.8 Earthing

Solidly bond all exposed metal parts to the earth link. For earth continuity, place serrated washers under bolt heads and nuts of all painted, structural, metal-to-metal joints.

Individually bond all motor earth terminals to the earth bar with copper conductors sized according to the motor cabling requirements.

Where Rail Mounted Earth Terminals are not mounted on aluminium or copper rails, individually bond each terminal to the earth bar with a suitably rated copper conductor.

Bond the following equipment to the switchboard earth bar with suitably rated copper conductors:

- (a) external switchgear enclosure
- (b) PLC backframes,
- (c) electronic variable frequency drive units,
- (d) soft starters,

Bond all metal surfaces of equipment mounted on module doors to the earth bar.

Bond one side of each current transformer secondary to the earth bar.

25.9 Equipment Mounting

Mount all items of equipment using metric, zinc plated metal thread set screws, screwed into tapped holes. Mount small items such as relays and miniature circuit breakers on DIN35 mounting rail.

Terminal mounting rail, DIN35 mounting rail and plastic wiring duct, may be secured by self drilling/threading screws.

Do not use self tapping screws.

Provide a minimum of 25 mm between the terminal side of all relays and equipment and the adjacent wiring duct or equipment, to facilitate wiring.

Do not mount any equipment in front of other equipment.

All power wiring and terminals shall be physically segregated from control and instrumentation wiring and terminals.

Do not locate terminals within 250 mm of the base of the cubicle or 300 mm of the top of the cubicle.

Locate mains and motor terminals such as to provide easy access to outgoing terminations, with cable holes clearly visible.

25.10 Terminations

Provide power terminal blocks, of suitable rating, in the switchboard for the termination of the incoming field wiring. Provide control terminal blocks, minimum size 10 amps, in each cubicle for the termination of the incoming field wiring. Provide a separate terminal for every field cable core including spare cores. Terminate each core within a cable in consecutive terminals.

Fully identify all switchboard wiring at both ends of every wire with Grafoplast "Trasp" type ferrules numbered in accordance with the circuit diagrams. The numbers and characters shall be printed in a contrasting colour to the base colour of the marker.

Terminate control wiring, at each end, with a pre-insulated crimp lug or cable crimp sleeve.

Where two control wires are to be terminated in a single tunnel terminal, twist both wires together and crimp in a common crimp sleeve designed for the purpose.

Crimp all crimp sleeves and crimp lugs to the wire ends with a tool having a ratchet device to ensure full crimping before tool will release. Do not use crimp tools without ratchet devices, pliers or similar blade tools to secure sleeves or lugs to wires.

The entire metal surface of any crimp sleeve or lug shall be contained within the terminal shrouding and shall not be visible.

Do not use pin or blade type crimp lugs in tunnel type terminals.

25.11 Painting

25.11.1 General

With the exception of aluminium and stainless steel components, paint all equipment mounting panels.

25.11.2 Paint Materials

Use non-poisonous, lead-free synthetic products, conforming to the relevant Australian Standards and apply strictly in accordance with the manufacturer's recommendations.

25.11.3 Surface Preparation

Where the protective coating of any steel surface is removed through welding, grinding, etc., the standard of surface preparation shall be to AS 1627 with minimum power tool clean to grade "St 3", followed by the application of a cold galvanising compound.

Degrease all surfaces using solvent or alkaline solutions.

25.11.4 Painting and Finish

Apply one (1) coat of etch primer having a suitable corrosion inhibiting compound.

If required, apply a putty sealer rubbed back to cover major imperfections and undercoats rubbed back to cover minor imperfections. Apply undercoats as a base for the final coats unless otherwise recommended by the paint manufacturer.

Apply a full-gloss heat cured enamel or 2pack polyurethane paint in accordance with the manufacturer's recommendations to achieve a smooth finish with no noticeable imperfections.

The minimum thickness of the finish paint coating shall be 60 micrometres.

Minimum pencil lead hardness factor shall be "H" to AS/NZS 1580.405.1.

Colour for equipment mounting plates shall comply with AS 2700 and shall be Y 44 sand.

25.12 Equipment Requirements

25.12.1 Compliance

Select equipment from Hunter Water Corporation preferred electrical equipment lists which can be accessed on their website at www.hunterwater.com.au/standardssuppliers.asp. Where suitable equipment is not listed, submit full technical details of alternative items and obtain written approval prior to use.

Provide proof of compliance with the relevant Australian Standard if requested. Such proof shall comprise a complete Test Certificate from an accepted independent Testing Authority or a Certificate of Suitability issued by an Australian Electricity Authority.

Equipment shall be as detailed in EIS-91 and the following:

Power circuit breakers, when mounted behind a cubicle door, shall be arranged so that only the operating toggles protrude through the cubicle door. Operating toggles are to be drilled so that "Danger" and/or "Out of Service" stages can be attached.

All power circuit breakers must show a tripped condition by the mechanical movement of the operating toggle to the centre position.

Indicating lights with a circular bezel shall be suitable for mounting in a 22.5 mm diameter hole. Lamps shall be 6 volt Ba9s MCC type supplied from an inbuilt transformer.

External connections to the indicating lights shall be by screwed terminals.

Pushbuttons shall be suitable for mounting in a 22.5 mm diameter hole.

25.12.2 Equipment Availability

Do not use switchboard equipment unless spare parts are available from Newcastle distributors. Confirm and demonstrate that adequate stocks of replacement parts for proprietary equipment supplied and used in the manufacture of the switchboards (eg contactors, starters, relays, timers, indicating lamps, fuses, etc), as specified in the equipment schedules, are readily available from Distributors within the Newcastle area.

25.12.3 Equipment Supplied by Others

Metering Equipment - Supply Authority supply.

Obtain the kWh Metering Equipment direct from the Supply Authority.

25.12.4 Equipment Supplied by Others at the Contractor's expense

Lock Barrel - obtain from Hunter Water Corporation Ltd.

Notify the Hunter Water Corporation a minimum of fifteen (15) working days prior to requiring the 81/3 lock barrels.

25.12.5 Specific Requirements for Soft Starters

Soft starters (electronic) where used, shall be rated as follows for the required kW output of the motor.

(a) By-pass operation - 12 starts per hour

(b) Without By-pass operation - ie under manual operation - 4 starts per hour with a 5 minute maximum run time following each start

The disturbance to the electrical supply system when using soft starters shall not exceed the limits set down in AS 2279. Radio interference external to the soft starters shall not exceed the limits set down in AS/NZS 2064.

To reduce the possibility of radio interference the soft starters chassis and cubicle shall be bonded to earth with a larger than normal earth conductor - minimum of 20% above normal size.

Provide space in the starter cubicle to allow for the retrofitting of a suitable R.F.I. filter network except where the consumers supply is from a substation dedicated to the installation. Provide and fit a suitable R.F.I. filter network if, during commissioning, the operation of the soft starters causes radio interference in excess of the limits set down in AS/NZS 2064.

25.12.6 Swinghandle Mechanism

The swinghandle mechanism as detailed on the "Switchgear Details" drawings are obtainable from Selectrics Industries Pty Ltd - Punchbowl NSW (phone (02) 709 3754) or their Newcastle agents Specialised Wholesalers.

25.13 Labelling

25.13.1 General

Clearly and accurately label every item of equipment within or on the switchboard.

Provide a label, mounted adjacent to each fuse base, engraved with the fuse element rating.

Labels shall be engraved laminated plastic except where photo anodised rigid aluminium has been specified and shall comply with the following requirements:

- (a) Except where otherwise required, fix labels adjacent to, but not on any item of equipment. Do not fix labels to wiring duct or duct lid.
- (b) Engraved lettering shall be black on a white background, except that the label for a main switch shall have red lettering on a white background, and warning and caution labels shall have white lettering on a red background.
- (c) Labels fixed by double backed tape shall not be smaller than 45 mm x 16 mm.
- (d) The minimum height of lettering shall be 3 mm and of sufficient definition to allow easy reading.

Do not use self threading or self tapping screws to secure labels.

25.13.2 Incoming Mains and Pump and Motor Detail Labels

Supply and fix labels as detailed on the Drawings or in the specification.

The cable sizes shown on the "incoming mains" label are to be in accordance with the cables to be installed. Install this label in an accessible place adjacent to where the incoming mains enter the switchboard.

Complete the Pump and Motor Details Label from the information on the E86 form completed by the pump supplier. Install this label in the location as shown on the Drawings. The typical arrangement and content of the label is shown on Motor & Pump Details Label sheet for the respective switchboard Drawings.

25.13.3 Main Labels

The switchboard is to have three (3) main labels worded respectively \diamond WATER PUMPING STATION. Labels are to be on 1.6 mm silver anodised aluminium sheet filled with black enamel. Lettering is to be 9 mm high. One label is to be fixed centrally at the top of each outer door of the switchboard using four (4) aluminium pop rivets.

25.13.4 Cubicle Labels

Each cubicle shall be labelled with its appropriate label as follows:

PUMP STARTERS & STATION CONTROL
PLC AND TELEMETRY
METERING AND MAIN SWITCH

Labels are to be on 1.6 mm silver anodised aluminium sheet filled with black enamel. Lettering to be 9 mm high.

These labels are to be fixed immediately below the main labels using four (4) aluminium pop rivets. Alternatively these cubicle labels may form part of the respective main labels - see Motor and Pump Details Label sheet in the Drawings.

25.13.5 Danger Notices

"Danger High Voltage" safety signs are to be positioned centrally below the Main Labels and Cubicle Labels on each outer door.

The Danger Notice is to be 300 mm x 225 mm manufactured from 1.6 mm Aluminium sheet and fixed to the doors by four (4) aluminium pop rivets.

These labels are obtainable from Hunter Valley Safety Signs (phone (049) 67 4722).

25.13.6 Asset and Equipment Number Labels

Supply and install Asset and Equipment Number Labels as listed in Appendix C. Labels are to be on 1.6 mm thick silver anodised aluminium sheet filled with black enamel. Lettering is to be 9 mm high. Fix the label below the central main label using four (4) aluminium pop rivets.

25.14 Programming of Logic Controller

Program all Programmable Logic Controllers to suit the installation.

Obtain the software program for Standard Duplex and Standard Triplex pumping stations from the Hunter Water Corporation.

Assign all rights of the software prepared for this Contract to the Hunter Water Corporation.

25.15 Inspection

The equipment shall be inspected by the manufacturers Quality Assurance Inspector during manufacture and prior to delivery to the site at stages as listed in the following schedule. The second inspection is not required for Outdoor switchboards.

- (a) First inspection Metalwork finished and relays, contactors, circuit breakers etc. installed.
- (b) Second inspection Sheet metal paintwork
- (c) Third inspection Equipment and Power Cables Installed
- (d) Final inspection Final Inspection and Testing

Inspections, other than the final inspection, are intended to maintain constructional standards and are not intended, unless otherwise arranged, as functional tests.

Notify the Superintendent a minimum of five (5) working days before each QA inspection is carried out to give the Superintendent opportunity to make arrangements to be represented if the Superintendent so chooses.

Within three (3) working days of each inspection submit a signed completed copy of the manufacturer's check list.

25.16 Final Inspection and Test

Test the switchboard at the works before delivery to ensure correct operation.

Perform the tests described in EIS-91 as required. The tests shall include the following as a minimum:

- (a) Insulation test of all power wiring with 1000 V insulation tester, tested phase to phase and neutral, phase to earth, neutral to earth.
- (b) For switchboards containing busbars, a 2.5 kV high potential test with minimum 5 mA leakage current followed by repeat of test (a) above. Report any leakage current or change in insulation resistance.
- (c) Test and record earth continuity of earth busbar and earthing conductors.
- (d) Test all protection equipment and motor protection relays by secondary injection of the current transformer circuits.
- (e) Test phase fail, phase reversal relays with correct and reversed phase sequence to ensure correct operation. Also test relay by removing one fuse.
- (f) Test operation of all Residual Current Device (RCD) circuit breakers and combined Residual Current Device/General Purpose Outlet (RCD/GPO) units. Units shall trip when leakage exceeds 18 mA.
- (g) Test voltmeter and voltmeter selector switch for correct voltage indication.
- (h) Test each motor starter for correct operation with all other drives and equipment turned off. Test shall include operation of thermal overload, phase failure, over temperature devices, etc, with starter selected for both manual and automatic operation. Test operation of all indicating lamps and control devices.
- (i) Test motor starter with load connected and observe ammeter movement. Check for high resistance connections.
- (j) Test each Programmable Logic Controller input from the connected device and ensure correct operation.
- (k) Test each Programmable Logic Controller output and ensure correct operation of connected devices.
- (l) Test operation of pressure control systems by simulation of changing pressures on primary device.
- (m) Test operation of instrument loops by simulation of primary device.
- (n) Simulation testing of Programmable Logic Controller.
- (o) Check that the Duty and Standby pumps alternate their duty upon each operation.

25.17 Notification of Electrical Work

Complete the Electrical Contractors Association of NSW Notification of Electrical Work form in its entirety after testing of the switchboard and prior to delivery.

Place the completed form (Supply Authority Copy & Customer Copy) in a clear plastic A4 size envelope or pocket and fix to the metering panel with tape.

25.18 Delivery and Storage

Following satisfactory final inspection prepare the equipment for transport. Protect all switchboards against mechanical and water damage.

Supply all labour and equipment for the assembly, loading and transportation of the switchboard(s) to the pumping station site.

Lift switchboards using lifting rods inserted through the lifting bops in the switchboard support frame or by specifically provided lifting lugs. Ensure that there is no damage to the switchboard.

Prior to transportation, where necessary, secure all equipment likely to be affected by shock or vibration. Remove and separately pack sensitive items.

Where equipment is delivered in two or more sections, provide timber framework to protect any protruding portions of equipment.

Adequately and effectively protect all equipment against damage from moisture, brinelling, handling or other cause during transportation and delivery.

25.19 Site Testing

After the switchboard has been installed, tests will be carried out on site to verify the performance under site conditions and to ensure performance of all equipment is satisfactory.

The Subcontractor's representative may be present at the site at his own expense, to witness the site tests.

25.20 Work As Executed Drawings

Mark up, using red pen, and submit all contract electrical drawings showing all departures from the tender drawings.

26. PART B - SELECTED SUBCONTRACT No 2 - INSTALLATION OF ELECTRICAL EQUIPMENT

26.1 Equipment to be supplied by Selected Subcontractor No 1 for Installation and Connection by the Selected Subcontractor No 2.

For each pumping station:

One (1) switchboard complete with terminals, but without cable glands and fixings;

One (1) Delivery Pressure Transmitter, one (1) Suction Pressure Transmitter, one (1) Low Delivery Pressure Switch, one (1) Low Suction Pressure Switch and two (2) Line Protection Units. The range and settings for the pressure switches and pressure transmitters is shown on the electrical drawing titled "Station Control Schematic".

26.2 General Requirements

Comply with the requirements of clause 24.

Do not make any amendments during construction without obtaining prior written approval from the Hunter Water Corporation. On completion of the Contract, include any such amendments on "Work as Executed Drawings".

26.3 Scope of Work

Carry out the following works:

- (a) Advise Supply Authority of all wiring, load requirements and submit all test requests.
- (b) Take delivery at the site and install the Electrical Switchboard.
- (c) Determine final size of consumer mains.
- (d) Supply and install consumers mains including consumers poles if required and earthing system.
- (e) Install pressure switches, pressure transmitters and line protection units.
- (f) Supply, install and terminate the pump cables and control cables.

- (g) Install electricity metering equipment as provided to the requirements of the Supply Authority.
- (h) Testing
- (i) Supply work as executed information.

26.4 Supply Authority Requirements and Metering

Supply Authority application and connection fees where applicable may have been paid by the Developer. Submit an Application For Supply if this application has not been submitted by the Developer. Ensure that permanent power is available prior to the completion of electrical installation.

Submit all other forms required by the Supply Authority including “Application For Service Requirements” and “Notification Of Electrical Work”.

Forward the Customer Copy of all forms to the Superintendent.

Mount the metering equipment inside the switchboard.

26.5 Consumer Mains Design

26.5.1 Point of Supply

The location of the point of attachment shown on the drawings is for tendering purposes only. Obtain a service marking from the Supply Authority.

26.5.2 Cable Size

Determine the size of consumer mains based on actual pump rating and where specified, the ultimate pump rating. The maximum voltage drop shall not exceed two percent.

26.5.3 Maximum Demand

The maximum demand for pumping stations with one or two pumps installed shall be based on all pumps running simultaneously, plus fan if installed, plus auxiliaries.

The maximum demand for pumping stations with more than two pumps installed shall be based on one less than the total number of motors to be installed ultimately, running simultaneously, plus fan if installed, plus auxiliaries.

26.5.4 Designs to be Submitted

Submit all calculations of cable sizing for review prior to installation.

26.5.5 Mains in Reserves

All consumer mains in dedicated reserves shall be installed underground unless approved otherwise by the relevant Council.

26.6 Consumers Mains Requirements

Install consumers mains to each main switchboard from the nominated point of supply.

Supply and install all poles, fittings, cable, conduit and trenching required to complete the installation.

The nominated point of supply as noted on the installation drawings will consist of one of the following:

- (a) Existing Supply Authority Pole

Extend underground cable from main switchboard, up existing Supply Authority pole for termination at pole substation or overhead reticulation. Fix the consumers main to the pole up to a height of 3.0 metres and leave sufficient cable and materials for the Supply Authority to extend the cables up the pole to the substation fuses or service fuses as required.

(b) Lead-in Pole and Underground Consumers Mains

Supply and install a lead-in pole as specified. Extend underground cable from main switchboard, up lead-in pole and complete the installation.

(c) Kiosk Substation or Underground Reticulation

Extend underground cable from main switchboard to existing Supply Authority substation, underground reticulation or distribution pillar as nominated. Provide all materials required by the Supply Authority to terminate the cable.

(d) Lead-in Pole and Overhead Consumers Mains

Supply and install a lead-in pole together with one or more spans of overhead mains, intermediate poles, stays etc and a terminal pole located adjacent to the pumping station. Extend underground cable from main switchboard up terminal pole and connect to overhead section of consumers mains.

26.7 Lead-in Pole and Overhead Mains Construction

26.7.1 Lead-in Pole

Where a "lead-in pole" is specified on the drawings, supply and install the pole to this specification and Supply Authority requirements.

Install the "lead-in pole" as close as possible to the front boundary of the property and as close as possible to the common boundary between two properties. Locate the "lead-in pole" so as to ensure that the service mains from the Supply Authority pole to this "lead-in pole" shall not cross any adjoining property boundary.

The size of the pole shall be as determined by the Supply Authority with the proviso that the sizes for galvanised steel poles shall be 100 mm diameter (nominal) or 165 mm diameter (nominal) in accordance with AS 3000 Table D5, Column 7 or the sizes for round, full length preservative treated timber poles in accordance with AS 3000 Table D8.

Supply and install all fixings for attachment of service lines to Supply Authority requirements.

26.7.2 Poles

All timber poles shall be dressed hardwood, natural round poles, minimum 225 mm diameter, with all sapwood removed. Treat poles against fungus and termites as described in AS 3000, to 600 mm above ground level.

Under no circumstances will untreated timber poles be accepted.

Alternative fungus treatment may be used only with the written approval of the Supply Authority and the Superintendent.

Fit all timber poles with a galvanised steel domed cap extending 25 mm down the sides and fastened at the side with galvanised steel nails.

Fit all galvanised steel poles with a welded steel cap.

26.7.3 Installation of Poles

Unless otherwise indicated, poles shall be buried to a minimum depth of 1600 mm.

Where poles will be subject to bending stresses, eg. where the aerial cables change direction or terminate, the poles shall be stayed to prevent leaning or bending.

26.7.4 Aerial Cables

Aerial cables shall be insulated aerial bundled conductor of adequate rating for the installation.

All fittings and terminations shall comply with the cable manufacturers requirements.

26.8 Underground Cable Installation

26.8.1 General

Consumers' mains shall be run underground, generally as shown on the drawings, by one of the approved methods listed below:

- (a) Buried direct. The individual cores shall be taped together at intervals not exceeding one metre. Particular care is to be taken with bedding and back filling. Provide light orange polymeric cable cover strips overlapping by a minimum of 50 mm. Cables entering conduits in pumping station plinths shall be sealed to stop ingress of moisture and vermin.
- (b) Installed in heavy duty UPVC conduit - minimum size of conduit to be 50 mm nominal bore and this conduit to be joined to the conduit protruding from under the pumping station roof slab using a series of approved conduit reducers.

The cable route within any public roadway shall be from the base of the pole, perpendicular to the kerb and then along the Supply Authority underground cable footpath allocation which is located in the road reserve, between 300 mm and 900 mm from, and parallel to, the property boundary.

Where crossing or running parallel to other services, underground cabling shall be spaced as approved by the Authority responsible for the adjoining service. At no point shall these mains be located within 300 mm of any water service. This separation is a requirement of AS 3500.1 clause 5.3.1.2, (National Plumbing and Drainage Code -Water Supply)

26.8.2 Trenching

Saw cut existing concrete or bitumen in a straight line to 75 mm minimum depth before excavation is commenced.

Provide an even bedding surface free from sharp projections.

All care is to be taken to cause minimum disturbance to tree root systems. Roots of 75 mm diameter, or larger, are not to be severed.

26.8.3 Underground Cable Marking

Cable marker tape shall be laid 150 mm above the cable cover strip or UPVC conduit, for the full length of all underground cables and conduits.

Identify the start, finish and all changes of direction of underground cables by installing approved cable marker brick(s) showing the direction of the cable/conduit run in both directions. Cable marker bricks shall be 150 mm x 150 mm x 300 mm deep with the words 'ELECTRIC CABLE' embossed into the surface. Paint the surface of the cable marker bricks yellow.

26.8.4 Cable Installation on Poles

All cables installed on Supply Authority poles shall be installed in accordance with the Supply Authority requirements and the New South Wales, Service and Installation Rules, including the required mechanical protection.

Single core cables with black sheathing may be saddled neatly to Private poles. Conduit of maximum size 63 mm diameter shall be used for other cable types. Install an approved rain hood or 180 degree conduit bend at the top of all conduits to ensure rain water cannot enter.

Protect cables and conduits running down the exterior of a pole to a height of 2500 mm above ground by a galvanised water pipe or a substantial, heavily galvanised channel fixed to the pole and extending 300 mm below the ground. Earth the water pipe or channel to the requirements of the Supply Authority.

26.8.5 Road Crossings

Provide an accurate plan of any road crossing to the Supply Authority in a manner suitable for incorporation into their records.

Re-instate the road surface to the requirements and approval of the Council or road authority.

Where a cable passes under a road or path, fix a marking plate at each side of the road or path to the concrete kerb or to a concrete block approximately 150 mm x 150 mm x 300 mm deep. The marking plate shall be approximately 75 mm x 75 mm x 2 mm thick brass or other approved material, engraved with the words "ELECTRIC CABLE" and an arrow pointing downwards or in the direction of the cable and fixed with four brass or stainless steel screw fixings to suit the material of the marking plate.

26.9 Earthing

Install earthing in accordance with Supply Authority requirements and AS 3000.

An equipotential earth bond shall be installed from the main earth stake. The bond conductor shall be of area as shown on the drawings but not less 6 mm² and shall be a continuous uncut cable looped to the water service.

The location of the main earth electrode shall be in the centre of the 175 mm x 175 mm recess in the switchboard slab located immediately behind the switchboard plinth or as shown on the drawings.

The main earth electrode shall be an Energy Authority of NSW approved copper clad earth rod with a minimum diameter of 13 mm and a minimum coating thickness 0.5 mm and shall be provided with an ALM-Dulmison brass earth clamp and a type ERB-1 connection box. The connection box shall be held in position with a 3:1 sand : cement mixture such that the top of the connection box is level with or slightly below the surrounding pavement. The inside of the connection box shall be clear of any grout mixture, cloth or paper and shall be filled with sand up to the level of the bottom of the box.

The main earth and the MEN link to the switchboard neutral shall be bonded in the switchboard.

26.10 Switchboard Installation

Liaise with the Switchboard supplier to determine the lifting facilities required to off load the switchboards at site. Provide appropriate lifting facilities and take delivery of the main switchboard. Lift switchboards using lifting rods inserted through the lifting loops in the switchboard support frame or by specifically provided lifting lugs. Ensure that there is no damage to the switchboard.

Fix the switchboards in the nominated positions. After fixing the switchboard to the plinth, seal the base to the plinth with grout or silicone sealant.

Fixings into concrete shall be minimum 10 mm diameter grade 316 stainless steel chemical or expansive type masonry anchors. Set the anchors strictly in accordance with the manufacturer's recommendations.

Place a fibre or insulating washer between any dissimilar metals (ie. between stainless steel, aluminium, or galvanised steel).

26.11 General Installation Requirements

26.11.1 Cables

Power and control cables shall be orange sheathed circular section PVC/PVC, V75, 0.6/1 kV grade complying with AS 3147. Conductors shall be stranded copper of minimum cross section 2.5 sq. mm for power cables and 1.5 sq. mm for control cables. Control cable shall be multicore with individually numbered cores.

Where cables leave rigid conduits or ladders for final termination they shall be enclosed in heavy duty PVC conduit equivalent to "Ultraflex" 170 Series "Rhino". Conduit shall be stable in sunlight and shall preferably be coloured black. Where black is not available use light grey. Do not use orange in sunlight.

Cable runs shall be continuous and terminated in approved terminal boxes fitted with terminal strips. "Through jointing" of cables will not be acceptable.

Care shall be taken in laying cables in cable ducts, ways, trenches and trays. Cables shall be neatly grouped and run parallel. Crossovers shall be confined to cables entering and leaving the main cable group.

Cable runs on cable trays and ladders shall not exceed three layers.

Fix cables to trays and ladders with nylon ties at minimum 600 mm intervals on horizontal tray and minimum 300 mm intervals on vertical tray.

Cables shall not be bent in a radius less than fifteen times their overall diameter.

Where applicable, submersible type water pumps will be supplied with their own cables integral with the unit with sufficient length to run unbroken from the switchboard to the pump.

The switchboard concrete upstand shall be joined to the pump pit by a series of UPVC conduits, as shown on the respective Drawings.

The routing of the cables will be from the concrete upstand supporting the switchboard into the appropriate conduits to the pump pit. Install cables to each pump in separate conduits. Install power cables and control cables in separate conduits.

Provide a 2 mm diameter Grade 316 stainless steel draw wire in each UPVC conduit between the concrete upstand and the pump pit. This stainless steel draw wire shall have a suitable shackle or pulling eye fitted to each end to facilitate the pulling of cables in/out of the conduit and shall be permanently fixed to the base of the upstand adjacent to each conduit.

26.11.2 Conduits

Conduits and fittings shall comply with either light duty UPVC conduits (LD-UPVC), heavy duty UPVC (HD-UPVC) to AS/NZS 2053.2 or galvanised screwed steel conduits, medium protection to AS/NZS 2053.7. Unless otherwise specified, conduits shall be supplied and installed in accordance with EIS-91.

Light duty UPVC conduits shall:

- (a) not be installed on exterior surfaces
- (b) not be exposed to mechanical damage
- (c) be supported over their entire length

Support conduits by saddles, cleats or other prior approved means so that no appreciable sag occurs in conduit runs and no weight is taken by conduit terminations.

Conduit saddles installed on exterior surfaces shall be hot dip galvanised or grade 316 stainless steel. Conduit saddles shall be double-sided. Fix conduit saddles installed on exterior surfaces with stainless steel bolts or stainless steel round-gear screws.

26.11.3 Cable Protection

Install all surface run cables in conduit.

Protect cables and conduits from ground or floor level to a height of 200 mm by a 3 mm thick galvanised steel guard.

26.11.4 Cable Tray

Manufacture cable tray from marine grade aluminium and comply with the requirements of EIS-91.

All bends shall be manufactured to ensure adequate bending radii for the installed cables. Joins in trays and tray components shall be welded or fastened by stainless steel screws and nuts with insulating washers between dissimilar metals.

26.11.5 Junction Boxes

All junction boxes shall be weatherproof with a minimum enclosure rating of IP56. Terminate all wiring/cable joins in junction boxes in fixed terminals.

26.12 Installation of Pump Cables

26.12.1 Location of Pumps

Pump number 1 shall be closest to the switchboard or in the case where pumps are equidistant from the switchboard, pump number 1 shall be the pump on the right hand side of the pit when viewed from the switchboard location. Pumps are numbered in sequence from number 1 including future pumps not currently installed ie. where centre pump of a three pumping station is not installed, pumps are connected to Pump 1 and Pump 3 starters.

26.12.2 Installation

All cables shall enter the pump pit via their respective conduits and shall pass immediately into conduit which has been secured to the pump pit wall as detailed in EIS-91. Cables running from the pit wall to any device in the pump pit shall be protected by flexible conduit installed in accordance with EIS-91.

Support pump cables so that no undue bending or stress is evident at motor cable glands.

26.13 Installation of Pressure Switches and Pressure Transmitters

Fix the pressure switches and pressure transmitters to the wall of the pit and connect to the appropriate 10 mm flexible pressure tubing from the tappings provided in the suction and delivery pipework.

Install the Line Protection Units protecting the pressure transmitters in a junction box rated at IP 56 minimum and secured to the pit wall in accordance with EIS-91.

26.14 Terminations at Switchboards

26.14.1 General

Where applicable, flexible cables attached to pumps shall not be cut or shortened but shall be neatly coiled in the space beneath the switchboard.

26.14.2 Glands

Gland all cables at the point of entry into switchboards. Single core cables shall be individually glanded.

Correctly size each cable gland and gland each cable on the cable sheathing. The top of the gland shall be on the underside of the gland plate with the lock-nut accessible from above.

All glands shall be non-corrosive. Glands installed on external surfaces shall be constructed from black phenolic resin. Glands installed in the base of switchboards shall be manufactured from phenolic resin or other plastic materials.

Run a band of silicon sealer between each gland plate and the surrounding enclosure prior to final positioning of the gland plate.

26.14.3 Terminations

Terminate all cables at each terminal with correctly sized cable lugs. Fit cable cores in tunnel type terminals with "bootlace" ferrules or pin lugs, with only one core per termination.

Terminate all spare cores in adjacent spare terminals.

Number each core at both ends according to circuit diagrams, with Grafoplast "Trasp" type ferrules. Print the numbers and characters in a contrasting colour to the base colour of the marker.

26.14.4 Mains and Pump Terminations

Arrange terminals so that current between cable lug and terminal does not pass through any intermediate lug ie, lugs shall not be mounted back to back on the same side of the terminal bar.

Two cable lugs, one each side of a copper busbar with a single fixing bolt and nut is suitable.

Maintain statutory clearances between busbars and lugs.

26.15 Installation in Pump Pit

All supports and fasteners used and installed in pump pit shall be manufactured from grade 316 stainless steel or approved non-corrosive products.

Do not use brass, mild steel, electro-plated mild steel, within the pump pit.

Place Insulating washers between any dissimilar metals to reduce corrosion due to electrolysis.

26.16 Testing

At the completion of the work, arrange for the works to be inspected and tested as detailed below:

Notify the Superintendent a minimum of five working days prior to any site tests being carried out. The Superintendent may elect to be present at any of the tests however, if the Superintendent does not elect to be present, proceed and carry out all tests and inspections.

Submit, within three days of completion of any site tests, reports of all tests and inspections.

Tests shall include but not be limited to

- (a) Insulation resistance of Consumer's Mains and motor cables. Resistance shall be greater than 30 M ohm, measured with a 1000 V insulation tester.
- (b) Phase rotation check on Consumer's Mains. Rotation shall be Red - White - Blue.
- (c) Check supply voltage phase to phase and phase to earth. Voltage variation between phases shall not exceed two percent (2%).
- (d) Test resistance of motor thermistors (if installed), with a high impedance multimeter. Thermistor resistance shall be between 150 and 600 ohms.
- (e) Test pressure switches and transmitters by simulating service pressures and cut in and cut out pressures. Ensure readings are correct for pressures applied. The range and settings for the pressure switches and pressure transmitters is shown on the electrical drawing titled "Station Control Schematic".
- (f) General inspection of the completed installation for compliance with the specification.

26.17 Notification of Electrical Work

Submit to the Supply Authority the "Notification of Wiring" completed by the switchboard manufacturer together with the "Notification of Wiring" covering the installation work.

The completed "Notification of Wiring" covering the switchboard will be attached to the switchboard metering panel.

Forward the Customer Copy of both Notification of Electrical Works forms to the Superintendent.

26.18 Drawings

Each pumping station will require the following Drawings associated with electrical installation work:

Drawing No 1	Installation Connection Diagram
Drawing No 2	Locality & Site Plan - giving approximate length & size of consumers mains

No amendments shall be made during construction without first being approved by the Superintendent. On completion of the Contract, the Subcontractor shall include any such amendments on "Work as Executed Drawings".

26.19 Work As Executed Drawings and Schedules

26.19.1 Contractors Installation Drawings

Amend and submit all electrical installation drawings to show all changes during installation, for inclusion in the Operations and Maintenance Manuals.

26.19.2 Principal Supplied Installation Drawings and Equipment Schedules

Mark-up one set of drawings and equipment schedules with red pen, to show all revisions and submit these for review. Revisions to drawings shall include adding final motor ratings, final cable sizes and underground cable routes details.

27. PART C - SELECTED SUBCONTRACT NO.3 - DESIGN AND INSTALLATION OF TELEMETRY SYSTEM

27.1 General Requirements

Comply with the requirements of clause 24.

Do not make any amendments during construction without obtaining prior written approval from the Hunter Water Corporation. On completion of the Contract, include any such amendments on "Work as Executed Drawings".

Select equipment from Hunter Water Corporation's lists of Approved Products and Manufacturers which can be accessed on the internet at:

www.hunterwater.com.au/services.asp

Where suitable equipment is not listed, submit full technical details of alternative items and obtain written approval prior to use.

27.2 Hardware Installation

Install the telemetry radio, antenna, surge protection and all associated cabling between the remote telemetry unit (RTU) in the switchboard and the antenna.

27.3 PLC Programming

Design, install and commission the PLC program for control of the station. The PLC program shall contain code to support all required functions of the telemetry system. Fully document the operation of the PLC program in accordance with AS 3876.

27.4 SCADA Database Configuration.

Configure the Hunter Water Corporation's SCADA database to allow remote monitoring. This work involves the following:

- Nominate an RTU and telemetry link number to provide minimal congestion to the existing network.
- Configure the RTU

Configure the database points associated with the RTU and consistent with those required for the particular station type.

Make necessary additions/alterations to the SCADA background diagrams

Add the necessary SCADA foreground points

Update the SCADA system network diagrams

27.5 Telemetry Commissioning

Commission the telemetry system for the pumping station including the checking and calibration of the pressure switches and pressure transmitters. The range and settings for the pressure switches and pressure transmitters is shown on the electrical drawing titled "Station Control Schematic". Notify Hunter Water's Control Centre before any SCADA alarms are enabled.

28. SELECTED SUBCONTRACT NO 4 - MANUFACTURE AND SUPPLY OF SMALL ELECTRIC DRIVEN WATER PUMPS

28.1 Selection of Pump Units

Obtain pumps from approved manufacturers/suppliers as indicated on Hunter Water Corporation's lists of Approved Products and Manufacturers which can be accessed on the internet at:

www.hunterwater.com.au/services.asp

Unless the pump brand and model number has been specified elsewhere, select the most appropriate pump unit which meets all specified requirements at lowest life cycle cost.

28.2 Requirements for Selected Subcontractor No 4

28.2.1 Water Pumps

The work comprises of the manufacture, testing and supply of water pumps and accessories as detailed in the Schedule of Technical Data and the Specification.

28.2.2 General Requirements

The pumping units and accessories shall comply with the requirements of the Schedule of Technical Data and the Specification.

This covers the supply of small electrically driven conventional centrifugal end suction or split case water pumpsets (motor and pump) complete with coupling, coupling guard and baseplate. A variation from this allows for single stage in-line centrifugal pumps where the impeller is close coupled to the motor for applications where motor power is 11 kW or less.

The construction of the pump is to be such that the complete rotating element can be removed from the casing as a unit without disturbing the suction and discharge pipework. The casing is to be cast iron and fitted with a casing wear ring.

The pump is to be fitted with a bronze or stainless steel impeller, casing wear ring, stainless steel shaft and mechanical seal. Principal dimensions are to conform to ISO 2858

The maximum speed for pumps driven by motors of greater than 22 kW is to be 1500 rpm. Pumps of 22 kW and less may operate to 2900 rpm, although a maximum of 1500 rpm is preferred.

Testing is only required for pumps driven by motors in excess of 15 kW , and where untested the manufacturer is to guarantee that the pump supplied will comply with the characteristic curve provided with the tender , subject to the tolerances in the code.

Motors to be TEFC and able to operate on 415 V 50 Hz supply.

28.2.3 Selected Subcontractors for Manufacture and Supply of Small Electric Driven Water Pumps

Where the pump brand, model number, etc. has already been nominated, this is shown on the Form E86 (Contractors Schedule of Pump and Motor Details) enclosed.

Selected Subcontractors for supply and delivery of small electric driven water pumps are:

- | | |
|------------------------------|--|
| (a) KSB Ajax Pumps Pty Ltd | 115 Bonds Road
PUNCHBOWL NSW 2196 |
| (b) Thompson Kelly & Lewis | 349 Lyons Road
FIVE DOCK NSW 2046 |
| (c) Southern Cross Machinery | 10 Stoddart Road
PROSPECT NSW 2149 |
| (d) Grundfos Pumps Pty Ltd | Unit 2/2-4
Newington Business Park
NEWINGTON NSW 2217 |
| (e) Weir Engineering Pty Ltd | PO Box 461
GOSFORD NSW 2250
15 Gindurra Road
SOMERSBY NSW 22500 |

28.2.4 Operating Range

The pumping unit is to operate without loading the motor to more than 95% of the motor MCR current at the specified duty point condition and must not overload the motor under any variation of pumping head.

The pumping units shall have steadily falling Head/Quantity curves from no-flow to maximum flow. The selected pump shall have an upper limit of the operating range (where stated) not exceeding 90% of the shut-off head for that pump/impeller combination. The duty point head should not exceed 85% of the shut-off head.

The pumps shall normally operate singly however shall be capable of operating in parallel unless otherwise specified.

28.2.5 Pump Duty

Pump duties are shown in the Technical Schedule TSSCW 1/85 - Extract Sheets.

The best efficiency point for each pump shall be as close as possible to the specified duty point unless otherwise specified.

The pump performance guarantee figures are to be stated in Technical Schedules TSSCW 1/85 Extract Sheets.

28.3 Economy of Operation

One of the factors that will be considered in the assessment of tenders will be the economy of operation. The total energy cost as calculated from the following formula, will be added to the Tender Sum for the purpose of comparing tenders:

$$E = 9.88 \times 1.1 \times R \times P \times Q$$

Where, E = Present worth value of energy cost over 15 year life of pumps.

9.88 = Present worth factor for a uniform annual series of payments over 15 years at a 5% discount rate - see note 1.

1.1 = Energy efficiency factor

R = \$/kWh

P = Guaranteed kWh/kL at duty point - see note 2

Q = kL pumped / year (This is set out in the Technical Schedule TSSCW 1/85 Extract Sheets)

Notes

1. The Principal reserves the right to examine the effect of different discount rates when assessing the relativity of tenders.
2. The guaranteed kWh/kL for each pump shall be submitted with the tender document.

28.4 Pumps - Detailed Requirements

28.4.1 General

The pumping units shall comply with the requirements set out in the Pumping Station General Arrangement Drawing.

The pumping units shall be current models which have been in successful operation under comparable conditions for at least two years.

Clearly and permanently mark the direction of pump rotation on the pump casing.

28.4.2 Mechanical Seals

The seals shall be suitable for potable water at ambient temperature and provide satisfactory operation under the specified conditions.

The seals shall incorporate carbon and silicon carbide/tungsten carbide faces, nickel chrome steel metal components and nitrile rubber secondary seals.

28.4.3 Suction and Discharge Flange Connections

Suction and discharge flanges are to comply with AS 4087 Class 14 or 16 with drillings off centre.

28.4.4 Holding Down Bolts

Supply holding down bolts, nuts and washers manufactured from Grade 316 stainless steel to AS 2837 to secure the baseplate of the pumpset, where applicable, using chemical adhesive anchors. Fasteners subject to vibration shall be provided with locking devices.

28.4.5 Couplings

Where applicable provide flexible type couplings keyed to the shafts with Taperlock bushes. Couplings are to be of a proprietary brand. Full coupling guards are to be provided

28.4.6 Pump Numbering

The pump with the lowest serial number shall be the No 1 pump and shall be installed closest to the electrical switchboard.

28.4.7 Nameplate and Asset Number Label

Attach a stamped or embossed stainless steel nameplate to each pump using stainless steel drive screws. Do not paint.

Nameplate details shall include manufacturer's name, pump type, size, serial number, order/contract number, speed, year of manufacture and pump casing test head.

Attach a stamped or embossed 1.6 mm thick stainless steel asset number label with 9 mm high lettering to each pump using stainless steel drive screws. The asset number is listed in Appendix C. Do not paint.

28.4.8 Protective Coatings

The pumps, motors and guards shall be supplied with painted finish to the pump manufacturer's standard enamel coating applied in accordance with the paint manufacturer's instructions. The baseplate, where applicable, is to be hot dipped galvanised.

28.4.9 Galvanising

Where items are required to be galvanised, the process to be employed shall be hot dip galvanising and the provisions of AS 1650 shall apply subject to the additional requirements for heavy galvanising specified below. AS 1214 and the relevant requirements of AS 1650 shall apply to galvanising of fasteners such as bolts, nuts and washers.

Where applicable, galvanise after fabrication. Prior to pickling and galvanising, remove weld slag and weld spatter by mechanical means.

Provide enclosed hollow sections with vent and drainage holes at opposite sides of the member, prior to pickling and galvanising. The size and exact location shall be in accordance with the galvaniser's recommendations.

The average thickness of the zinc coating shall be not less than:

- (a) 84 µm for steel 5 mm thick and over (the equivalent coating mass is 600g/m²).
- (b) 63 µm for steel less than 5 mm thick (the equivalent coating mass is 450g/m²).
- (c) 52 µm for fasteners (the equivalent coating mass is 375g/m²).

Where heavy galvanising is specified, the average thickness of the zinc coating shall be not less than 50% above the respective thickness specified above and may be achieved by using one, or a combination of, the following methods:

- (a) Abrasive blast cleaning of the surfaces which are to be galvanised, prior to pickling and galvanising. Abrasive blast cleaning shall be carried out in accordance with AS 1627 Part 4 provided that the minimum standard of surface preparation shall be Class 2 - "medium" blast cleaning and the surface profile height shall be not less than 50 µm nor more than 75 µm. Pickling and galvanising shall be carried out as soon as practicable after the abrasive blast cleaning.
- (b) Increasing the period of immersion in the galvanised bath.
- (c) Increasing the galvanising temperature.

28.4.10 Drawings, Documents and Manuals

- (a) Provide completed technical schedule TSSCW 1/85 Extract Sheets 1 to 3 with the tender.
- (b) Supply pump installation drawings for each pumping station to the main Contractor with one (1) copy to the Superintendent for review.
- (c) Within 4 weeks of witness testing the pumps, provide four (4) copies of Installation, Operations and Maintenance information as described in clause 23 for inclusion in the Operations and Maintenance Manuals.
- (d) Provide one (1) copy of Work-as-Executed drawings.

28.5 Electrical Requirements

28.5.1 Motor Performance and Characteristics

The motor and driven unit torque/speed characteristics shall ensure smooth positive acceleration in conjunction with the scheduled starting method under all specified conditions of operation. The final speed during the first step of starting shall exceed the speed of breakdown torque.

All motors will be started by means of automatic starters designed to AS 1202.

All motors shall be suitable for Direct On Line starting, and motors 4.5 kW and above shall also be suitable for electronic soft starting.

Motors shall satisfy the Electricity Supply Authority's requirements particularly in regard to interference to other consumers and frequency injection systems.

Within the operating range the current in each phase shall be less than the MCR current for a supply voltage within the specified range, and for a voltage variation between phases which is within the tolerance that the Electricity Supply Authority permits.

Motor starting, or continuous operation at MCR shall not cause a temperature rise in excess of that specified, and shall not cause nuisance operation of any protective device.

Starting characteristics shall be Design N to AS 1359.41-1986.

28.5.2 Motor Construction

Motor winding insulation shall be Class F, and minimum Class E temperature rise.

For motors 75 kW and above, at least one P.T.C. (Positive Temperature Coefficient) type thermistor shall be installed in each of the three phases of the motor windings prior to baking, wired in series and connected to fixed identified terminals in the motor terminal box.

Achieve protection classification TP2, except where motor size or construction is such that only TP1 is possible. If protection classification TP1 is offered this is to be stated in the tender.

Provide a separate engraved nameplate labelled "THERMISTOR DETAILS" and containing all the information required by AS 1023.1. for the details of thermistors.

Terminate motor windings in the terminal box for delta connection with both ends of each phase winding terminated on a stud-type terminal.

Phase time sequence of the electricity supply will be red/white/blue (clockwise rotation) and the motor shall be suitable for connection of the motor cables directly to this supply sequence. Any interchanging of phases to achieve correct shaft rotation shall be within the motor terminal box.

Provide an earth terminal inside the motor terminal box.

Motors over 40 kW are to be fitted with anti-condensation heaters.

The motor finish shall be in accordance with that indicated for the pump.

Attach a stamped or embossed stainless steel nameplate to each motor using stainless steel drive screws. Do not paint. The information on the motor nameplate shall include the motor details on Form E86.

28.5.3 Method of Starting

The only acceptable methods of starting shall be DOL (direct on line) or electronic soft start.

28.5.4 Motor Protection

- (a) Provide motor over temperature protection for motors 75 kW and above. Motor over temperature protection is not required for motors under 75 kW.
- (b) Tenderers are to state in their tender those protective devices that must be operated as a condition of the warranty. When specifying these protection devices, tenderers are to fully describe any items that must be included in the switchgear for the satisfactory operation of the protective devices, together with the cost of the switchgear items.

28.5.5 Electrical Requirements

Supply details of electrical requirements (Contractors Schedule of Pump and Motor Details - E86 form) to the selected subcontractor for the Manufacture and Supply of Electrical Equipment.

28.5.6 Power Factor and Efficiency

Single speed motors, when operating at rated full load and rated speed, shall exhibit efficiencies and power factors equal to or greater than those indicated in the following table:

kW rating range	2 POLE		4 POLE		6 POLE		8 POLE	
	eff %	p.f.	eff %	p.f.	eff %	p.f.	eff %	p.f.
Less than 0.5 kW	64	0.62	60	0.62	54	0.62	54	0.56
0.5 kW to 1 kW	70	0.77	70	0.70	66	0.65	60	0.58
1 kW to 5 kW	75	0.80	75	0.74	70	0.70	70	0.65
5 kW to 30 kW	84	0.85	85	0.83	84	0.75	82	0.74
30 kW to 100 kW	90	0.85	90	0.85	90	0.80	90	0.75
Greater than 100 kW	92	0.88	93	0.85	93	0.81	93	0.77

28.6 Tests at Manufacturer's Works

Tests at the Manufacturer's works (for pumps with motors 15 kW and above) shall form the basis of acceptance of performance of equipment supplied under the Contract.

Certificates giving records of tests carried out and for such other items as the Hunter Water Corporation may direct shall be provided to the Hunter Water Corporation for approval prior to dispatch of pumping units from the Manufacturer's works.

28.7 Commissioning and Site Tests

After all equipment supplied under the Contract has been installed, the Subcontractor will be notified fourteen (14) days prior to the date of commissioning and site tests and may be present at the Subcontractor's expense.

The Subcontractor's absence from commissioning and site tests shall not relieve the Subcontractor's responsibility for the satisfactory performance and operation of all equipment supplied under the Contract.

Commissioning shall be the carrying out of inspections, adjustments and tests to ensure the Works are ready to commence operation and placing them into service in the manner specified for regular use.

Site tests during commissioning will be to ascertain that all equipment under the Contract has been properly installed and to verify their satisfactory performance under normal operational conditions.

28.8 Nature and Extent of Works Testing

28.8.1 Pumps

Pump tests at the Manufacturer's Works shall be carried out in accordance with Australian Standard AS 2417 Part 2 - Class C, subject to conditions as follows:

- (a) Each pump shall be tested with its own Contract motor over the range of operating conditions set out in clauses 28.2.4 to 28.2.5 inclusive.
- (b) Test data shall be translated only in respect of voltage and frequency.
- (c) Tolerances as defined in AS 2417 Part 2 - Class C for non mass-produced pumps shall be allowed on guarantees over the specified working range.

28.8.2 Motors

Motors for which type test certificates are not available shall be performance tested at Manufacturer's Works in accordance with Australian Standard AS 1359 Part 60. Performance tests shall be carried out on the motor only and not as part of an integral motor/pump unit.

For the integral motor/pump tests (clause 28.8.1) the shaft output power of the motor will be calculated using the motor efficiency stated on the type test certificate or as performance tested as above.

Motors/pumps, 4.5 kW and above shall be started using the method of starting approved for the motor/pumps and the test shall demonstrate reliable starting in accordance with clause 28.5.1 for a supply voltage not exceeding 415 volts.

Motor/pumps 75 kW and above shall be tested with all thermistors and any other protective devices connected to compatible control relays. The tests shall demonstrate that nuisance tripping does not occur.

CONTRACTORS SCHEDULE OF PUMP AND MOTOR DETAILS Form E86

SUPPLY AND DELIVERY OF ELECTRIC DRIVEN WATER PUMPS FOR

..... **WATER PUMPING STATION**

The Schedule is in addition to that submitted with the tender. One copy duly completed for each pumping station shall be submitted by the Contractor within 15 working days from the date of acceptance of the tender. This information will allow manufacturing of the switchboard.

PUMP AND MOTOR DETAILS

Manufacturer Pump	Motor
Model Pump	Serial No.....
Serial No.	Serial No.....
Serial No.	Serial No.....
Serial No.	Speed rpm.....
Duty Head m Required Provided	Rating kW.....
Duty Flow L/s Required Provided	Full load Current A.....
Efficiency %	Locked Rotor Current A.....
Impeller Dia. mm	No Load Current A
Inlet Flange Size (AS 4087).....	Overload Setting A.....
Discharge Flange Size (AS 4087)	Insulation Class A.....

CABLE CONSTRUCTION PER MOTOR

Cable No. 1	No. & Size of Motor Cores..... x mm ²
	Colours or Numbers of Motor Cores.....
	Current Rating of Motor Cores.....A
	No. & Size of Earth Cores..... x mm ²
	No. & Size of Control Cores x mm ²
	Overall Diameter..... mm
Cable No. 2	No. & Size of Motor Cores..... x mm ²
	Colours or Numbers of Motor Cores.....
	Current Rating of Motor Cores..... x .....A
	No. & Size of Earth Cores..... x mm ²
	No. & Size of Control Cores x mm ²
	Overall Diameter..... mm
Cable No. 3 (If Required)	No. & Size of Motor Cores..... x mm ²
	Overall Diameter..... mm
Cable Length:	.....

Contractors Signature:

SCHEDULE OF TECHNICAL DATA (Mandatory)

TSSCW 1/85 - EXTRACT FOR PUMPING STATION SHEET 1 OF 3

..... **WATER PUMPING**
STATION

<u>Page</u>	<u>Line</u>	<u>Description</u>	<u>Requirement</u>	<u>Offer</u>
				(X) Indicates Compliance
S2	22	<u>PUMP SET DESCRIPTION</u>		
	23	Type	Centrifugal	()
	24	Speed	Max.....r/min	.....r/min
	25	Shaft Mounting	Horizontal/Vertical	()
	26	Type of Drive	Direct /Close Coupled	()
	27	Rotation - Viewed from Pump Non Drive end	Clockwise / Anticlockwise	()
	28	Baseplate (BP) & Holding down bolts (HDB)	BP R/NR ; HDB R/NR	BP () ; HDB ()
	29	Supply of Motor	Required / Not Required	()
	31	Duty Point Required @.....m	..... L/s @ m	.....L/s
	36	<u>TESTS</u>		
	37	Works Performance Test	()	
	38	Tolerances for AS 2417 test	Q..... H..... / See Code.....	()
	41	<u>PERFORMANCE GUARANTEES OF OFFER</u>		
	42	Duty Points		| Stage 1 |
	43	Flow rate L/s	L/s	..... |
	44	Total Head (m)	m	..... |
	45	Pump Efficiency %	%	..... |
	46	Power Input to Pump kW	kW	..... |

Construction of Water Booster Pumping Stations

47	Motor Efficiency	%	..... |
.....			
48	kWh/kL pumped	kWh/kL	..... |
.....			
49	NOL Power - duty impeller	kW	.....
50	Shut off head, duty impeller	m	.....

Tenderer's Signature:.....

SCHEDULE OF TECHNICAL DATA (Mandatory)

TSSCW 1/85 - EXTRACT FOR PUMPING STATION SHEET 2 OF 3

..... **WATER PUMPING**
STATION

<u>Page</u>	<u>Line</u>	<u>Description</u>	<u>Requirement</u>	<u>Offer</u>
				(X) Indicates Compliance
S3	1	<u>PUMP</u>		
	2	Manufacturer's Name	To be Stated	.....
	3	Place of Manufacture	To be Stated	.....
	4	Pump Model and Mass	To be Stated	..... / ..... kg
	6	<u>Casing</u>		
	7	Number of Stages	To be Stated	.....
	8	Flanges I.D. suction & discharge	To be Stated	.....mm/..... mm
	9	Flange Table	AS 4087 Class 14 or 16	S (.....) ;
D (.....)				
	12	<u>Impeller</u>		
	13	Diameter for duty & max casing	To be Stated	Duty..... mm dia. Casing..... mm dia
	15	<u>Casing Plate , Shaft & Seals</u>		
	19	Mechanical seal make, type ,model	To be Stated	.....
	20	Face Materials	To be Stated	.....
	24	<u>Bearings</u>		
	25	Type	Ball / Roller	.....
	26	Lubrication	Grease / Oil	.....
	27	<u>Couplings</u>		
	28	Make & Model	To be Stated	.....
	31	<u>PUMP MATERIALS</u>		
	32	Casing	To be Stated	.....
	33	Casing wear ring & impeller	To be Stated /
	34	Shaft	To be Stated	.....

Tenderer's Signature

SCHEDULE OF TECHNICAL DATA (Mandatory)

TSSCW 1/85 - EXTRACT FOR PUMPING STATION SHEET 3 OF 3

		..... WATER		PUMPING	
		STATION			
<u>Page</u>	<u>Line</u>	<u>Description</u>	<u>Requirement</u>	<u>Offer</u>	
				(X) Indicates Compliance	
S4	1	<u>MOTOR</u>			
	2	Manufacturer's. Name	To be Stated	.....
	4	Place of Manufacture	To be Stated	.....
	6	Compliance with Standards	AS1359, AS1360, AS1023	()	
	7	Type (squirrel cage etc.)	.....	( )
	8	Nominal Speed	To be Stated	.....r/min	
	9	Rating	To be Stated	..... kW	
	11	Direction of rotation (viewed from drive end)	Clockwise / Anticlockwise	.....
	18	Ambient Air Temperature	Max .....°C : Min .....°C	()	
	23	Insulation	Class..... to AS 1359	.....
	37	MCR		100% 75%	
				MCR MCR	
50%					
MCR					
	38	Rated Voltage	To be Stated	.....	.....
	39	Rated Current	To be Stated	.....	.....
	40	Locked Rotor Current	To be Stated	.....	.....
	41	Efficiency	To be Stated	.....	.....
	43	Power Factor	To be Stated	.....	.....
	47	Temperature rise at windings	To be Stated	.....	.....

Tenderer's Signature:

SCHEDULE OF TECHNICAL DATA (MANDATORY)

SWITCHGEAR AND CONTROL GEAR ASSEMBLIES - EQUIPMENT SCHEDULE

FOR WATER PUMPING STATION

Drawing Nos

OUTDOOR TYPE STARTERS

SCA

OFFER

(X) Indicates Compliance

Maker's Name:

Enclosure Material:

Degree of Enclosure: IP55 ()

Tenderer confirms that all equipment complies with Hunter Water Corporation Preferred Equipment List.	X Signifies Compliance
Drawing: SCP-920	()
SCP-921	()
SCP-922	()

Switchboard manufacturer is required to furnish complete details for the following items of equipment :-

Component	Switchboard Layout Ref No	Equipment Offered		
		Manufacturer	Cat. No	Rating
Pump Main Circuit Breaker / Contactor Unit				
Main Switch				
Low Delivery Pressure Switch				
Low Suction Pressure Switch				
Suction Pressure Transmitter				
Delivery Pressure Transmitter				

Tenderer's Signature

APPENDIX A - PRECOMMISSIONING CHECKLIST

The items listed below (where required) shall be certified as being complete by the Contractor and submitted to the Superintendent prior to commencing commissioning.

PUMPING STATION:

MECHANICAL

**ITEMS:
CONTRA
TO
COMPLIA**

**CTOR
CERTIFY
NCE**

- | | | |
|----------|---|-------|
| 1 | Pressure gauge and tapping cocks provided on the suction and delivery pipes. | ..... |
| 2 | All pipework within the pump well complete and suitably anchored. | ..... |
| 3 | Gate valves fitted on the suction to the pumps and the delivery side of the reflux valves with spindles and handwheels. Gate valves and reflux valves operating satisfactorily. | ..... |
| 4 | Specified stainless steel or aluminium pump numbers are correctly installed on the pump pit walls adjacent to the pumps. | ..... |
| 5 | Pump with the lowest serial number (or number../1) installed as Pump 1 (ie. nearest to switchboard). | ..... |
| 6 | Pump and / or baseplate supported on grout pads and foundation bolts tight. | ..... |
| 7 | With delivery gate valves shut, fill the pump casings with water (vent casing). | ..... |

APPENDIX A - PRECOMMISSIONING CHECKLIST Contd

ELECTRICAL

**ITEMS:
CONTRA**

CTOR

TO

CERTIFY

COMPLIA

NCE

- 1 "DANGER ELECTRIC" marker bricks installed at ground level and painted yellow.
- 2 Pole / pillar termination method is as per the specification and the Supply Authority requirements.
- 3 Cable supports for the pump cables, pressure transmitter cables and pressure switch cables are correctly located and properly fixed.
- 4 Pressure transmitter cables are installed in separate conduit to power cabling
- 5 Motor cables supported in the pit so as to avoid damage when removing other pump/pumps.
- 6 Motor cables in pit have minimal slack and do not present undue stress on motor cable glands.
- 7 Pressure switches have been adjusted to correct settings
- 8 All rubbish, sand and dirt removed from pump pit.
- 9 Correct orientation and fixing of the switchboard.
- 10 Earth electrode installed in specified connection box.
- 11 Earth pit, main earth electrode and water service bond installed.
- 12 All cables properly glanded at the switchboard.
- 13 Switchboard plinth and all gland plates sealed with silicon sealant.
- 14 Appropriate lugs fitted to all flexible cables, and cables correctly identified at terminations.
- 15 Check pump detail plate (in switchboard) has been engraved with pump motor nameplate details.

- 16** Set the overloads to the motor rating (0.58 times for star/delta), set overloads to manual and transition timers to 5 seconds (where fitted). Set "integral" breakers instantaneous setting.

APPENDIX A - PRECOMMISSIONING CHECKLIST Contd

ELECTRICAL	ITEMS:	Contd CONTRA TO <u>COMPLIA</u>
	CTOR CERTIFY <u>NCE</u>	
17	All switchboard terminations have been retensioned, particularly those terminations carrying motor current.	.....
18	Motor terminations are in accordance with the connection diagram. With star-delta starters, cable No. 1 is connected to the wiring from the overload.	.....
19	"Notification of Electrical Work" submitted to:- a Supply Authority b Copy to HWC	..........
20	Electricity supply has been connected and energised.	.....
21	With the motor circuit breakers open and the control isolators off, turn the main switch on and check that the supply monitoring relay picks up (indicating correct supply phase sequence).	.....
22	Measure the voltages both phase to phase and phase to neutral. Compare the actual voltages relative to typical no-load voltage of 435/250V, and the voltage variation between phases should be less than 2%.	.....
23	With the main switch, pump circuit breakers and control isolating switches off, megger all motors at 500V. This must give greater than 1 Mohm, and ideally greater than 30 Mohms. Record Results: Pump. 1.....Mohm Pump. 2.....Mohm Pump. 3.....Mohm	.....
24	If thermistors are fitted, use a low voltage ohmmeter to check that the resistance T1 to T2 is between 150 and 600 ohms. Record Results: Pump. 1.....ohm Pump. 2.....ohm Pump. 3.....ohm	.....

CONTRACTOR'S SIGNATURE:..... DATE

AUDIT CARRIED OUT BY SUPERINTENDENT'S REPRESENTATIVE: DATE

APPENDIX B - COMMISSIONING SCHEDULE

NOTE: Commissioning is normally carried out with all installation work complete, electricity supply connected, pumps installed and pipework connected. For pumps which cannot be operated in reverse rotation ensure that the coupling halves have not been connected.

PUMPING STATION:

- 1 Turn the pump /motor shaft by hand to ensure they are free to rotate.
- 2 Check motor and pump nameplate for all details and for compliance with the data shown on the pump rating plate. Take a copy of nameplate information.
- 3 Open inlet valves to both pumps
- 4 With the main switch, pump circuit breakers and control isolating switches off, megger all motors at 500V. This must give greater than 1 Mohm, and ideally greater than 30 Mohms.

Record Results: Pump. 1.....Mohm
Pump. 2.....Mohm
Pump. 3.....Mohm
- 5 Set Reduced Voltage Starter as per manufacturer's instructions.
- 6 Turn the circuit breaker for one pump on and with personnel clear of **all** pumps, momentarily turn the control switch to `on' and check for correct rotation as indicated by the arrow on the pump casings and also that the correct pump starts. Switch pump circuit breaker off. Repeat for all the remaining pumps.
- 7 Connect coupling halves (where applicable). Operate each pump momentarily and check for leaks , pump /motor vibration or noise.
- 8 Switch all circuit breakers and the main switch off.

CONTRACTOR'S SIGNATURE:..... DATE

AUDIT CARRIED OUT BY SUPERINTENDENT'S REPRESENTATIVE: DATE

APPENDIX C - ASSET AND EQUIPMENT NUMBER LABELS LIST

APPENDIX D - DRAWING LIST

[END OF STS405]