# TWEED SHIRE COUNCIL

# DEVELOPMENT CONSTRUCTION SPECIFICATION

# C401

# **WATER RETICULATION**

**VERSION 1.6**

# SPECIFICATION C401 - WATER RETICULATION

## CITATION

This document is named “Tweed Shire Council, Development Construction Specification C401 - Water Reticulation”.

## ORIGIN OF DOCUMENT, COPYRIGHT

This document was originally based on AUS-SPEC - Development Construction Specification C401 - Water Reticulation, March 2002 (Copyright SWR-TM). Substantial parts of the original AUS-SPEC document have been deleted and replaced in the production of this Tweed Shire Council Development Specification. The parts of the AUS-SPEC document that remain are still subject to the original copyright.

## VERSIONS, C401 WATER RETICULATION

| VERSION | AMENDMENT DETAILS | CLAUSES AMENDED | DATE ISSUED (The new version takes effect from this date) | Authorised by the Director of Engineering and Operations |
|---|---|---|---|---|
| 1.1 | Original Version | | 1 July 2003 | |
| 1.2 | Updated references to Standard Drawings and WSAA Water Supply Code. Reference new Mechanical and Electrical Specifications to replace MEW E101<br>Separation requirements for water mains per WSAA<br>Green detectable marking tape required on mains.<br>Trench stops of cement stabilised sand bags or concrete bulkheads required for grades 5% to 14%. Clarify height requirements for trench stops.<br>White hydrant covers, not yellow.<br>Pipeline testing not to commence until all utility services installed in the area. Reduce test duration from 8 to 4 hours. Adopt WASA formula for allowable leakage and specify 1000m max test length.<br>Update hydrant and valve marking requirements. Delete references to marking plates. Blue metal marking posts, not timber. Delete sub-clause 4 relating to fixing of marking plates after installation. | Various<br>C401.19<br>C401.27.16<br>C401.28.1<br>C401.30.3<br>C401.37<br>C401.41 | 18 August 2010 | |
| 1.3 | Amend minimum trench widths, to provide minimum 450mm<br>Clarify height requirements for | Table C401.1 | 19 March 2013 | |

| | | | | |
|---|---|---|---|---|
| | bulkheads, in line with trench stops<br><br>Amend witness point to hold point for pressure testing mains, amend hydrostatic test pressure, add excessive leakage rate to rectification works triggers and specify final water inspections immediately prior to subdivision final, as a hold point. Delete alternative compressed air test method.<br><br>Add hold point for disinfection, and require flushing after disinfection | C401.29<br><br>C401.37<br><br>C401.39 | | |
| 1.4 | Replace all references to SWAC with "Certifying Engineer"<br><br>Remove references to AS1289.5.7.1 | Various<br><br>C401.40 | 5 February 2016 | |
| 1.5 | Amend/ Addition to reference documents<br>Inclusion of pipe protection<br>Removal and inclusion of pipe materials<br>Amendment to Sluice Valves<br>Amendment to PRV's<br>Amendment to Cover<br>Amendment to Pipe Bedding<br>Amendment to Test Pressure<br>Inclusion of Live Water Connections<br>Inclusion of chlorine testing<br>Inclusion of Appendices – Appendix A – Pumping Station Pre-Commissioning | C401.02 & various<br>C401.03<br>C401.04 to .10<br>C401.13<br>C401.17<br>C401.20<br>C401.26<br>C401.37<br>C401.38<br>C401.39<br>Appendices | 25 March 2019 | |
| 1.6 | Addition of Standard Design plans to Reference Documents<br><br>Correction to air valve DN size<br><br>Amendments to Thrust and Anchor Blocks | C401.02<br><br>C401.14<br><br>C401.33 | 18 January 2022 | |

| | | | | |
|---|---|---|---|---|
| | Update reticulation test pressure and trunk mains water pressure | C401.37 | | |

# DEVELOPMENT CONSTRUCTION SPECIFICATION C401

# WATER RETICULATION

## GENERAL

### C401.01 SCOPE

1. This Specification is for the construction of: ***Suitable Works***

   (a) Mains up to DN600 nominal size;

   (b) Small pump stations.

2. This Specification excludes the construction activities for: ***Exclusions***

   (a) Reservoirs, including repainting of reservoirs;

   (b) Treatment plants;

   (c) Dams;

   (d) Headworks, including bores and weirs;

   (e) Dosing plant;

   (f) Larger pump stations;

3. The Subdivider shall carry out the work, and supply materials meeting the requirements of the reference documents, and, in particular, in accordance with the requirements of the WATER SUPPLY CODE OF AUSTRALIA except as otherwise specified herein. ***Compliance with Standards***

### C401.02 REFERENCE DOCUMENTS

1. Documents referenced in this Specification are listed below whilst being cited in the text in the abbreviated form or code indicated. The Subdivider shall possess, or have access to, the documents required to comply with this Specification. ***Documents***

2. References to the WATER SUPPLY CODE OF AUSTRALIA are made where there are parallel sections or equivalent clauses to those in this Specification. Where not called up as part of this Specification, these references are identified by part and section numbers and enclosed in brackets thus (WSA Edition, Part, Section). ***Water Supply Code***

**(a) Council Specifications**

| | | |
|---|---|---|
| C271 | - | Minor Concrete Works |
| C211 | - | Control of Erosion and Sedimentation |
| D11 | - | Water Supply |
| EL01-EL19 | - | Electrical Specifications |
| ME01-ME04 | - | Mechanical Specifications |

**(b) Australian Standards**

*Australian Standards*

References in this Specification or on the design plans to Australian Standards are noted by their prefix AS or AS/NZS.

*Currency*

Where not otherwise specified in this Specification or the design plans, the Subdivider shall use the latest Australian Standard, including amendments and supplements, available within two (2) weeks of close of tenders.

| | | |
|---|---|---|
| AS/NZS 1111 | - | ISO metric hexagon commercial bolts and screws |
| AS/NZS 1112 | - | ISO metric hexagon nuts, including thin nuts, slotted nuts, and castle nuts |
| AS 1152 | - | Specification for test sieves |
| AS/NZS 1260 | - | PVC pipes and fittings for drain, waste and vent applications |
| AS 1272 | - | Unsintered PTFE tape for thread sealing applications |
| AS 1289.5.4.1 | - | Compaction control test – Dry density ratio, moisture variation and moisture ratio |
| AS 1289.5.7.1 | - | Compaction control test (Rapid method) |
| AS 1349 | - | Bourdon tube pressure and vacuum gauges |
| AS 1432 | - | Copper tubes for plumbing, gas fitting and drainage applications |
| AS 1444 | - | Wrought alloy steels – Standard, hardenability (H) series and hardened and tempered to designated mechanical properties |
| AS 1449 | - | Wrought alloy steels – Stainless and heat-resisting steel plate, sheet and strip |
| AS/NZS 1477 | - | PVC pipes and fittings for pressure applications |
| AS 1565 | - | Copper and copper alloys – Ingots and castings |
| AS 1579 | - | Arc welded steel pipes and fittings for water and waste water |
| AS/NZS 1594 | - | Hot-rolled steel flat products |
| AS 1627.4 | - | Metal finishing – Preparation and pre-treatment of surfaces – Abrasive blast cleaning |
| AS 1646 | - | Elastomeric seals for waterworks purposes |
| AS 1657 | - | Fixed Platforms, walkways, stairways and ladders – Design, construction and installation |
| AS 1830 | - | Iron castings – Grey cast iron |
| AS 1939 | - | Degrees of protection provided by enclosures for electrical equipment |
| AS 2032 | - | Code of practice for installation of PVC pipe systems |
| AS 2033 | - | Installation of polyethylene pipe systems |
| AS 2129 | - | Flanges for pipes, valves and fittings |
| AS/NZS 2280 | - | Ductile iron pressure pipes and fittings |
| AS 2419.2 | - | Fire hydrant installations – fire hydrant valves |
| AS 2528 | - | Bolts, studbolts and nuts for flanges and other high and low temperature applications |
| AS 2544 | - | Grey iron pressure fittings |
| AS/NZS 2566.1 | - | Buried flexible pipelines – Structural design |
| AS 2638 | - | Sluice valves for waterworks purposes |
| AS 2837 | - | Wrought alloy steels – Stainless steel bars and semi-finished products |
| AS/NZS 3000 | - | Electrical installations (Wiring rules) |
| AS/NZS 3008 | - | Electrical installations – selection of cable |
| AS 3439 | - | Low voltage switchgear and control gear assemblies |
| AS/NZS 3518 | - | Acrylonitrile butadiene styrene (ABS) pipes and fittings for pressure applications |

| | | |
|---|---|---|
| AS 3571 | - | Glass filament reinforced thermosetting plastics (GRP) pipes – Polyester based – Water supply, sewerage and drainage applications |
| AS 3578 | - | Cast iron non-return valves for general purposes |
| AS 3681 | - | Guidelines for the Application of polyethylene sleeving to Ductile Iron pipelines and fittings |
| AS 3690 | - | Installation of ABS pipe systems |
| AS 3691 | - | Solvent cement and priming (cleaning) fluids for use with ABS pipes and fittings |
| AS 3862 | - | External fusion-bonded epoxy coating for steel pipes |
| AS 3952 | - | Water supply –Spring hydrant valve for waterworks purposes |
| AS 3996 | - | Metal access covers, road grates and frames |
| AS 4087 | - | Metallic flanges for waterworks purposes |
| AS/NZS 4129 | - | Fittings for polyethylene (PE) pipes for pressure applications |
| AS/NZS 4130 | - | Polyethylene (PE) pipes for pressure applications |
| AS/NZS 4158 | - | Thermal-bonded polymeric coatings on valves and fittings for water supply purposes |
| AS/NZS 4321 | - | Fusion bonded medium density polyethylene coating & lining for pipes and fittings |
| AS/NZS 4680 | - | Hot-dipped galvanised (zinc) coatings on fabricated ferrous articles |
| AS/NZS 4441(Int) | | Oriented PVC (OPVC) pipes for pressure applications |
| AS 4794 | - | Non-return valves – Swing check and tilting disc |

**(c) Other**

Institute of Public Works Engineering Australia (IPWEA)

- Streets Opening Conference Information Bulletin on Codes and Practices (Sections 3 and 4 detailing locations and depths of other services and preferred location for water reticulation pipes)

Building Codes Board of Australia

- Building Code of Australia - PART E1, Fire Fighting Equipment.

Plumbing Code of Australia (PCA)

**Water Services Association of Australia (WSAA)**

| | | |
|---|---|---|
| WSA 01-2004 | - | POLYETHYLENE PIPELINE CODE |
| WSA 03-2011 | - | WATER SUPPLY CODE OF AUSTRALIA |
| WSA 03-2011 | - | PRODUCT AND MATERIAL INFORMATION AND GUIDEANCE |
| WSA 03-2002-DRAWINGS) | - | WATER SUPPLY CODE OF AUSTRALIA (STANDARD |
| WSA PRODUCT SPECIFICATIONS FOR PRODUCTS AND MATERIALS - WSA PS 200 TO 404 (Where Relevant) | | |

British Standard

| | | |
|---|---|---|
| BS 410 | - | Specification for test sieves |

**(d) Standard Design plans that apply to this section;**

Tweed Shire Council (TSC) Standard Drawings

| | | |
|---|---|---|
| S.D. 301 | - | Water Reticulation Layout - Cul De Sacs |
| S.D. 302 | - | Property Service Layout - DN50 or Smaller Services |
| S.D.303 | - | Horizontal Thrust Blocks Water Mains – Test Pressure 1200kPa |
| S.D.304 | - | Thrust and Anchor Blocks for Vertical Bends Water Mains – Test Pressure 1200kPa |
| S.D.305 | - | Thrust Blocks for Valves and Inline Thrust Water Mains – Test Pressure 1200kPa |
| S.D. 311 | - | Automatic Air Release Valve Installation Details |
| S.D. 312 | - | Sluice Valve Installation Details |
| S.D. 313 | - | Fire Hydrant Installation Details |
| S.D. 314 | - | DN100 Pressure Reducing Valve Installation Details |
| S.D. 316 | - | Marking for Location of Hydrants |
| S.D. 320 | - | Property Services Connection to Main |
| S.D. 321 | - | DN20 & DN25 Property Service Details |
| S.D. 322 | - | DN40 & DN50 Property Service Details |
| S.D. 323 | - | DN50 or Smaller Property Service with DN100 or Larger Fire Service |
| S.D. 324 | - | DN100 or Larger Property Service |
| S.D. 325 | - | DN100 or Larger Property Service with DN100 or Larger Separate Fire Service |
| S.D. 327 | - | DN100 or Larger Fire Sprinkler Service |
| S.D. 341 | - | Trench Drainage Bulk Heads and Trench Stops |

Water Code of Australia (WSA 02-2002, Part 4, Standard Drawings WAT-1100 to WAT-1409)

DPWS Standard Design plans

***Precedence***

Tweed Shire Council Drawings shall take precedence over Water Supply Code of Australia Drawings.

Where any standard drawing used in conjunction with this Specification includes technical requirements that conflict with this Specification, the requirements of this Specification shall take precedence.

# MATERIALS

## C401.03 GENERAL

1. The Subdivider shall comply with the requirements of the manufacturer's recommendations regarding the handling, transport and storage of materials and as further specified in this Specification. ***Due Diligence***

2. Pipes and fittings are to be delivered, handled and stored protected from damage, contamination and where applicable ultra violet light. During delivery transport and storage, pipe ends must remain capped/sealed. Capping/Sealing must be adequate to prevent water and other contaminants entering the pipe. The Subdivider shall take account of the time for storage and type of shelter. ***Protection***

3. The Subdivider shall not use damaged or defective materials, including coatings and linings, outside the manufacturer's recommended limits. ***Rejection***

## C401.04 UNPLASTICISED AND MODIFIED PVC (uPVC and OPVC)

1. Where approved by TSC, PVC Pressure Pipe shall be used as specified below: ***PVC***

   (a) Unplasticised PVC (uPVC) pressure pipe shall be specified to be manufactured in accordance with AS/NZS 1477 Series 2 and AS/NZS 4765, designed in accordance with AS/NZS 2566.1, and with rubber ring (elastomeric) spigot and socket joints.

   (b) Oriented PVC (OPVC) pressure pipe shall be specified to be manufactured in accordance with AS/NZS 1477 and AS/NZ 4441. Where OPVC is proposed in design the Minimum Required Strength (MRS) shall be no greater than the following values;
   - 400 MRS for PN12.5
   - 450 MRS for PN16.

     (Note: 500 MRS is not accepted by TSC)

2. PVC pipes and fittings for mains and suction pipes shall be installed in accordance with AS 2032 and AS/NZS 2566.1. ***Installation***

3. Pipes and fittings are to be handled and stored protected from sunlight. The Subdivider shall provide protection for the pipes and fittings from ultra violet light and damage. ***Protection***

4. The Designer shall ensure that PVC pressure pipe is compatible with ductile iron pipe where necessary. ***DI Compatible***

5. Fittings for use with PVC pressure pipe shall be DICL elastomeric seal jointed. ***Fittings***

6. PVC-M shall not be used on pressure pipe. ***PVC-M***

## C401.05 DELETED

## C401.06 GLASS REINFORCED PLASTIC (GRP)

1. Where approved by TSC, Glass filament reinforced thermosetting plastics (GRP) pipes may be used and shall comply with AS 3571 and installed in accordance with AS/NZS 2566. (WSA 03-2011, Part 1, Section 4). ***Standard***

2. Pipes and fittings shall be handled and stored protected from sunlight. The Subdivider shall provide protection for the pipes and fittings from ultra violet light and damage. The Subdivider shall take account of the time for storage and type of cover. ***Protection***

## C401.07 DUCTILE IRON (DI) PIPE AND FITTINGS

1. Ductile iron (DI) pipes and fittings shall comply with AS/NZS 2280 and shall be of the class, size and lining, as shown on the design plans, and installed in accordance with AS/NZS 2566.1. Jointing shall be with rubber rings (elastomeric), complying with AS 1646, to the class and type as shown on the design plans. ***Standard***

2. Flanges shall be to the table shown on the design plans. Bolts and nuts for flanged joints shall be galvanised, or stainless steel as for the pumps specified herein, unless shown otherwise on the design plans. ***Flanges***

3. All pipework shall be sleeved externally with polyethylene sleeving in accordance with the requirements of AS 3681 unless specified otherwise to be coated and lined. All fittings shall be fusion-bonded coated, in accordance with AS/NZS 4321, or wrapped. The wrap all unprotected joints in the trench with a petrolatum tape system approved by the Certifying Engineer. ***Corrosion Protection***

## C401.08 STEEL PIPELINE AND FITTINGS

1. Where approved by TSC, Steel pipelines and fittings may be used and shall comply with AS 1579 and AS/NZS 1594 and shall be of the class, size, lining and coating as shown on the design plans. (WSA 03-2011 Part 1, Section 4.). ***Standard***

2 The Subdivider shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Certifying Engineer. ***Corrosion Protection***

3. The jointing system shall be rubber ring (elastomeric), complying with AS 1646, unless shown otherwise on the design plans. ***Joints***

4 The Subdivider shall not lay continuously welded steel pipelines parallel to, when in close proximity, high voltage power lines. ***High Voltage Powerlines***

## C401.09 COPPER PIPE AND FITTINGS

1. Where approved by TSC, Copper tube and fittings may be used and shall comply with AS 1432 and shall be of the size and type as shown on the design plans. ***Standard***

2. The Subdivider shall install copper tube, capillary and compression fittings, insulated from ferrous mains, as shown on the design plans. (WSA 03-2011) ***Insulated***

### C401.10 MATERIALS FOR CUL DE SACS - POLYETHYLENE (PE)

1. Polyethylene pipe shall comply with AS/NZS 4129 and AS/NZS 4130 and shall be of the class and size as shown on the design plans and installed in accordance with AS 2033. (WSA 03-2011 Part 1, Section 4) ***Standard***

2. Jointing shall be by butt thermal fusion or by electrofusion couplings, or with compression fittings. ***Jointing***

3. Fittings up to 110mm shall comply with AS/NZS 4129. Fittings from 110mm to 600mm shall be ductile iron in accordance with AS/NZS 2280 and coated internally and externally in polyethylene in accordance with AS/NZS 4129. ***Fittings***

4. The Subdivider shall provide pipe of the appropriate external diameter consistent with the required internal diameter shown on the design plans. ***Internal Diameter***

### C401.11 STEELWORK

1. Structural steelwork, including ladders, brackets, and covers, complying with AS 1657, shall be abrasive blast cleaned to AS 1627.4 Class 2.5 and hot dip galvanised to AS/NZS 4680. (WSA 03-2011 Part 1, Section 4.) ***Corrosion Protection***

## VALVES AND HYDRANTS

### C401.12 GENERAL

1. The Subdivider shall ensure that the valves and hydrants supplied are compatible with the pipework such that proper sealing is provided between the pipe flanges and the valve. The concrete lining in pipework shall not be chipped away or reduced to provide clearance from the working parts of valves. ***Compatibility with Pipework***

2. The Subdivider shall ensure that the valves and hydrants are installed so as to facilitate maintenance. The Subdivider shall take into account the manufacturer's recommendations, the requirements shown on the design plans, the type of connection, lubrication of connecting bolts, and the location of valves within valve chambers or type of backfill material. (WSA 03-2011, 2, 15.13) ***Installation***

3. The type of external corrosion protection of buried valves and hydrants shall be fusion-bonded medium density polyethylene coating to AS 3862 and AS/NZS 4321 or thermal-bonded polymeric coating to AS/NZS 4158. ***Corrosion Protection***

4. Flanges shall comply with AS 2129 and AS 4087 and shall be of the class and size shown on the design plans. ***Flanges***

### C401.13 STOP VALVES

1. Sluice valves shall be resilient seated valves manufactured in accordance with AS 2638. The valves shall be flanged where permitted by TSC unless shown otherwise on the design plans. (WSA 03-2011, Part 1, Section 8). Sluice valves on dead ends and future end connections shall use anchorage systems. ***Sluice Valves***

2. Ball valves shall be flanged where permitted by TSC unless shown otherwise on the design plans. (WSA 03-2011, Part 1, Section 8) ***Ball Valves***

3. Butterfly valves shall be flanged where permitted by TSC, unless shown otherwise on the design plans. (WSA 03-2011, Part 1, Section 8) ***Butterfly Valves***

4. Knife Gate valves shall be flanged where permitted by TSC unless shown otherwise on the design plans. (WSA 03-2011, Part 1, Section 8) ***Knife Gate Valves***

5. Scour valve assemblies shall be as shown on the design plans. (WSA 03-2011, Part 5, & WSA 03-2002, Part 4, WAT –1307) ***Scour Valves***

6. Valves shall be operated by a removable key. The Subdivider shall size "Tee Key" valve operators and hand wheels to operate the valves under all operating conditions throughout their full range with no greater than 180 Newtons applied to the ends of the key bar or the rim of the wheel. ***Operation***

7. Hand wheels, where specified, shall display an embossed or engraved arrow, together with "open" and/or "close" corresponding to the valve operation. ***Hand Wheel Arrow***

## C401.14 AIR VALVES

1. Air valves shall be of the double air valve type with integral isolating valve of minimum size DN50, and shall be installed as shown in the design plans. (WSA 03-2011, Part 1, Section 8) ***Standard***

2. Air valves shall be installed such that they can be maintained without affecting supply. ***Isolation***

3. The Subdivider shall obtain the consent of TSC for the use of other types of air valves. ***Alternate Type***

## C401.15 NON-RETURN VALVES

1. Non return valves shall be of the swing check type to AS 3578 or AS 4794 of cast iron or steel body, cover and disc with bronze body and disc seat rings. The leaf shall swing clear and provide an unobstructed waterway. (WSA 03-2011, Part 1, Section 8) Wafer style non-return valves shall not be used. ***Standard***

2. The body cover shall be located and sized to allow the valve flap to be removed and the seat to be inspected without removing the valve body. ***Maintenance***

3. Where shown on the design plans, non-return valves shall have an extended spindle, minimum grade 316 stainless steel complying with AS 1449, fitted with an adjustable counterweight, together with a proximity switch to indicate a no-flow condition. ***No Flow Switch***

4. No flow switches shall have the following features: ***Switch Features***

   (a) Be of the eccentric cam operated limit switch type.

   (b) Have a minimum rating of 10 amps, 240 V AC, 50- Hz.

   (c) Be oil tight and dust proof to IP 65.

   (d) Be suitable for 25mm conduit entry.

   (e) Be mounted on rigid stainless steel complying with AS 1449 adjustable brackets. The brackets shall be free of sharp edges and exposed corners.

### C401.16 SPRING HYDRANTS

1. Spring hydrant bodies shall be manufactured in accordance with AS 3952 and installed in accordance with AS 2419.2 except as varied below. (WSA 03-2011, Part 1, Section 8) ***Standard***

2. The top of spring hydrants shall be between 100mm and 200mm below finished surface level as detailed in WSA 03-2011, Part 5, & WSA 03-2002, Part 4, WAT-1104. If necessary, this shall be achieved by the use of hydrant risers of various heights. ***Access***

3. Spring hydrants shall be protected internally and externally with fusion-bonded coating in accordance with AS4158, or equivalent protection approved by the Certifying Engineer.

### C401.17 PRESSURE REDUCING VALVES

1. Pressure reducing valves shall be of the type as shown on the design plans. ***Type***

2. Pressure reducing valves shall be installed with isolating valves and hydrants to facilitate maintenance. ***Installation***

3. Pressure Reducing Valves shall be surveyed to confirm upstream and downstream levels. Levels are to be provided to Council for calibration and acceptance testing.

## PIPELINE CONSTRUCTION

### C401.18 GENERAL

1. The Subdivider shall not change the pipeline alignment without prior concurrence of TSC. The Subdivider shall provide full details, of any proposed changes to the pipeline alignment, to the Certifying Engineer for submission to TSC. This action constitutes a **HOLD POINT**. The Certifying Engineer shall obtain the decision of TSC prior to the release of the hold point. ***Alignment Changes***

***HP***

### C401.19 LOCATION

1. The location of the mains and pump stations, sizes of mains, types of chambers and covers and the classes of pipes shall be as shown on the design plans. The pipelines shall be laid to grades and locations shown on the design plans and to tolerances in the WATER SUPPLY CODE unless directed otherwise by the Certifying Engineer (WSA 03-2011, Part 2, Section 21). The Subdivider shall confirm the locations immediately prior to construction. (WSA 03-2011, Part 2, Section 11). ***Pipe Laying Method***

2. Water mains shall be located in accordance with WSA 03-2011, 1, 2.7 obeying all separation requirements, unless otherwise directed by TSC. ***Separations***

## C401.20 COVER OVER PIPELINES

1. The minimum depth of cover to be provided for mains, measured vertically from the finished ground level to the top of any socket, shall be as follows: ***Minimum Cover***

   (a) 500mm for public and private lots not subject to vehicular loading,

   (b) 600mm for footways, driveways, nature strips, public and private lots in industrial/commercial areas subject to vehicular loading,

   (c) 750mm for sealed road pavements, other than major roads, subject to vehicular loading,

   (d) 1200mm over major road carriageways

2. Lesser cover may be provided where special protection of the pipelines has been shown on the design plans or approved by TSC. ***Special Protection***

3. Greater cover shall be provided at valves, where special situations occur, where there is conflict with other services or to meet grading requirements. ***Special Needs***

4. Where approved by TSC, the maximum cover over an existing trunk water main shall be 3000mm. The maximum cover over an existing reticulation water main shall be 1000mm. ***Maximum Cover***

## C401.21 CROSSINGS

1. Where a pipeline crosses a Main or State road, creek or involves features shown on the design plans, under the control of any Authority, the Subdivider shall carry out the work in accordance with the requirements of that Authority. The Subdivider shall provide written notification to the Authority of the intention to carry out the work, and pay the appropriate fees. (For Aqueducts, see WSA 03-2011, Part 2, –Section 15.16). The Subdivider shall obtain the written approval from the Authority prior to commencement of work. Such written approval shall be supplied to the Certifying Engineer if requested. This action constitutes a **WITNESS POINT**. The Certifying Engineer shall advise at the time of notification by the Subdivider whether the option to request the written approval is to be exercised. ***Subdivider's Responsibility*** ***WP***

2. Where shown on the design plans, the Subdivider shall use trenchless methods for the installation of the mains. The installation of the main by open trenching shall not be permitted over the lengths designated for trenchless installation unless otherwise approved by TSC. (For details see WSA 03-2011, Part 2, Section 15.15). ***Existing Road Crossings***

3. The Subdivider shall address, in its Method Statement for trenchless conduit installation, the following: ***Trenchless Installation Methodology***

   (a) General description of method and sequence of operation.

   (b) Size, depth and position of temporary pits required.

   (c) Use of specialist subcontractors.

   (d) Specialist equipment to be used.

   (e) Grout type and method of injection.

4. The encasement pipe shall be as detailed on the design plans. The encasement pipe shall extend 1.0m behind the back of the kerb on either side of the carriageway. ***Encasement Pipe***

5. The carrier pipe shall be positioned on support cradles and the carrier pipe shall be centrally located within the encasement pipe. ***Support Cradles***

6. After installation and pressure testing of the carrier pipe, the Subdivider shall fill the annular space between the carrier pipe and the encasement pipe with a suitable grout or cementitious grout filler. ***Grouting***

7. Where the carrier pipe is ductile iron cement lined (DICL), any length of pipe which is enclosed within the encasement pipe need not be wrapped in polyethylene tubing.

## C401.22 EARTHWORKS

1. The Subdivider shall carry out all excavations for structures and pipelines to the lines, grades and forms shown on the design plans or as directed by the Certifying Engineer within the specified tolerances. The Subdivider shall comply with all requirements of the appropriate Authority including having regard for drainage, dewatering, silt control, noise abatement, proximity to existing buildings and generally for the amenity of adjacent owners. (WSA 03-2011, Part 2, Section 13). ***Subdivider Responsibility***

2. The Subdivider shall leave a clear space of 600mm minimum between the edge of any excavation and the inner toe of stockpiles. No excavated materials shall be stockpiled against the walls of any building or fence without the written permission of the owner of such building or fence. Topsoil from excavations shall be stockpiled separately and utilised to restore the surface after backfilling. ***Excavated Material***

3. At the completion of work each day, the Subdivider shall install safety fencing to Statutory requirements along the edges of open excavations to isolate them from the public. The Subdivider shall provide fenced walkways and vehicular crossings across trenches to maintain access at all times from carriageway to individual properties or within individual properties and advise all affected residents beforehand. All installations shall be of adequate size and strength and shall be illuminated to prevent accidents. ***Public Safety*** ***Access to Property***

4. The Subdivider shall locate, protect and repair, as necessary, all services affected by the Works at the Subdivider's expense. ***Existing Services***

5. The Subdivider shall carry out erosion and sedimentation control at all construction sites in accordance with the Specification for CONTROL OF EROSION AND SEDIMENTATION. ***Erosion Control***

6. The Subdivider shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open. (WSA 03-2011, Part 2, Section 13.2). ***Limiting Excavations***

## C401.23 MINIMUM TRENCH WIDTH FOR PIPELINES

1. The minimum clear width of trench (inside internal faces of timbering or sheet piling, if used) to a height of 150mm above the top of the pipe shall be as shown in Table C401.1.

| NOMINAL SIZE OF PIPE (DN) | MINIMUM CLEAR WIDTH OF TRENCH (mm) (inside timbering or sheet piling, if any) | |
|---|---|---|
| | PIPE OTHER THAN PVC/PE | PVC/PE PIPE |
| 100 | 450 | 450 |
| 150 | 450 | 450 |
| 200 | 500 | 450 |
| 225 | 550 | 500 |
| 250 | 550 | 500 |
| 300 | 600 | 550 |
| 375 | 700 | 650 |
| 400 | 700 | 650 |
| 450 | 750 | 700 |
| 500 | 850 | 800 |
| 525 | 850 | 800 |
| 600 | 950 | 900 |

**Table C401.1 - Minimum Trench Widths**

2. Where the design plans provide for a trench to be excavated across a paved surface, the width of the trench shall be kept to a minimum. Bitumen and concrete surfaces shall be carefully cut, by sawcutting or other means approved by the Certifying Engineer, so as to provide a neat straight line free from broken ragged edges. ***Minimum Disturbances***

3. The Subdivider shall widen the trench where necessary for the installation of valves and fittings and protective coating systems. ***Widen For Fittings***

### C401.24 EXCAVATION DEPTH

1. The Subdivider shall excavate trenches to 75mm below the underside of the pipe barrel and socket or coupling except for mains to be laid on other than rock foundations or as otherwise shown on the design plans. ***75mm Below***

2. The excavation shall be carried out such as to ensure solid and uniform support for each pipe over the whole length of barrel with chases provided for joints and wrapping. ***Pipe Support***

### C401.25 SUPPORT OF EXCAVATION

1. The Subdivider shall adequately support all excavations to Statutory requirements as the Works proceed. When withdrawing supports, the Subdivider shall exercise every precaution against slips or falls. (WSA 03-2011, Part 2, Section 13.5) ***Precautions Against Slips or Falls***

2. The Subdivider shall ensure that timber is left in place where its removal may endanger structures in the vicinity of the excavation. ***Timber Left in Place***

## C401.26 PIPE BEDDING

1. When excavation of the trench has been completed the Subdivider shall obtain the Certifying Engineer's approval prior to commencing pipe laying, jointing and bedding. This action constitutes a **HOLD POINT**. The Certifying Engineer's approval of the excavated trench is required prior to the release of the hold point.

***Approval***

***HP***

2. Crusher screenings shall only be used for pipe bedding where sand or other non-cohesive material is not readily available locally or where the Subdivider can demonstrate that its use will not impede repair operations. (WSA 03-2011, Part 2, Section 14).

***Crusher Screenings***

3. Pipes (excluding PVC/PE pipes) may be laid directly on other than rock foundation. The Subdivider shall provide non-cohesive granular bedding, having a minimum thickness of 100mm below the barrel and socket of the pipe, where rock or other hard material occurs in the bottom of the trench. The bedding material shall conform to the WSA 03-2002, Part 4 WAT-1200 Soil Classification Guidelines.

***Pipes other than PVC/PE***

4. For PVC/PE pipes, irrespective of foundation, the material to be used for pipe bedding (underlay a minimum of 100mm below the underside of the pipe barrel and socket, side support and overlay to a depth of 150mm above the top of the pipe) as shown in Figure 5.1 in AS 2032 shall be in sand or other non-cohesive granular material, either crushed, natural or blended, and its grading shall fall within the limits in Table C401.2. Subdivider

***PVC/PE Pipes***

| Sieve Size Aperture Width (AS1152) | Equivalent BS Sieve Size (BS410) | Percentage Passing |
|---|---|---|
| 9.5 mm | 3/8 inch | 100 |
| 6.7 mm | ¼ inch | 90 - 100 |
| 425 μm | No. 36 | 40 - 90 |
| 150 μm | No. 100 | 0 - 10 |

**Table C401.2 - Grading of Bedding Material for PVC and PE Pipes**

5. Use embedment materials that:

***Embedment Materials***

   (a) Comply with the maximum particle sizes in Table C401.3

   (b) Comply with the Purchase Specification for embedment materials as nominated in the Design drawings or Specification

   (c) Comply with the environment, ie: Sand specified for sand environments

| Pipe Diameter (DN) | Particle Size (mm) | Bedding Materials |
|---|---|---|
| All | 7 to 14 | Aggregate |

**Table C401.3 – Particle Size**

6. All mains laid on grades steeper than 50 per cent shall be as outlined in C401.29 and TSC SD341. ***Grades Greater Than 50%***

## C401.27 LAYING AND JOINTING OF PIPES

1. Unless detailed otherwise in this Specification, the Subdivider shall install pipes in accordance with AS 2032, AS 2033, AS/NZS 2566.1 or AS 3690 as appropriate. (WSA 03-2011, Part 2, Section 15 & WSA 03-2002, Part 4 WAT-1102 to 1105). ***Installation***

2. Before being laid, all pipes, fittings, valves, and materials to be used shall be cleaned and examined by the Subdivider and, if required by the Certifying Engineer, the Subdivider shall suspend each one in a sling to enable the Certifying Engineer to inspect it. If directed by the Certifying Engineer, the Subdivider shall oil valves and repack valve glands. ***Examination***

3. The Subdivider shall ensure that the interior of the pipeline is clean and free from obstructions. Plugs shall be used to prevent foreign matter entering sections of pipeline which are left uncompleted overnight. ***Cleaning***

4. The Subdivider shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. Any temporary supports shall be removed prior to completion of backfilling. ***Flotation***

5. Except where solvent cement joints are needed to make up or install fittings, joints in pipelines shall be flexible, rubber ring (elastomeric) joints, either roll-on or skid type or, where shown on the design plans, mechanical joints, either fixed flange or bolted gland type. ***Joint Type***

6. For pipes with rubber ring (elastomeric) joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. The Subdivider shall make the joint such that the witness mark shall, at no point, be more than 1mm from the end of the socket. ***Rubber Ring***

7. Pipes may be cut as needed or directed by the Certifying Engineer to suit closing lengths, to remove damaged pipe or fittings or to remove sockets if necessary when jointing a socketed fitting. ***Cut Pipes***

8. For field cuts, a mechanical pipe cutter shall be used, except that PVC/PE pipes may be cut using a power saw or a fine toothed handsaw and mitre box. For field cuts of ductile iron or steel, the Subdivider shall ensure that fire-fighting equipment, in working order, is on the site prior to the field cuts being made. If the Subdivider proposes to use a petrol engine pipe cutter in an excavation, the Subdivider shall ensure that a safe atmosphere is maintained in the excavation at all times. ***Pipe Cutting***

9. The Subdivider shall prepare the ends of any pipes cut in the field to the manufacturer's written instructions, or as directed by the Certifying Engineer. ***End Preparation***

10. Where pipes are cut in the field, the Subdivider shall make a witness mark on the pipe using a felt-tip marking pen at the length specified by the manufacturer from the end of the pipe. The Subdivider shall not use PVC/PE pipes with scored witness marks. Where the same manufacturer does not make spigots and sockets, the Subdivider shall refer to the socket manufacturer for the correct marking depth. ***Witness Mark***

11. Where PVC/PE pipes are to be joined to ductile iron pipes, the joints shall be made by inserting a PVC/PE spigot into a ductile iron socket. Ductile iron spigots shall not be joined to PVC/PE sockets. Alternatively, multi-fit mechanical couplings or flanged adaptor couplings may be used to join pipes of different materials. ***Different Joints***

12. The Subdivider shall conform with the relevant Statutory and OH&S requirements when cutting and disposing of asbestos cement pipes. ***Existing AC Pipe***

13. Flexibly jointed pipelines with gradual changes in alignment or grade shall be laid with the joint being deflected after it has been made. The Subdivider shall comply with the manufacturer's written recommendations in respect of maximum deflection for each joint provided that no joint shall be deflected to such an extent as to impair its effectiveness. ***Joint Deflection***

14. The maximum angle of deflection between adjacent pipes shall be limited to $2^{o}$ or 0.035 radian in areas subject to mine subsidence or slippage. ***Limit of Joint Deflection***

15. Unless otherwise directed by the Certifying Engineer, the Subdivider shall lay pipes on continuously rising grades from scour valve to air release valve, notwithstanding any minor irregularities in the ground surface. ***Grade***

16. Green detectable marking tape shall be laid along the line of all mains. The tape is to be positioned at either the interface between the bedding material and the backfill material, or 150mm above the top of the service when the backfill material is the same as the bedding material. ***Detectable Tape***

## C401.28 TRENCH STOPS

1. Where a pipe is laid on bedding at a grade of 5 per cent to 14 per cent, the Subdivider shall construct, as below, trench stops consisting of bags filled with cement stabilised sand and sealed, or concrete bulk heads. Refer to standard drawing S.D.341. ***Grade 5% to 14%***

   (a) At the socket side of the joint nearest to the position of a stop required in accordance with the formula hereinafter, a recess 100mm deep to suit the width of bag shall be excavated into the bottom of the trench across its full width and into both sidewalls and extend to within 300mm below finished surface level, or up to a maximum 1 metre above the pipe obvert (whichever is the lesser).

   (b) The bags shall be placed around and above the pipe, as in (a) above, so as to give close contact with the pipe and to fill the entire space between the excavated recess and the pipe. Bags shall not be placed onto sand bedding.

2. The distance between trench stops shall be determined by the following formula: ***Spacing***

$D = \frac{100}{G}$, whereby

D = Distance between stops in m,
G = Grade of pipe expressed in percentum.

## C401.29 CONCRETE BULKHEADS

1. Where a pipe is installed at a grade of 15 per cent to 29 per cent, the Subdivider shall construct concrete bulkheads. Where a pipe is installed at a grade 30 per cent to 50 per cent, the Subdivider shall construct concrete bulkheads integral with concrete encasement. Where a pipe is installed at a grade 50% and over the Subdivider shall provide a site specific design. Bulkheads shall be of 20MPa concrete complying with TSC Standard Drawing SD341 and Specification C271 MINOR CONCRETE WORKS, 150mm minimum thickness as follows: (WSA 03-2002, Part 4 WAT-1209 and WSA 03-2011, Part 2, Section 15.10) ***Grade 15% to 29% and 30% to 50% and over 50%***

   (a) Where concrete bedding or encasement to pipe is required, the 150mm thick bulkhead shall be cast integral with the concrete bedding or encasement across the width of trench and shall be keyed into both sidewalls a minimum of 150mm. The bulkhead shall extend to within 300mm below finished surface level, or up to a minimum 1 metre above the pipe obvert (whichever is the lesser).

   (b) Where other bedding, or no bedding, is applicable, the bulkhead shall also be keyed into the bottom of the trench 150mm for the full width of trench.

   (c) A 75mm nominal diameter drain hole shall be provided in the concrete bulkhead immediately above the top of the encasement bedding or foundation and crushed rock or gravel shall be placed in and at the upstream end of the drain hole to act as a filter. The gravel shall be 10 to 20mm in size within 150mm in all directions upstream and above the invert of the drain hole beyond which another 150mm thick surround of gravel 2 to 10mm in size shall be placed.

2. The distance between concrete bulkheads shall be determined by the following formula: ***Spacing***

   Concrete bulkhead

   $D = \frac{L}{G}$

   Concrete encasement (continuous) and concrete bulkhead

   $D = \frac{100}{G}$, whereby

   L = 80 X Pipe length, m
   = 450 m max
   if L> 100 m use intermediate trench-stops at spacing < 100/G
   D = Distance between bulkheads in m
   G = Grade of pipe expressed in percentage

## C401.30 VALVE AND HYDRANT CHAMBERS

1. The Subdivider shall construct around each valve and hydrant a chamber of the type and to the details shown on the design plans. (WSA 03-2011, Part 2, Section 15.13). ***Type***

2. The concrete shall comply with the Specification C271 MINOR CONCRETE WORKS. ***Concrete***

3. Valve and hydrant chamber covers shall be manufactured from white coloured materials, and not painted white after installation. ***Colour Designation***

4. Where the type of valve chamber is such that the body, or part of the body, of the valve is to be backfilled before the valve chamber is constructed, the Subdivider shall either wrap the valve using a tape consisting of synthetic fibre open weave cloth impregnated with saturated hydro-carbons, applied in accordance with the valve manufacturer's written instructions, or apply at least one (1) coat of corrosion preventing material to the valve body after the valve has been installed but before backfilling. The coating material shall be compatible with the coating material which has been applied to the valve prior to delivery. ***Corrosion Protection***

## C401.31 CHAMBER COVERS AND FRAMES

1. Covers and frames shall not be warped or twisted. Surfaces shall be finished such that there are no abrupt irregularities and gradual irregularities shall not exceed 3mm. Unformed surfaces shall be finished to produce a surface that is dense, uniform and free from blemishes. Exposed edges shall have a minimum 4mm radius. ***Finish***

2. Tolerances for the dimensions on the COVER shall be - 3mm + NIL. ***Cover Tolerance***

3. Tolerances for the dimensions on the FRAME shall be - 3mm + 3mm. ***Frame Tolerance***

4. Covers shall be seated as shown on the design plans or as directed by the Certifying Engineer. ***Cover Seating***

5. Covers shall be finished flush with the surface in road pavements, footpaths and other paved surfaces. Elsewhere, covers shall be finished 25mm above the surface of the ground, or such other level as directed by the Certifying Engineer, in a manner designed to avoid as far as possible, the entry of surface water. ***Cover Levels***

6. Cast iron covers and frames shall be manufactured in accordance with AS 3996 and shall be installed and filled with concrete, as necessary, in accordance with the manufacturer's written requirements. ***Installation***

7. The Subdivider shall take care to avoid lateral movement, cracking and subsidence when installing plastic covers and frames. ***Plastic Covers***

## C401.32 SERVICE CONNECTIONS

1. The Subdivider shall provide service connections in accordance with the approved design plans, or if not detailed in these plans, in accordance with the WATER SUPPLY CODE (WSA 03-2002, Part 4 WAT-1108 and WAT-1109). ***Provision***

2. The Subdivider shall leave the water main exposed for a distance of half a metre either side of the service connection to enable the necessary inspections by the Certifying Engineer prior to backfilling by the subdivider. ***Main Exposed***

## C401.33 THRUST AND ANCHOR BLOCKS

1. Thrust and anchor blocks shall be constructed where shown on the design plans to the dimensions depicted in TSC Standard Drawings S.D.303 to S.D.305or as otherwise directed by the Certifying Engineer. The blocks shall be provided at valves, flexibly jointed bends, tees, enlargers and reducers or any other point where unbalanced forces resulting from internal pressures will occur. (WSA 03-2002, Part 4 WAT –1205 to WAT - 1207 and WSA 03-2011, Part 2, 15.7). ***Location***

2. The Subdivider shall provide permanent thrust blocks of minimum 20MPa concrete, complying with the Specification C271 MINOR CONCRETE WORKS, such that the thrust blocks bear against undisturbed material normal to the direction of thrust resulting from internal pressures over the bearing area not less than that specified in S.D.303 and 305 or as directed by the Certifying Engineer. ***Thrust Blocks***

3. The Subdivider shall provide permanent anchor blocks of minimum 20MPa concrete, complying with the Specification C271 MINOR CONCRETE WORKS, of a volume not less than that specified in S.D.304 or as directed by the Certifying Engineer. ***Anchor Blocks***

4. The Subdivider shall provide temporary anchorages adequate to restrain the pipe when under test. ***Temporary Anchorage***

5. The Subdivider shall obtain the consent of TSC for the type and use of restrained joints, as an alternative to thrust blocks, in the case of congested service corridors and urgent commissioning. ***Restrained Joints***

## C401.34 CONCRETE ENCASEMENT

1. Where pipes have less than 450mm of cover above the top of the pipe barrel, or where directed by the Certifying Engineer, they shall be encased in concrete. Concrete shall be 20MPa complying with the Specification C271 MINOR CONCRETE WORKS and have the following minimum dimensions: (WSA 03-2002, Part 4 WAT-1202, WAT–1203, WAT–1204, WAT–1211, WAT–1212, WAT - 1213 and WSA 03-2011, Part 2, Section 16.6) ***Location***

   (a) For trenches in other than rock: 150mm minimum under, on both sides and on top of the pipe barrel.

   (b) For trenches in rock: 75mm minimum under the pipe barrel, 150mm on top of the pipe barrel and for the full width of trench excavated.

2. In trenches of other than rock or fissured rock, a contraction joint consisting of a layer of bituminous felt 12mm thick shall be formed in the concrete encasement at the face of each socket or at one (1) face of each coupling. ***Contraction Joint***

3. Reinforcement in concrete encasement shall be as shown on the design plans. ***Reinforcement***

## C401.35 WRAPPING OF PIPELINES

1. Where shown on the design plans, the Subdivider shall enclose a pipeline or a section thereof, in layflat polyethylene sleeving. (WSA 03-2011, Part 2, Section

15.11).

2. The materials to be used shall be high impact resistance polyethylene sleeving, of minimum thickness 0.2mm polyethylene film approved by the Certifying Engineer and 50mm wide plastic adhesive tape. ***Material***

3. The width of the sleeving when flat shall be in accordance with the manufacturer's written recommendations for the size and type of the pipeline which is to be encased. Precautions shall be taken so that exposure to direct sunlight does not exceed 48 hours. ***Width***

4. For dual trenching, pipelines shall be identified by colour sleeving, blue stripe for potable water and lilac for recycled water, or an appropriate identification tape. ***Colour***

5. Application of the polyethylene sleeving and plastic adhesive tape shall be in accordance with the pipe manufacturer's written instructions or as directed by the Certifying Engineer. The Subdivider shall take due care not to damage the sleeving during its application or during the backfilling of the trench. Each pipe shall be encased in a length of sleeving overlapped for a minimum of 250mm at each field joint, and the ends of each length of sleeving shall be held in position with at least three (3) circumferential turns of adhesive tape. As the polyethylene sleeving material covering the pipe will be loose, excess material shall be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of strips of plastic tape at approximately one (1) metre intervals. Bends, tapers and similar fittings shall be covered by polyethylene sleeving as specified for the pipes. The Subdivider shall hand wrap valves, hydrants and irregular shaped fittings and joints using flat polyethylene sheets secured with plastic adhesive tape, or other suitable material, to provide an adequate seal. The flat polyethylene sheets may be obtained by splitting suitable lengths of sleeving. ***Application***

6. The Subdivider shall rectify any damage done to the polyethylene sleeving before, during or after backfilling of the trench. ***Damage***

### C401.36 CORROSION PROTECTION OF STEEL BOLTS AND NUTS

1. The Subdivider shall wrap all galvanised steel bolts and nuts, used for installation below ground, of flanges, bolted gland joints, mechanical joints, tapping bands using a tape, approved by the Certifying Engineer, consisting of synthetic fibre open weave cloth impregnated with saturated hydrocarbons applied in accordance with the manufacturer's recommendations or as directed by the Certifying Engineer. Bolts and nuts shall be dry, clean and free from rust immediately before wrapping. ***Wrapping***

## PIPELINE TESTING AND RESTORATION

### C401.37 TESTING OF PIPELINES

1. The Subdivider shall pressure test mains to detect leakage and defects in the pipeline including joints, thrust and anchor blocks. This action constitutes a **HOLD POINT**. No testing should be commenced until all utility services (e.g. electricity, telecommunications, gas) have been installed in the area. The Certifying Engineer shall advise at the time of notification by the Subdivider whether the option to inspect the testing is required. Prior to pressure testing, the Subdivider shall provide the Certifying Engineer with a current calibration certificate for the equipment. The equipment shall have a range of 0-2500 kPa with a gauge face greater than 100mm in diameter for reading pressures. ***HP***

2. Pipelines shall be tested in sections approved by the Certifying Engineer as soon as practicable after each section has been laid, jointed and backfilled, provided that:

   (a) If so specified, or if the Subdivider so desires, some or all of the pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of the Certifying Engineer; and

   (b) The pressure testing shall not be commenced earlier than seven (7) days after the last concrete thrust or anchor block in the section has been cast. ***Timing***

3. For the purpose of this clause, a section shall be defined as a length of pipeline which can be effectively isolated for testing, eg by means of main stop valves. ***Section Definition***

4. Pressure testing shall not be carried out during wet weather unless otherwise approved by the Certifying Engineer. ***Wet Weather***

5. During pressure testing, all field joints, which have not been backfilled, shall be clean, dry and accessible for inspection. ***Field Joints***

6. During the pressure testing of a pipeline, each stop valve shall sustain at least once, the full test pressure on one (1) side of the valve in closed position with no pressure on the other side for at least 15 minutes. ***Stop Valves***

7. Before testing a pipeline section, the Subdivider shall clean it to the satisfaction of the Certifying Engineer and fill it slowly with water, taking care that all air is expelled. Purging of air from pressure mains shall be promoted by opening air valves. In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section shall be kept full of water for a period of not less than 24 hours prior to the commencement of the pressure testing. ***Filling with Water***

8. For reticulation mains where working pressure should not exceed 780kPa, the hydrostatic test pressure: ***Reticulation Test Pressure***

   (a) For DICL shall be applied to each section of the pipeline, shall be (but not exceed) 1200kPa.

   (c) For PE80 shall be applied to each section of the pipeline, shall be (but not exceed) 1200kPa.

   (d) For uPVC and OPVC shall be applied to each section of the pipeline, shall be (but not exceed) 1200kPa.

For trunk mains where working pressure exceeds 780kPa, the hydrostatic test pressure shall be specified by the Water Authority. ***Trunk Main Test Pressure***

9. The Subdivider shall maintain the specified test pressure as long as required by the Certifying Engineer while the Subdivider examines the whole section. In any case, the specified test pressure shall be maintained for not less than 4 hours. For the purpose of determining the actual leakage losses, the Subdivider shall carefully measure and record the quantity of water added in order to maintain the pressure during the period of testing. For PE and uPVC pipelines, the general test procedure as outlined in WSA 01-2004-3.1, Part 2, Section 13.5.3 should be adopted. ***Duration of Test***

10. The pressure testing of a section shall be considered to be satisfactory if:

(a) There is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;

(b) There is no visible leakage; and

(c) The measured leakage rate does not exceed the permissible leakage rate as determined by the following formula:

$Q_1 = (0.14xDxLxH)/1000$

where:

$Q_1$ = permissible leakage rate (litres per hour)
D = internal diameter of pipe (mm)
L = length of main tested (km)
H = average test head (m)

(d) Unless otherwise specified by the superintendent, adopt a maximum test length of 1km.

11. Any failure, defect, visible leakage or excessive leakage rate which is detected during the pressure testing of the pipeline or during the Defects Liability Period shall be made good by the Subdivider at the Subdivider's expense. ***Rectification***

12. Final water inspections are to be carried out immediately prior to subdivision final practical inspection, to ensure all water infrastructure is compliant. ***Timing of Final Inspection***

## C401.38 CONNECTION TO EXISTING PIPES

1. Connections to existing pipes carrying water shall be made at such times as will cause the least interference with the supply. The Subdivider shall make arrangements with TSC or other Authority concerned for the timing of the work including the need to isolate the existing mains and notification of affected dwelling occupants. The Certifying Engineer shall be given five (5) working days notice of such arrangements. (WSA 03-2011, Part 2, Section 22). ***Time of Least Interference***

2. Connections to live water mains shall be carried out by Tweed Shire Council accredited contractors. Live water service connections and meter installation to be undertaken by Tweed Shire Council. ***Live Water Connections***

## C401.39 DISINFECTION AND FLUSHING OF PIPELINES

1. The Subdivider shall disinfect all water mains after satisfactory testing in accordance with this Specification. (WSA 03-2011, Part 2, Section 20). This action constitutes separate **HOLD POINT inspections**. ***After Testing*** ***HP***

2. The Subdivider shall adopt procedures for the disinfection of the mains with the concurrence of TSC. ***Procedures***

3. The Subdivider shall flush all water mains to an approved location, as directed by the Certifying Engineer, after disinfection and testing is performed to ensure chlorine levels are at normal requirements are met. ***Flushing***

4. Chlorine testing should be undertaken in the order as follows: ***Chlorine Testing***

   Test 1: 10 to 20 mg of chlorine per litre of water (ie: approximately 1.5 litres of chlorine per 10,000 Litres of chlorine)

   Test. 2. Test after 24 hours and ensure levels are not below 5mg.

   Test. 3. Make sure reading is below 1mg after flushing.

## C401.40 BACKFILL AND COMPACTION

1. After laying and jointing of a pipeline has been completed the Subdivider shall present the laid and jointed pipes for inspection by the Certifying Engineer prior to the commencement of trench backfilling. This action constitutes a **HOLD POINT**. The Certifying Engineer's approval of the laid and jointed pipes is required prior to the release of the hold point. ***Notification*** ***HP***

2. Backfill shall not be placed until the Certifying Engineer has given approval. ***Approval***

3. Material for the side support and overlay of the pipe shall comply with the requirements for pipe bedding specified in Clause C401.26. The material shall be compacted in layers of not more than 150mm to 95 per cent of the standard maximum dry density of the material used when determined in accordance with the relevant method specified in WSA 03-2011, Part 2, Section 16 ***Side Support and Overlay***

4. The Subdivider shall backfill the remainder of the excavation and compact the backfill in layers of not more than 150mm thick as follows: (WSA 03-2011, Part 2, Section 17). ***Remainder of Trench***

   (a) Where the trench is within a roadway, proposed roadway, or footpath area, the remainder of the trench shall be: (WSA 03-2011, Part 2, Section 17) ***Roadway Area***

      (i) Backfilled with a non-cohesive granular material, with a grading falling generally within the limits detailed herein for pipe bedding and compacted to Density Index of 70 when determined in accordance with AS1289.5.6.1 for cohesionless materials ***Backfill to Subgrade Level with Non-Cohesive Granular***

         1. Below 0.5m of the road surface

         2. In the road reserve, but excluding the road pavement

(ii) Backfilled with excavated material, and compacted to 100 per cent of the standard maximum dry density of the material when determined in accordance with AS1289.5.4.1, when within 0.5m of the road surface, but excluding the road pavement layers. ***Backfill to Subgrade Level with Excavated Material***

(iii) Backfilled with road base and sub-base material as per existing or proposed pavement layers and compacted to 100 per cent of the standard maximum dry density of the material when determined in accordance with AS1289.5.4.1 ***Backfill of Pavement Layers***

(b) Elsewhere, unless stated otherwise, the remainder of the trench shall be backfilled with ordinary excavated backfill material. Where suitable material is not available, granular material may be used for the full depth of backfilling. The material shall be compacted to a density Index of 70 when determined in accordance with AS1289.5.6.1 for cohesionless materials or 98 per cent of the standard maximum dry density of the material when determined in accordance with AS1289.5.4.1 for cohesive materials.

5. The Subdivider shall carry out backfilling and compaction without damaging the pipe or its external coating or wrapping or producing any movement of the pipe. ***Care***

6. The Subdivider shall carry out compaction tests 75mm to 100mm below the level being tested. ***Compaction Tests***

7. The Subdivider may compact backfill by trench flooding only where ***Flood Compaction***

(a) The ground and backfill material is cohesionless sand.

(b) Water for flooding has been sourced at the site.

(c) The process will not create mud which would be moved off site by vehicles or construction plant.

(d) Additives are not used.

## C401.41 VALVE AND HYDRANT MARKING

1. The Subdivider shall clearly mark the position of each stop valve, scour valve, air valve and hydrant on completion of backfilling in a manner and position in accordance with TSC Standard Drawing S.D. 316 and/or as approved by the Certifying Engineer. ***Valve and Hydrant***

2. The Subdivider shall provide kerb marking for each valve and hydrant, in reflective white paint with glass beads. Where there is no kerb, or as otherwise directed by the Certifying Engineer, the Subdivider shall provide and set in the ground a post with the relevant marking plate fixed at the top of the post, facing the fitting. The distance to the valve or hydrant in metres, to an accuracy of 0.1m, shall be permanently marked on the plate with legible numbers a minimum 80 mm high. ***Plates on Posts***

3. The post shall conform to the following requirements: ***Post Details***

   (a) The post shall be of sufficient length to be set firmly in place under saturated ground conditions.

   (b) When installed, the post shall project 1000mm above the ground, provided that where tall grass or crops are likely to obscure the post, its height above the ground shall be increased to 1500mm.

   (c) The post shall be metal, with blue powder coating. Timber posts are not to be used.

4. The Subdivider shall provide white thermoplastic markings on the road pavement for hydrants, stop valves, scour valves and air valves as soon as practicable after each hydrant or valve is installed, in accordance with standard drawing S.D. 316. ***Pavement Marking***

5. For hydrants, the Subdivider shall affix blue two-way reflective raised pavement markers to the road pavement. ***Raised Pavement Markers***

## C401.42 RESTORATION OF SURFACES

1. The Subdivider shall clean pavements, lawns and other improved areas and leave them in the same order as they were at the commencement of the Works. The Subdivider shall restore any fencing removed during construction and shall restore lawns with turf cut and set aside from the original surface and with turf imported from a source approved by the Certifying Engineer. (WSA 03-2011, Part 2, Section 23). ***Original Condition***

2. The Subdivider shall maintain all restored surfaces in the condition to which they are restored until the expiry of the Defects Liability Period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the Defects Liability Period. The Subdivider shall maintain pavements with crushed igneous rock, gravel or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement. ***Maintenance***

3. The Subdivider shall maintain all restored surfaces in the condition to which they are restored until the expiry of the Defects Liability Period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the Defects Liability Period. The Subdivider shall maintain pavements with crushed igneous rock, gravel, asphaltic concrete or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement. Final restoration may include, if required by the Certifying Engineer, the removal of temporary restoration. ***Temporary Pavement Restoration***

4. In other than roadways, the Subdivider shall place the backfill sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the Defects Liability Period in order that the surface of the completed trench may then conform to the adjacent surface. Surplus material shall be removed and disposed of to areas arranged by the Subdivider. Where dry weather conditions have persisted after the original backfilling, including during the Defects Liability Period, the Subdivider shall take all necessary steps to consolidate the trench before removing surplus materials from the site. ***Backfill***

5. In locations where, in the opinion of the Certifying Engineer, surplus material left in the vicinity of the trench would not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench to the satisfaction of the Certifying Engineer in such a way as to avoid future erosion of the backfill and adjacent ground surfaces. The Subdivider shall maintain the backfill and adjacent ground until the expiry of the Defects Liability Period. ***Disposal of Surplus Material***

6. Where, within public or private property, the reasonable convenience of persons will require such, the Subdivider shall level trenches at the time of backfilling or otherwise as directed by the Certifying Engineer. The Subdivider shall make good any subsequent settlement, as required by placing additional fill. ***Settlement***

7. The Subdivider shall immediately restore any damaged or disturbed private property and services. ***Restoration***

8. Should the Subdivider elect to tunnel under paving, kerb and gutter or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces, and payment shall be made for the restoration of the surfaces as though they had been removed and replaced. The Subdivider shall remain responsible for the repair of the improved surfaces, if subsequently damaged due to subsidence of the backfill, until the end of the Defects Liability Period. ***Tunnelling***

9. The Subdivider shall provide notice to affected property owners of any pending works. ***Property Owner Advice***

## PUMP STATIONS

### C401.43 PUMPS

1. Pump construction materials for centrifugal end suction pumps shall comply with the following: ***Materials***

| DESCRIPTION | MATERIAL |
|---|---|
| **PUMP** | |
| Casing and suction bend | Cast iron AS 1830 Gr T200 |
| Wear rings | Cast iron AS 1830 Gr T200 |
| Impeller | 316 Stainless steel AS 1449 |
| Impeller nut | Gunmetal AS 1565-905C |
| Shaft | 316 Stainless steel AS 2837 |
| Shaft sleeve | Phosphor bronze AS 1565-9060/316 |
| Neck bush, lantern ring | Phosphor bronze AS1565-9060 |
| Gland | Cast Iron AS1830 Gr T200 |
| Gland studs | 316 Stainless steel AS 2837 |
| Gland nuts | 316 Stainless steel AS 2837 |
| Fixing nuts and bolts handhole | 316 Stainless steel AS 2837 |
| Covers | 316 Stainless steel AS 1449 |
| Fitted bolts and nuts, casing and dowels | 316 Stainless steel AS 2837 |
| Forcing screws | 316 Stainless steel AS 2837 |
| Water thrower and drip tray | 316 Stainless steel AS 1449 |
| Pump set base plate | Cast iron AS 1830 Gr T200/Fabricated steel |
| **MOTOR** | |
| Motor frame and end shield | Cast iron/Mild steel |
| Motor terminal box | Cast iron/Mild steel |
| Motor fan cover | Mild steel |
| Motor fan | Metal |
| **HOLDING DOWN BOLTS** | 316 Stainless steel AS 2837 |
| **MECHANICAL SEALS** | |
| Seal faces | Tungsten carbide or equal |
| Springs | Nickel chrome steel |
| Secondary seal | Fluoro carbon or nitrile rubber |

2. The Subdivider shall provide a written warranty from the Manufacturer of the equipment. This action constitutes a **HOLD POINT**. The Certifying Engineer's approval of the warranty is required prior to the release of the hold point. ***HP***

3. The Manufacturer's warranty shall require the Manufacturer to accept liability for any defect in materials or workmanship which becomes apparent at any time within two (2) years after the date of delivery of any piece of equipment used in the subdivision works. ***Manufacturer's Liability***

4. All nuts and bolts shall be manufactured in accordance with AS/NZS 1111 and AS/NZS 1112 150 metric series and fitted with washers beneath bolts heads and nuts. ***Nuts and Bolts***

   (a) All bolts, nuts and washers shall be stainless steel to AS 1449 and AS 2837, minimum grade 316. All bolts, nuts and washers are to be of the same grade and supplied passivated.

   (b) All threads are to be rolled.

   (c) All bolt heads and nuts shall be hexagonal.

   (d) All bolts, studs, set screws and nuts for bolting flanges and other pressure containing purposes shall conform to AS 2528.

   (e) All nuts and bolts subjected to vibration shall be fitted with lock washers or lock nuts.

   (f) All concrete anchor bolts, nuts, locking nuts and large series washers required for the bolting down of pump set discharge bends shall be provided. These anchor bolts shall be as recommended by the equipment designer with a minimum diameter of 16mm.

   (g) Concrete anchor bolts shall be chemical masonry anchor type, set to their full depth, suitable for the required duty.

5. Bolts on all flanges will protrude no more than 10mm past the nut when tightened. ***Bolts and Flanges***

6. The Subdivider shall apply sufficient anti-seize/anti-galling material to the threads of all stainless steel fasteners. The material shall be Polytetrafluroethylene (PTFE), either tape to AS 1272, dipped or sprayed, or molybdenum disulphide. ***Anti-Galling, Anti-Seize***

## C401.44 PRESSURE GAUGES

1. The Subdivider shall install one (1) diaphragm protected, glycerine oil filled, direct mounting, bottom connection pressure gauge complying with AS 1349 per centrifugal pump installation. Cases shall be fabricated from stainless steel complying with AS 1449 or bronze. The protective diaphragm shall be suitable for dismantling for cleaning without affecting the accuracy of the gauge. ***Compliance***

2. The gauge face shall be 100mm in diameter and calibrated in metres head of water. The gauge shall accurately indicate the pump operating head and the pump no-flow head. ***Calibration***

3. Each gauge shall be supplied with the nominally sized metric equivalent of three (3) of the following bronze fittings: gate valve, union, nipple and reducing nipple. ***Inclusions***

4. Gauges and fittings shall be screwed into the pipe wall of ductile iron pipes, or pipe-fittings, 150mm and larger. In pipework less than 150mm, gauges and fittings shall be screwed into a tapping band. Where shown on the design plans, the Subdivider shall install a ball valve to allow removal of the gauge. ***Installation***

5. The pressure gauge range for single or parallel pumps duty shall be 0 to 1.7 times the closed valve head of the pumps. ***Gauge Range***

## C401.45 ELECTRICAL COMPLIANCE

1. The Works shall be in accordance with the Electrical Services Minimum Requirements contained in EL01-EL19 except where this Specification or the design plans indicate otherwise. The technical requirements detailed on the design plans shall take precedence over the requirements of this Specification should clauses be in disagreement. ***Standards***

2. EL01-EL19 covers the general requirements for materials, workmanship, and methods of installation as follows: ***DPWS Requirements***

   (a) General

   (b) Reticulation and wiring

   (c) Switchboards and Associated Equipment

   (d) Accessories

   (e) Luminaries – Supply and Installation

   (f) Electric Motors

   (g) Painting, Colour Coding and Labelling

3. Except where EL01-EL19 requires a higher standard, Works shall be carried out in accordance with AS/NZS 3000, the Service Rules of the Supply Authority and all relevant Statutory Authorities. ***Compliance***

4. The Subdivider shall supply proof of compliance with a standard or specified test. Such proof shall comprise a test certificate from an approved independent testing authority. ***Proof of Compliance***

5. The Subdivider shall submit all designs and material to each Authority having jurisdiction for approval. The Subdivider shall arrange for each Authority having jurisdiction to inspect the Works. The Certifying Engineer shall be advised a minimum of 7 working days in advance of the date of any inspection by an Authority. This action constitutes a **WITNESS POINT**. The Certifying Engineer shall advise at the time of notification by the Subdivider whether the option to attend the inspections is to be exercised. ***Approval***

   ***WP***

## C401.46 SWITCHGEAR AND CONTROL GEAR ASSEMBLY (SCA)

1. The Subdivider shall supply and install the SCA designed and assembled by a manufacturer approved by the Certifying Engineer. ***Approved Manufacturer***

2. The SCA shall be of outdoor, stationary, free standing, metal-enclosed, cubicle type series with a minimum degree of protection of IP56D as specified in AS 1939. ***Type***

3. All equipment shall be securely mounted on suitable mounting panels and comprise individual compartments. A steel galvanised channel base shall be provided. ***Construction***

4. Starter contactors shall have the appropriate rating for the proposed pumps to AC3. ***Starter Contactors***

5. All necessary terminals with terminal and cable numbers shall be supplied and installed in accordance with the design plans. ***Terminals***

6. The Subdivider shall liaise with the electricity supply authority to supply a lock barrel for the metering equipment, at the Subdivider's expense. The Certifying Engineer shall supply standard lock barrels for use on the SCA at no cost to the Subdivider. ***Lock Barrels***

7. The electrical characteristics of the SCA shall be: ***Character-istics***

   Main Circuit: 415/240 V, 50 Hz, 3-phase, 4-wire.

   Motor Control Circuit: 240 V, 50 Hz.

   Common Control Circuit: 240 & 24 V, A.C.

   Prospective short-circuit current:

      14kA for 1 second.

   Peak Factor: 2.2

      Power Factor Correction (Determined in consultation with TSC)

   Earthing (M.E.N. system)

8. All cables shall enter the SCA from below. ***Cable Entry***

9. The Subdivider shall supply data from the switchgear supplier confirming Type "2" co-ordination between contactors, motor protection relays and corresponding circuit breakers, to the Certifying Engineer. ***Switchgear Data***

10. The "AUTO" mode shall be capable of being overridden by turning the starter selector switch to the "ON" position. Manual operation would normally be used in the event of failure of the telemetry system or for function testing. A warning label (R/W/R) advising selector switches to be left in the "AUTO" mode shall be fitted to common control cover. ***Operation***

11. The Subdivider shall carry out factory tests in the presence of the Certifying Engineer's Representative and in accordance with Schedule EL01-EL19 and the results shall comprise all routine Tests specified in AS 3439. ***Factory Tests***

12. Functional tests referred to in Schedule EL01-EL19 shall include electrical function tests as defined in AS3439. ***Functional Tests***

13. The Subdivider shall ensure, after approval has been given by the Certifying Engineer, that any relays, programmable logic controllers, and fittings likely to be adversely affected during delivery shall be adequately protected or shall be removed and packed separately in protected containers. Where equipment has been removed, cover plates shall be provided. ***Packing***

14. The Subdivider shall be responsible for any damage that may occur during transit and unloading at site. ***Damage***

15. The Subdivider shall ensure that spare parts, tools etc, are packed separately from the main plant and shall be marked "Spare Parts", "Tools" etc, as applicable. ***Tools***

16. The Subdivider shall supply spare parts in accordance with the schedule supplied by the Certifying Engineer. ***Spare Parts***

17. The Subdivider shall supply and install control equipment that is compatible with the existing equipment. ***Pump Control***

## C401.47 ELECTRICAL INSTALLATION

1. The Subdivider shall liaise with the Supply Authority for the electricity supply to the pump station site. ***Liaison***

2. The Subdivider shall be responsible for all facilities required by the Supply Authority for revenue metering equipment and the payment of all associated connection, inspection fees and capacity charges. ***Subdivider's Responsibility***

3. The Subdivider shall supply and install all cabling including consumer mains, motor, control and flow meter cables, conduits and electrical pits. ***Cabling***

4. The Subdivider shall install all wiring in HD-PVC underground conduits laid in accordance with the Supply Authority's requirements, with a minimum 500mm below the finished ground level in non-trafficable areas and 600mm below the finished ground level in trafficable areas. The trench and backfill material shall be free of rocks and other foreign matter likely to damage the conduits. ***Conduits***

5. The Subdivider shall run electrical marker tape 150mm below the finished ground level directly above the conduits for the entire length of the conduits. Marker tape shall be orange in colour, 150mm wide and stamped with the words "DANGER – ELECTRIC CABLES BELOW" or similar. ***Marker Tape***

6. The Subdivider shall route all underground cabling with the approval of the Certifying Engineer. Brass marking plates shall be positioned on any concrete surround clearly showing the direction of the incoming consumer mains. Wording and markings shall read "Danger – Electrical Cables Below". This action constitutes a **HOLD POINT**. The Certifying Engineer's approval of the route of all underground cabling is required prior to the release of the hold point. ***Route***

***HP***

7. The Subdivider shall determine the Points of Attachment on site and the Subdivider shall supply and install any consumer's connection poles for the consumer mains required by the Supply Authority. ***Point of Attachment***

8. The consumer mains shall be generally run underground and commence at the Point of Attachment on a steel consumers pole (if applicable), installed near the property boundary and run in conduit to the switchboard. ***Consumer Mains***

9. The minimum size of the consumers mains shall be sized to satisfy the following requirements: ***Size***

   (a) Current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30 per cent minimum.

   (b) Be sized for a voltage drop less than 1.5 per cent to the maximum demand as calculated.

   (c) Be single core PVC/PVC cables. XLPE insulated cable may also be used.

   (d) Comply with the requirements of the Supply Authority.

   (e) Pole termination method shall be as shown on the design plans.

   (f) AS/NZS 3000 and AS/NZS 3008

10. In addition to the requirements of the Supply Authority and EL01-EL19 the main earthing conductor shall be run in conduit to the main earthing electrode. The main earthing connection shall be contained in an earthing electrode connection box similar to ALM type ERB-1 up to 50mm$^2$ cable and a Type 4 pit for larger cable. ***Earthing Conductor***

11. The Subdivider shall provide a separate earthing conductor and electrode for the surge diverters. Each electrode shall be bonded and suitably labelled with an engraved brass label l. ***Surge Diverters***

12. The Subdivider shall bond the pump station metallic pipework to the main earth. ***Pipework***

13. The Subdivider shall install metering facilities within the SCA. The metering facilities and panel shall be Energy Authority approved and suitable for the installation of the metering equipment required by the Supply Authority. ***Meters***

14. The Subdivider shall supply and install the following metering equipment: ***Metering Equipment***

    (a) Plug-in meter bases or all electricity meters (tariffs) supplied by the Supply Authority, as may be required by the Supply Authority.

    (b) Service potential fuses.

    (c) Current transformers metering equipment (if required).

    (d) All necessary wiring and other accessories as required by the Supply Authority.

    (e) Key locking facilities for Supply Authority access.

15. The Subdivider shall gland cables entering the outdoor SCA compartment using non-ferrous metallic or plastic glands with neoprene compression seals and connect the on-flow switch and pump motor cables to the appropriate terminals. Cables shall not be jointed. ***Cable Entry***

16. The Subdivider shall seal, at the completion of commissioning tests, all conduits into the outdoor SCA with a non-setting sealing compound to prevent the ingress of vermin. ***Sealing***

## C401.48 TESTING AND COMMISSIONING OF PUMP STATION

1. The Subdivider shall test and/or inspect all materials, equipment, installation and workmanship to prove compliance with the Specification requirements. The submission to the Certifying Engineer of satisfactory test results constitutes a **HOLD POINT**. The approval of the Certifying Engineer is required prior to the release of the hold point. ***Compliance*** ***HP***

2. Tests and inspections shall comply with relevant Australian Standards. ***Standards***

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

4. 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***

5. The Subdivider shall conduct pre-commissioning in a logical sequence in accordance with the programme prepared by the Subdivider and approved by the ***Sequence***

Certifying Engineer.

6. The Subdivider 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. ***Record Sheets***

7. Specific requirements for pre-commissioning shall include, but are not limited to: ***Requirements***

   (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. These tests shall also include adjusting instrument set points and alarm settings and proving correct operation of alarms.

   (e) Equipment and system operating tests. The Subdivider shall certify compliance of each item and submit a signed copy to the Certifying Engineer prior to commissioning.

8. The Subdivider shall carry out pre-commissioning tests to the satisfaction of the Certifying Engineer and shall record the results of the tests on the appropriate Pre-commissioning Record Sheet. ***Recording***

9. The Subdivider shall furnish the Certifying Engineer with one (1) signed copy of each completed Pre-commissioning Record Sheet countersigned by the Certifying Engineer's Representative who witnessed the test. ***Submission***

10. 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. ***Commissioning***

11. The Subdivider shall give five (5) working days notice of the Subdivider's intention to undertake commissioning and supply to the Certifying Engineer the copies of each of the pre-commissioning record sheets and three (3) copies of the operational and maintenance manuals at the time that notice of commissioning is given. This action constitutes a **WITNESS POINT**. The Certifying Engineer shall advise at the time of notification by the Subdivider whether the option to attend the commissioning is to be exercised. ***Notification*** ***WP***

12. The Subdivider shall conduct commissioning in a logical sequence in accordance with a programme prepared by the Subdivider and approved by the Certifying Engineer. ***Sequence***

13. Throughout commissioning the Subdivider shall be responsible for the test programme. ***Responsibility***

14. The Subdivider shall provide continuous supervision by personnel experienced in the operation of the equipment and shall have qualified personnel in attendance ***Supervision***

to carry out all necessary adjustments and/or remedial work during the commissioning tests.

15. The Subdivider shall prepare, schedules, test record sheets and programmes for approval by the Certifying Engineer prior to each stage of the overall commissioning. ***Documentation***

16. The Subdivider shall 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 accordance with EL01-EL19. ***Final Testing***

17. The Subdivider shall arrange for all testing, commissioning and any adjustments to be carried out by qualified personnel. ***Qualified Personnel***

## C401.49 PRACTICAL COMPLETION OF PUMP STATION

1. The Subdivider shall fulfil the following requirements before the Certificate of Practical Completion is issued: ***Certificate***

   (a) Receipt by the Certifying Engineer of a certificate of approval from the relevant statutory authorities.

   (b) Pump station is in working order as demonstrated by the testing and commissioning.

   (c) Approval by the Certifying Engineer of Operating and maintenance manuals.

   (d) Receipt by the Certifying Engineer of as-built drawings of the pump station.

## C401.50 TELEMETRY

1. The Subdivider shall make provision for equipment to link the pump station to the existing telemetry network to be provided by TSC at the Subdivider's expense. ***Subdivider's Cost***

2. The pump station shall operate automatically by control signals from the telemetry system. In addition, either one (1) or any combination of pumps may operate at any one (1) time by control signals from the telemetry system. ***Operation***

## C401.51 OPERATION AND MAINTENANCE MANUALS

1. Manuals shall contain the following information: ***Information***

   (a) Subdivider's name, address and telephone number.

   (b) Client's Contract number, job name.

   (c) Pump station general arrangement drawing showing pumps, motors, valves, pipework, switchboard and electrical installation.

2. Manuals for pumps shall contain the following information: ***Pumps***

   (a) Manufacture.

   (b) Type and model number.

   (c) Serial number.

(d) Dimensioned general arrangement drawing of pump and motor.

(e) Sectional arrangement drawing with parts and list.

(f) Dimensioned sectional arrangements detailing:

(i) Maximum and minimum shaft/bearing clearance (radial)

(ii) Maximum and minimum impeller/bowl clearance (radial)

(iii) Maximum and minimum impeller/bowl clearance (axial)

(iv) Impeller/bowl wear rings.

(v) Motor/pump coupling - type, make and model number.

(vi) Mechanical seals where applicable.

3. Manual for motors shall contain the following information: ***Motors***

(a) Manufacture.

(b) Type and model number.

(c) Serial number.

(d) Dimensioned general arrangement drawing.

(e) Sectional arrangement drawing for submersible motor power cabling where applicable.

(f) Gland sealing arrangement drawing for submersible motor power cabling where applicable.

(g) Cables where applicable.

(h) Terminal block arrangement drawing where applicable.

4. Manuals for valves shall contain a dimensioned sectional arrangement drawing with parts and material list for all valves. ***Valves***

5. Manuals shall contain the following test curves:- ***Test Curves***

(a) Pump witnessed test curves.

(b) Motor test curves.

(c) Motor torque/speed/efficiency characteristic curves.

6. The operating and maintenance manual shall include: ***Operation and Maintenance***

(a) Safe working procedures: For switching and isolating the supply and distribution system;

(b) Description of Operation;

(c) Maintenance procedures: Recommended maintenance periods and procedures;

(d) Tools: Particulars of maintenance equipment and tools provided, with instructions for their use.

(e) Equipment: A technical description of the equipment supplied, with diagrams and illustrations where appropriate;

(f) Dismantling: Where necessary, procedures for dismantling and reassembling equipment;

(g) Spare parts: A list of the spare parts provided.

7. Trouble shooting instructions shall be included for pumps, motors, valves and SCA. ***Trouble Shooting***

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

## CONSTRUCTION COMPLIANCE

### C401.52 WORK-AS-EXECUTED DETAILS

1. The Subdivider shall submit Work-As-Executed Plans in accordance with Development Design Specification D13. ***Main Requirements***

### C401.53 OPERATION AND MAINTENANCE MANUALS

The Subdivider shall submit to the Certifying Engineer all operation and maintenance manuals at the time of commissioning or when handed over for Council's operation. All operation and maintenance manuals must be included in the subdivision works compliance certificate attachments.

## SPECIAL REQUIREMENTS

### C401.54 RESERVED

# APPENDICES

## C401. APPENDIX A – PUMPING STATION PRE-COMMISSIONING

The pre-commissioning coordinator shall determine the relevant checks that must be all satisfied before formal commissioning can take place.

| **Electrical** |
|---|
| Confirm that 'Notification of Electrical Work' has been submitted to Country Energy and Tweed Shire council Water Unit |
| Check that electricity supply has been connected and energised |
| Check 'DANGER ELECTRICAL CABLES BELOW' marker bricks are installed at ground level and painted yellow AND Certifying Engineer has approved the route of the underground cables. |
| Check pole / pillar termination method is as per the specification and the Supply Authority requirements |
| Verify level controller calibration |
| Check flood level regulator has been adjusted to the required level and terminated in switchboard |
| Check no-flow protection equipment (if specified) fitted and wired correctly |
| Check switchboard has been installed correctly |
| Check earth electrode installed as specified and measure and record earth resistance |
| Check earth pit, main earth electrode and bond installed and labelled as specified |
| Check all cables are properly glanded at the switchboard |
| Check appropriate lugs fitted to all flexible cables, and cables correctly identified at terminators |
| Check pump detail plate (in switchboard) has been engraved with pump motor nameplate details |
| Check all switchboard labels are as specified |
| Check all safety labels installed as specified |
| Check all switchboard terminals have been re-tensioned, particularly those terminations carrying motor current |
| Check all wire numbers are as shown on the drawings |
| Check all terminal numbers are as shown on the drawings |
| Check all fuses / circuit breaker settings are correct |
| Check all other motor protection equipment operates as specified |
| Carry out point to point wiring checks |
| Check motor terminations are in accordance with the connection diagram. With star-delta starters, cable No. 1 shall be connected to the wiring from the overload. |
| **MECHANICAL** |
| Check all safety signage is installed and is appropriate e.g. crane SWL, 'Danger', automatic equipment signs, hearing protection requirement etc |
| Check building and equipment identification e.g. site signage, water pumps, pipework, gauges and isolating valves, |
| Check crane functionality and coverage over strategic equipment |
| Check accessibility and installation of valves and appurtenances |
| Check that all equipment is properly guarded |
| Check stairways, handrails and landing comply with design requirements and are properly installed |
| Check that manufacturers' requirements in terms of installation, lubricants and quantities, and alignment have been complied with for relevant equipment |
| Check accessibility to equipment for operation and maintenance |
| Check pressure gauge cocks provided on the inlet side of each reflux valve and on the pressure main side |
| Check all pipework within the pumping station is complete and suitable supported and anchored |

| |
|---|
| Check all pipework valves e.g. gate valves comply with WSA PS-261 and reflux valve comply with WSA PS-264. Gate valves and reflux valves operate and gate valve direction for closing is correct orientation |
| Check chart recorder supplied (if specified) |
| Prime pumps with water |
| Check direction of rotation of all rotating equipment is correct and free |
| With the relevant gate valve open, start one pump in manual mode and check that the water level drops and the pump operates without undue noise and vibration. Shut down pump at approximately design cut-out level |
| Shut gate valve and restart pump and check for any leaks in pipework or at the discharge connection |
| Repeat for both pumps recording amperage, voltage head and flow. Check pump performance against test results |
| Check pipework for leakage |
| Check control and protection equipment functionality for manual and automatic modes |
| Check all safety signage is installed and is appropriate e.g. crane SWL, 'Danger', automatic equipment signs, hearing protection requirement etc |
| **CIVIL** |
| Building is as per design and Building code? |
| Building connected to power, lighting working, doors suitable? |
| Has water been connected with meter and all fittings working? |
| **TECHNICAL** |
| PLC developed and tested? |
| RTU inspected and installed to standard? |
| Communications to site checked and satisfactory? |
| **DOCUMENTATION** |
| Has Manufacturer’s warranty been received and approved by the Certifying Engineer? |
| Drawings – WAE completed are received? |
| Functional Description provided for process? |
| Operations manuals provided that sufficiently explain how to operate and maintain the assets? |
| Performance Information received (Pump Curves, factory testing results)? |
| Defects Liability and Warranties are provided and adequate? |
| Proposed training for assets is acceptable? |