1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide water supply pump stations as documented, including booster pumps, non return valves, mechanical, connections to the network, pipe work, manifold, equipment, devices, pressure accumulator tank, power, telemetry, alarms and housing structures.

Precedence
Precedence: The technical requirements of, or any standard drawing provided by, the Water Authority, used in conjunction with and in conflict with this worksection, take precedence.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 0319 Minor concrete works.
- 1101 Traffic control.
- 1341 Water supply – reticulation (Construction).

1.3 REFERENCED DOCUMENTS

The following documents are incorporated into this worksection by reference:

Standards
AS 1111 ISO metric hexagon bolts and screws—Product grade C
AS 1111.1-2000 Bolts
AS 1112 ISO metric hexagon nuts
AS 1112.1-2000 Style 1 – Product grades A and B
AS 1112.2-2000 Style 2 – Product grades A and B
AS 1272-1974 Unsintered PTFE tape for thread sealing applications
AS 1349-1986 Bourdon tube pressure and vacuum gauges
AS/NZS 1359 Rotating electrical machines - General requirements
AS/NZS 1359.5:2004 Three-phase cage induction motors - High efficiency and minimum energy - performance standards requirements
AS 1627 Metal finishing—Preparation and pre-treatment of surfaces
AS 1627.4-2005 Abrasive blast cleaning of steel
AS 1657-1992 Fixed platforms, walkways, stairways and ladders—Design, construction and installation
AS/NZS 1680 Interior lighting
AS/NZS 1680.2.4:1997 Industrial tasks and processes
AS 2528-1982 Bolts, stud bolts and nuts for flanges and other high and low temperature applications
AS/NZS 3000:2007 Wiring rules
AS/NZS 3008 Electrical installations—selection of cables
AS/NZS 3008.1.1:2009 Cables for alternating voltages up to and including 0.6/1 kV—Typical Australian installation conditions
AS/NZS 3190:2011 Approval and test specification - Residual current devices (current-operated earth-leakage devices)
AS/NZS 4680:2006 Hot-dipped galvanized (zinc) coatings on fabricated ferrous articles
1.4 STANDARDS

General
Standard: To WSA 03 Part 2.

1.5 INTERPRETATIONS

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
- ITP: Inspection and Test Plan.
- PLC: Programmable Logic Controller.
- PVC: Polyvinyl Chloride.
- RTU: Remote Telemetry Unit.
- SCA: Switchgear and Control gear Assembly.
- SCADA: Supervisory Control and Data Acquisition.

Definitions
General: For the purposes of this worksection the definitions given in WSA 03 and the following apply:
- Commissioning: Running the plant and equipment to make sure there is 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.
- Electricity distributor: Any person or organisation that provides electricity from an electricity distribution system and includes distributor, supply authority, network operator, local network service provider, electricity retailer or electricity entity, as may be appropriate in the relevant jurisdiction.
- Nominal size (DN): Dimensionless whole number, which is indirectly related to the physical size, in mm of the bore or outside diameter of the end connections.
- Pre-commissioning: 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.
- Water Agency: An authority, board, business, corporation, Council or local government body with the responsibility for planning or defining, design, construction and maintenance requirements for a water supply and/or sewerage systems.

1.6 SUBMISSIONS

Approvals
Submissions: To the Superintendent's approval. Submit the following for approval:
- Calculations: Survey set out of pump station and quantity calculations.
- Components: Pumps, pipes, fittings, valves and hydrants.
- Work-as-executed drawings: Include water supply pump station information sheets and works.
- Execution details: Refer to HOLD POINTS.
- Materials: Off-site certificates of components.
- Samples: For conformity testing to relevant standards.
- Technical data: Product information.
1.7 HOLD POINTS AND WITNESS POINTS

Notice
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

HOLD POINTS table

<table>
<thead>
<tr>
<th>Clause title/ Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Authorised products and materials</td>
<td>Submit for approval alternative products and materials.</td>
<td>2 weeks before ordering</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Electrical equipment</td>
<td>Submit all shop drawings for approval</td>
<td>2 weeks before ordering</td>
<td>Superintendent</td>
</tr>
</tbody>
</table>

**EXECUTION**

<table>
<thead>
<tr>
<th>Clause title/ Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td>General - Electrical safety and earthing</td>
<td>Test for defects and submit a certificate of safety declaration.</td>
<td>1 week</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Electrical installation - Marker tape</td>
<td>Submit for approval underground cabling requirements.</td>
<td>2 weeks</td>
<td>Superintendent</td>
</tr>
</tbody>
</table>

**Practical completion**

<table>
<thead>
<tr>
<th>Clause title/ Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td>General - Requirement</td>
<td>Test and commission and submit completed commissioning record sheet</td>
<td>3 working days</td>
<td>Water Agency and/or Superintendent</td>
</tr>
<tr>
<td>General - Requirement</td>
<td>Obtain approval of the Operating and Maintenance Manuals</td>
<td>1 week before operating</td>
<td>Water Agency and/or Superintendent</td>
</tr>
</tbody>
</table>

WITNESS POINTS table

<table>
<thead>
<tr>
<th>Clause title/ Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compliance with manufacturers recommendations</td>
<td>Inspect material and products at time of delivery.</td>
<td>2 working days</td>
</tr>
</tbody>
</table>

**EXECUTION**

<table>
<thead>
<tr>
<th>Clause title/ Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>General - Set out</td>
<td>Confirm the set out locations immediately prior to construction.</td>
<td>3 working days.</td>
</tr>
</tbody>
</table>

| **Electrical requirements** | |
| General - Approval of electrical products and materials | Submit proposal for all equipment for approval | 2 weeks |

**Pre-commissioning**

<table>
<thead>
<tr>
<th>Clause title/ Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Test and prepare the pump station and submit pre-commissioning record.</td>
<td>3 working days</td>
</tr>
</tbody>
</table>

**Commissioning**

<table>
<thead>
<tr>
<th>Clause title/ Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>General - Notification</td>
<td>Give notice of the intention to undertake commissioning</td>
<td>5 working days</td>
</tr>
</tbody>
</table>
2 PRE-CONSTRUCTION PLANNING

2.1 SCHEDULING

Program of works
General: Program the works as follows:
- Materials: Arrange the program so that it conforms with the approved products and materials.
- Authorities: Arrange approvals and conform to the local environmental requirements e.g. protection of the environment and heritage areas.
- Control of erosion and sedimentation: Prepare an erosion and sediment control plan before starting the works.

3 MATERIALS

3.1 GENERAL

Authorised products and materials
Products and materials: Provide only products and materials authorised by the Water Agency, the drawings and this specification. Submit for approval any alternative or non-authorised products and materials. This is a HOLD POINT.

Unauthorised material: Remove unauthorised or non-conforming materials from the site within 24 hours.

Conformance with manufacturer’s recommendations
Requirement: Handle, transport and store materials in conformance with the manufacturer’s recommendations and in a manner to prevent damage or deterioration or excessive distortion. Inspect all products and materials at the time of delivery and reject products and materials not in conformance with this specification and the manufacturers recommendations. This is a WITNESS POINT.

On site storage: Store in protective crating or packaging until immediately before use.

Damaged or defective materials: Do not use damaged or defective materials, including coatings and linings, outside the manufacturer’s recommended limits.

Equipment
Manufacturer’s warranty: Provide a written warranty from the manufacturer of the equipment covering liability for any defect in materials or workmanship which becomes apparent at any time within 2 years after the date of delivery of any piece of equipment.

Material: Minimum material requirement to the WSA 130 Table 2.2.

3.2 PUMP EQUIPMENT

General
Pumps: Provide pumps to WSA 130, WSA 131 and the Pump equipment schedule.

Independent witness testing: Test all pumps before delivery. Provide certificate for testing and the following data:
- Head (m)/quantity (L/s) curve.
- Pump input power curve (kW).
- Pump efficiency curve (%).
- NPSHR curve(s).

Motors: Test motors before delivery and submit certificate in conformance with AS/NZS 1359.5.

Pump equipment schedule

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Equip 1</th>
<th>Equip 2</th>
<th>Equip 3</th>
<th>Equip 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchasing requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal size (DN x DN)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump capacity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.3 ELECTRICAL EQUIPMENT

General
Provide: Provide all switchboard(s), control panels, level control devices and level probe support brackets required for each pump station.
Shop drawings: Submit all shop drawings for approval before manufacture. This is a HOLD POINT.

Switchboards
Requirement: Provide complete switchboards with circuit breakers, contactors, fuses, soft starters, relays, timers, instruments and accessories.
Type: Outdoor, stationary, free standing, metal-enclosed, cubicle type series with a minimum degree of protection of IP56D in conformance with AS 60529 and the following:
- Securely mount all equipment on suitable mounting panels.
- Individual compartments.
- Provide a steel galvanized channel base.
Test: Test switchboards before delivery and provide certificate from the manufacturer.
Manufacturer: Conform to AS/NZS 3190 and submit certification including ITP and circuit diagrams.
Fault current: Show prospective fault currents for each installation on the respective power circuit diagrams. Confirm all fault levels with the electrical distributor.

3.4 STEEL AND CONCRETE

Structural steel and concrete
General: Conform to the NATSPEC 03 Structure worksections relevant to the structure being constructed.

Ancillary steelwork
Ladders, brackets and covers: To AS 1657.
Abrasive blast cleaning: To AS 1627.4 Class 2.5.
Protection: Hot-dip galvanize to AS/NZS 4680.

Ancillary concrete works
Premixed, normal class concrete: To 0319 Minor concrete works.

3.5 PIPES AND FITTINGS

General
Requirement: Provide pipes and fittings in conformance with the drawings, the schedules and 1341 Water supply – reticulation (Construction).

3.6 VALVES AND HYDRANTS

General
Requirement: Provide valves and hydrants in conformance with the drawings, the schedules and 1341 Water supply – reticulation (Construction).
3.7 NUTS, BOLTS AND WASHERS

General
Standard: To AS 1111.1, AS 1112.1 and AS 1112.2, ISO metric series and fitted with washers beneath bolts heads and nuts as follows:
- Stainless steel to ASTM A240/A240M, minimum grade 316.
- Passivated.
- Rolled threads.
- Hexagonal heads.
- To AS 2528.
- Fit with lock washers/nuts as required for vibration.

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Requirement: Conform to 1101 Control of traffic.

4.2 ESTABLISHMENT

General
Set out: Confirm pump station and equipment location before construction. This is a WITNESS POINT.
Space allocations: Conform to any space allocation agreements, local agreements with land owners or other utility service provider.
Temporary drainage during construction
General: Conform to the requirements of 1341 Water supply – reticulation (Construction).

4.3 EXCAVATION

General
Requirement: Conform to the requirements of 1341 Water supply – reticulation (Construction).

4.4 BOOSTER PUMPS

Construction
General: Construct the water booster pumping station and associated works to the documented levels, grades, materials and methods. Implement and maintain environmental protection measures before disturbing the natural surface on site. Conform to 1152 Road openings and restorations if work is carried out in roadways.
Installation
General: Install pumps, discharge equipment and other associated equipment in conformance with the drawings and manufacturer’s recommendations. Undertake and complete all work, including fittings, before connecting to the water supply system.
Provision for maintenance
Maintenance: Provide dismantling joints and valves in the pipe work to facilitate removal of the pumps for maintenance and minimise the need for surge control devices. Make sure all pumps in the booster are identical and interchangeable with a pump operation of no more than 47.5 Hz and include temperature sensors.

4.5 PRESSURE GAUGES

General
Requirement: Install one diaphragm protected, glycerine oil filled, direct mounting, bottom connection pressure gauge complying with AS 1349 for centrifugal pump installation.
Inclusions: Provide each gauge with sized metric equivalent of 3 bronze fittings including gate valve, union, nipple and reducing nipple.
Protective case: Fabricate from stainless steel in conformance with ASTM A240/A240M or bronze. Provide a case which can be dismantled for cleaning without affecting the accuracy of the gauge.
Calibration: 100 mm diameter gauge face, calibrated in head (m) of water indicating the pump operating head and the pump no-flow head.

**Installation**

Requirement: Conform to the following:
- Pipework ≥ 150 mm: Screw gauges and fittings into the pipe wall of ductile iron pipes or pipe fittings. Install a ball valve to allow removal of the gauge where required.
- Pipework < 150 mm: Screw gauges and fittings into a tapping band.

Gauge range: For single or parallel pumps duty, 0 to 1.7 times the shut off head of the pumps.

### 4.6 BOLTS

**General**

Protrusion of bolts on flanges: No more than 10 mm past the nut when tightened.

Anti-galling, anti-seize: Apply to threads of all stainless steel fasteners either of the following:
- Polytetrafluoroethylene (PTFE): Either tape to AS 1272, dipped or sprayed.
- Molybdenum disulphide.

Concrete anchor bolts, nuts, locking nuts and large series washers: Provide anchor bolts with a minimum diameter of 16 mm to the equipment manufacturer’s details.

Concrete anchor bolts: Chemical masonry type set to full depth.

### 4.7 ELECTRICAL REQUIREMENTS

**General**

Standards: To AS/NZS 3000.

Proof of conformance: Provide proof of conformance with test certificate from an approved independent testing authority.

Electrical safety and earthing to water services: Test for defects in the electrical supply, provide a conductive bridge around the work area if required, notify occupants and electricity distributors of any change. Provide a certificate of safety declaration to proceed. This is a HOLD POINT.

Approval of electrical products and materials: Submit proposal for all equipment for approval. This is a WITNESS POINT.

Power system and supply: Provide for continuous monitoring of the availability of incoming power supply, power supply at the station and the control power supply.

Lighting: To AS/NZS 1680.2.4.

Lightning and surge protection: Provide to all incoming power supply and control power supply.

**Electrical installation**

Supply authority requirements and metering: Conform to the following:
- Submit an Application for supply to the electricity distributor.
- Make sure that permanent power is available before completion of the electrical installation.
- Submit an Application for service requirements and Notification of Electrical work to the electricity distributor.
- Pay all fees associated with the metering including inspection fees and capacity charges.
- Provide copies of all applications.
- Mount the metering equipment inside the switchboard or as shown on the drawings.

Point of supply: Obtain a service marking from the electricity distributor. Confirm the point of attachment.

Cabling: Provide all cabling including consumer mains, motor, control and flow meter cables, conduits and electrical pits.

Underground cabling: Submit for approval underground cabling requirements. This is a HOLD POINT.

Conduits: Install all wiring in HD-PVC underground conduits in conformance with the following:
- Laid to the electricity distributor’s requirements.
- Tolerances:
  - Non-trafficable areas: Minimum 500 mm below the finished ground level.
  - Trafficable areas: 600 mm below the finished ground level.
- Clear the trench and backfill material of rocks and other foreign matter likely to damage the conduits.

Marker tape: Run electrical marker tape 150 mm below the finished ground level directly above the conduits for the entire length of the conduits. Conform to the following:
- Colour: Orange.
- Width: 150 mm.
- Warning text: Stamped with the words DANGER—ELECTRIC CABLES BELOW or similar.

Brass marking plates: Position brass marking plates on any concrete surround clearly showing the direction of the incoming consumer mains and including the following:
- Wording and markings: DANGER – ELECTRICAL CABLES BELOW.

Consumer mains: Generally run the consumer mains underground and commence at the Point of Supply/Attachment on a consumer’s steel pole (if applicable), installed near the property boundary and run in conduit to the switchboard.

Minimum size: Size consumer mains to satisfy the following requirements:
- Current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30% minimum.
- A voltage drop less than 1.5% to the maximum demand as calculated.
- Single core PVC/PVC cables. XLPE insulated cable may also be used.
- In conformance with the requirements of the electricity distributor.
- Pole termination method as shown on the drawings.
- To AS/NZS 3000 and AS/NZS 3008.1.1.

Earthing

Combined earthing system: Provide an MEN earthing system in conformance with AS/NZS 3000, the electricity distributor and the relevant state Service and Installation Rules.

Earthing conductor: Size and installation to the relevant state Service and Installation Rules and AS 3000. Run the main earthing conductor in conduit to the main earthing electrode.

Earthing connection: Contain the main earthing connection in an earthing electrode connection box,
Pipe work: Bond the pump station metallic pipe work to the main earth
Surge diverters: Provide a separate earthing conductor and electrode for the surge diverters, bond each electrode and label with engraved brass label.
Labelling: Label all major earth connection cables clearly at both ends.

Metering equipment

Requirement: Install metering facilities and panel within the switchboard as follows:
- To the approval of the electricity distributor.
- Suitable for the installation of the metering equipment required by the electricity distributor.
- Plug-in meter bases or all electricity meters (tariffs) supplied by the electricity distributor, as may be required by the electricity distributor.
- Service potential fuses.
- Current transformers metering equipment (if required).
- All necessary wiring and other accessories required by the electricity distributor.
- Key locking facilities for electricity distributor access.

Lock barrels: Liaise with the electricity distributor to supply a lock barrel for the metering equipment.

Switchboard

Standard: To AS 60947.5.1.

Switchboard manufacturer: Provide the switchboard and control gear designed and assembled by an approved manufacturer. Full AS/NZS 3190 certification including ITP and AS/NZS 3190 documentation for circuit diagrams.

Type: Outdoor, stationary, free standing, metal-enclosed, cubicle type series with a minimum degree of protection of IP56D in conformance with AS 60529. If the switchboards are installed within the pump station buildings the minimum degree of protection will be IP51. Switchboards to conform to the following:
- Securely mount all equipment on suitable mounting panels.
- Provide individual compartments for equipment as documented.
- Provide a steel galvanized channel base.

SCA electrical characteristics: Conform to the following:
- Main Circuit: 415/240 V, 50 Hz, 3-phase, 4-wire.
- Motor Control Circuit: 240 V, 50 Hz.
- Common Control Circuit: 240 and 24 V, A.C.
- Prospective short-circuit current: 14 kA for 1 second.
- Peak Factor: 2.2.
- Power Factor Correction (Determined in consultation with the Water Agency).
- Earthing (Multiple Earthed Neutral (MEN system).

**Switchboard installation**

Lifting and placement: Provide appropriate lifting facilities including lifting rods inserted through lifting loops in the switchboard support frame or lifting lugs.

Equipment mounting: Mount switchboards as shown on the drawings.

Thermal derating of equipment:
- Derate switchgear installed in switchboards to the manufacturer’s recommended derating or to 88% of the equipment's nominal current rating, whichever is the greater.
- Derate solid state power equipment installed in switchboards to the manufacturer’s recommended derating or to 77% of its nominal 35°C current rating, whichever is the greater.

Switchgear data: Confirm Type 2 co-ordination between contactors, motor protection relays and corresponding circuit breakers.

Starter contactors: Confirm starter contactors have the appropriate rating for the proposed pumps to AC3 duty.

Lightning and surge protection: Confirm provision for all incoming power supply and control power supply as documented.

Operation: Make sure the AUTO mode can be overridden by turning the starter selector switch to the ON position.
- Manual operation: For use in the event of failure of the telemetry system or for function testing.
- Warning label: Provide a warning label (R/W/R) advising selector switches to be left in the AUTO mode to common control cover.

Pump control: Provide control equipment compatible with the existing equipment.

Lock barrel: Standard lock barrels for use on the switchboard are provided by the Superintendent.

Terminals: Provide the necessary terminals with terminal and cable numbers in conformance with the drawings. Connect the pump motor cables to the appropriate terminals. Do not joint cables.

Cable entry: Provide gland cables entering the outdoor switchboard compartment using non-ferrous metallic or plastic glands with neoprene compression seals.

Sealing: At the completion of commissioning tests, seal all conduits into the outdoor SCA with a non-setting sealing compound to prevent the ingress of vermin.

**Completion of electrical works**

Notification: Submit to the electricity distributor, the Notification of wiring completed by the switchboard manufacturer together with the Notification of wiring covering the installation work.

Switchboard metering panel: Attach a copy of the Notification of wiring for the switchboard to the switchboard metering panel.

Verification: Arrange inspection and testing for the electrical works in conformance with the electricity distributor.

Work-as-executed drawings: Provide electrical installation drawings showing changes that occurred during installation. Show prospective fault current for each installation on the respective power circuit diagrams.
4.8 CONTROL AND TELEMETRY

General
Requirement: Install telemetry hardware including radio, antenna, surge protection and associated
cabling between the RTU in the switchboard and the antenna as documented. Submit proposal for
equipment as required.
Communication service: Provide a communication service compatible with the existing system.
SCADA: Install SCADA to conform with manufacturers recommendations including upstream and
downstream clearances. Connect pump station, reservoir, tank, control valves, flow meters and
chambers to the SCADA for monitoring and control to conform with the drawings.
Alarms and controls: Provide an alarm and control system as documented and in conformance with
the following:
- Do not use flashing lights.
- Wire digital input signals into a dedicated labelled terminal strip.
- Wire all signals from the dedicated terminal strip to an RTU cubicle marshalling terminal strip and
then to the RTU.

Telemetry hardware
Requirement: Provide telemetry hardware in conformance with the following:
- Compatible with any existing systems.
- Allowing space in the switchboard for future installation of terminals.
- Analogue signals running to an interfacing strip with 2 terminals per signal and of the disconnect
type.
- Standby power supply for an 8 hour power supply failure.
- Lightning and surge protection housing within the cubicle.

Telemetry software
Telemetry software: RTU/PLC programming and configuration in conformance with the logic drawings,
process and instrumentation drawings, configuration list, I/O lists and including central monitoring and
display system.

4.9 PRE-COMMISSIONING

General
Requirement: Test and prepare the pump station in conformance with the pre-commissioning
procedure, schedules and record sheets in conformance with WSA 03 clause 6.2.3.2. Submit one
signed copy of each completed pre-commissioning record sheet countersigned by the agreed
independent witness when giving notice of the intention to start commissioning. This is a WITNESS POINT.

Specific requirements
Inclusions: Including but not limited to the following:
- Initial charges of lubricant in addition to any special lubricant requirements for initial flushing or
treatment of the system or for running in.
- Physical checks and tests including:
  . 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.
- Electrical and instrument installation tests, including motor insulation tests and checking instruments
against certified instruments and correcting as necessary.
- Tests for the correct functioning of automatic and manual control and protection equipment,
including simulating danger conditions, mal-operations and failures. These tests also include
adjusting instrument set points and alarm settings and proving correct operation of alarms.
- Equipment and system operating tests: Certify compliance of each item and submit a signed copy prior to commissioning.

4.10 COMMISSIONING

General
Notification: Give notice of the intention to undertake commissioning. This is a WITNESS POINT.
Procedure: Test and commission the pump station in conformance with the commissioning procedure, schedules and record sheets in conformance with WSA 03 clause 6.2.3.
Supervision: 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.
Final testing: Carry out final testing and commissioning (min. 1 day duration) of the electrical services in conjunction with the mechanical equipment (e.g. pump, etc) including setting and adjustment of equipment in conformance with state regulations.

4.11 PRACTICAL COMPLETION

General
Requirement: Conform to the following before the Date of Practical Completion:
- Submit a certificate of approval from the relevant statutory authorities.
- Submit one signed copy of each completed commissioning record sheet countersigned by the agreed independent witness. This is a HOLD POINT.
- Obtain Superintendent approval of the Operating and Maintenance Manuals. This is a HOLD POINT.
- Submit work-as-executed drawings of the pump station.

Work-as-executed details
Requirement: Submit work-as-executed details as follows:
- Work-as-executed drawings in the same format is the design drawings, certified by a Registered Surveyor.
- Showing the actual location of pump station and details including the size and type of pipes, valves, hydrants and pumps, switchboard equipment details.
- Asset register data.

Operation and maintenance manuals
Submit: Provide 3 copies of operation and maintenance manuals at the time of notification of commissioning. Include the following information in the manuals:
- Contractor’s name, address and telephone number.
- Client’s contract number, job name.
- Circuit diagrams.
- Electrical and mechanical layout.
- Workshop fabrication drawings.
- Commissioning manual.
- Pump station general arrangement drawing showing pumps, motors, valves, pipework, switchboard and electrical installation.
- Safe working procedures: For switching and isolating the supply and distribution system.
- Description of operation.
- Maintenance procedures: Recommended maintenance periods and procedures.
- Tools: Particulars of maintenance equipment and tools provided, with instructions for their use.
- Equipment: A technical description of the equipment supplied, with diagrams and illustrations where appropriate.
- Dismantling: Where necessary, procedures for dismantling and reassembling equipment;
- Spare parts: A list of the spare parts provided.
- Trouble shooting instructions for pumps, motors, valves and SCA.
- Assembly/disassembly procedures: Step-by-step procedures for dismantling and reassembly of pumps, motors and valves using any special tools.
- Replacement procedures: Step-by-step procedures for replacement of wearing parts such as bearing, seals, wear rings, etc.
Pump and motor curves: Include the following test curves in the manuals:
- Pump witnessed test curves.
- Motor test curves.
- Motor torque/speed/efficiency characteristic curves.
Pumps: Include the following information in the manuals for pumps:
- Manufacturer.
- Type and model number.
- Serial number.
- Dimensioned general arrangement drawing of pump and motor.
- Sectional arrangement drawing with parts and list.
- Dimensioned sectional arrangements detailing:
  - Maximum and minimum shaft/bearing clearance (radial).
  - Maximum and minimum impeller/bowl clearance (radial).
  - Maximum and minimum impeller/bowl clearance (axial).
  - Impeller/bowl wear rings.
  - Motor/pump coupling—type, make and model number.
  - Mechanical seals where applicable.
Motors: Include the following information in the manual for motors:
- Manufacturer.
- Type and model number.
- Serial number.
- Dimensioned general arrangement drawing.
- Sectional arrangement drawing for submersible motor power cabling where applicable.
- Gland sealing arrangement drawing for submersible motor power cabling where applicable.
- Cables where applicable.
- Terminal block arrangement drawing where applicable.
Valves: Include the following information in the manuals for valves:
- Dimensioned sectional arrangement drawing with parts and material list for all valves.

4.12 LIMITS AND TOLERANCES

Application
Summary: In addition to the limits and tolerances documented in 1341 Water supply – reticulation (Construction) the following are applicable to this worksection, summarised in Summary of limits and tolerances table.

Summary of limits and tolerances table

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXECUTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete anchor bolts, locking nuts and washers diameter</td>
<td>16 mm minimum</td>
<td>Bolts and flanges</td>
</tr>
<tr>
<td>Electrical requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cover to HD-PVC underground conduits</td>
<td></td>
<td>Electrical installation</td>
</tr>
<tr>
<td>- Non-trafficable areas</td>
<td>500 mm minimum below the finished ground level</td>
<td></td>
</tr>
<tr>
<td>- Trafficable areas</td>
<td>600 mm below the finished ground level</td>
<td></td>
</tr>
</tbody>
</table>