



NEW SOUTH WALES

DEVELOPMENT CONSTRUCTION SPECIFICATION

C401

WATER RETICULATION

AUS-SPEC appreciates the role of the NSW Water Directorate in comprehensively updating the design and construction specifications for water and sewer works.

Amendment Record for this Specification Part

This Specification is Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
<i>EXAMPLE 1</i>	<i>Provision for acceptance of nonconformance with deduction in Payment</i>	<i>XYZ.00</i>	<i>AP</i>	<i>KP</i>	<i>2/6/97</i>
1	Measurement and Payment Pay Items	C401.56	O	JRM	2/22/00

SPECIFICATION C401: WATER RETICULATION**GENERAL****C401.01 SCOPE**

1. The Work to be constructed under this Specification consists of 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 Contractor 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 RETICULATION 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 Contractor shall possess, or have access to, the documents required to comply with this Specification. **Documents**
2. References to the WATER RETICULATION 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 Part, Section). **Water Reticulation Code**

(a) Council Specifications

- C271 - Minor Concrete Works
- C211 - Control of Erosion and Sedimentation

(b) Australian Standards

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

Where not otherwise specified in this Specification or the Drawings, the Contractor shall use the latest Australian Standard, including amendments and supplements, available within two weeks of close of tenders.

Currency

- 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, gasfitting 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/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 controlgear 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 – DN 80 Spring hydrant valve for general 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 4765(Int) Modified PVC (PVC-M) pipes for pressure applications

(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)

NSW Department of Public Works and Services (DPWS)

- MEW E101 - Electrical Services Minimum Requirements
- WS-SPEC - Technical Requirements (TRs) and Strategic products Specifications

Water Services Association of Australia (WSAA)

- WSA 03 - Water Reticulation Code of Australia
- Standard Drawings - WATER RETICULATION CODE OF AUSTRALIA drawings shall be used in preference to PWS Standard Drawings (WSA 03 Part 3)

British Standard

- BS 410 - Specification for test sieves

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.

Precedence**MATERIALS****C401.03 GENERAL**

1. The Contractor 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. The Contractor 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 PVC-M)**

1. Unplasticised PVC (uPVC) and modified PVC (PVC-M) pipes and fittings for mains and suction pipes shall comply with AS/NZS 1477 and AS/NZS 4765, shall be suitable for use with rubber ring (elastomeric) seal, complying with AS 1646, joints and shall be of the class and size as shown on the Drawings. (WSA 03 Part 4, section 4.6)

Standard

2. PVC pipes and fittings for mains and suction pipes shall be installed in

Installation

accordance with AS 2032 and AS/NZS 2566.1.

3. Pipes and fittings are to be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor shall take account of the time for storage and type of shelter.

Protection

C401.05 ACRYLONITRILE BUTADIENE STYRENE (ABS)

1. ABS pipes and fittings shall comply with AS/NZS 3518 to the class, size, use, shape and colour as shown on the Drawings and installed in accordance with AS/NZS 2566.1 and AS 3690.

Standard

2. ABS pipes and fittings shall be joined in accordance with the manufacturer's instructions using solvent cement to AS 3691.

Jointing

C401.06 GLASS REINFORCED PLASTIC (GRP)

1. Glass filament reinforced thermosetting plastics (GRP) pipes shall comply with AS 3571 and shall be of the class and size as shown on the Drawings and installed in accordance with AS/NZS 2566.1. (WSA 03 Part 4, section 4.8).

Standard

2. Pipes and fittings shall be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor 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 Drawings, 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 Drawings.

Standard

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

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 Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

**Corrosion
Protection**

C401.08 STEEL PIPELINE AND FITTINGS

1. Steel pipelines and fittings shall comply with AS 1579 and AS/NZS 1594 and shall be of the class, size, lining and coating as shown on the Drawings. (WSA 03 Part 4, section 4.10).

Standard

2. The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

**Corrosion
Protection**

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

Joints

4. The Contractor 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

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| 1. Copper tube and fittings shall comply with AS 1432 and shall be of the size and type as shown on the Drawings. | Standard |
| 2. The Contractor shall install copper tube, capillary and compression fittings, insulated from ferrous mains, as shown on the Drawings. (WSA 03 Part 4, section 11) | Insulated |

C401.10 POLYETHYLENE (PE)

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|---|--------------------------|
| 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 Drawings and installed in accordance with AS 2033. (WSA 03 Part 4, section 4.12). | 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 Contractor shall provide pipe of the appropriate external diameter consistent with the required internal diameter shown on the Drawings. | Internal Diameter |

C401.11 STEELWORK

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| 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 Part 4, section 4.15). | Corrosion Protection |
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VALVES AND HYDRANTS**C401.12 GENERAL**

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|---|------------------------------------|
| 1. The Contractor 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 Contractor shall ensure that the valves and hydrants are installed so as to facilitate maintenance. The Contractor shall take into account the manufacturer's recommendations, the requirements shown on the Drawings, the type of connection, lubrication of connecting bolts, and the location of valves within valve chambers or type of backfill material. (WSA 03 Part 3) | 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 Drawings. | Flanges |

C401.13 STOP VALVES

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| 1. Sluice valves shall be resilient seated valves manufactured in accordance with AS 2638. The valves shall be flanged where permitted by the Water Authority unless | Sluice Valves |
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shown otherwise on the Drawings. (WSA 03 Part 4, sections 4.19)

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|----|--|--------------------------|
| 2. | Ball valves shall be flanged where permitted by the Water Authority unless shown otherwise on the Drawings. (WSA 03 Part 4, sections 4.24) | Ball Valves |
| 3. | Butterfly valves shall be flanged where permitted by the Water Authority unless shown otherwise on the Drawings. (WSA 03 Part 4, sections 4.20) | Butterfly Valves |
| 4. | Knife Gate valves shall be flanged where permitted by the Water Authority unless shown otherwise on the Drawings. (WSA 03 Part 4, sections 4.19) | Knife Gate Valves |
| 5. | Scour valve assemblies shall be as shown on the Drawings. (WSA 03 Part 3 WAT -211) | Scour Valves |
| 6. | Valves shall be operated by a removable key. The Contractor 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

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|----|---|-----------------------|
| 1. | Air valves shall be of the double air valve type with integral isolating valve of minimum size DN80, and shall be installed as shown in the Drawings. (WSA 03 Part 4, section 4.22) | Standard |
| 2. | Air valves shall be installed such that they can be maintained without affecting supply. | Isolation |
| 3. | The Contractor shall obtain the consent of the Water Authority for the use of other types of air valves. | Alternate Type |

C401.15 NON-RETURN VALVES

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| 1. | Non return valves shall be of the swing check type to AS 3578 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 Part 4, section 4.21) 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 Drawings, 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 Part 4, section 4.23)

Standard

2. The top of spring hydrants shall be between 100mm and 200mm below finished surface level as detailed in WSA 03 Part 3, WAT-202. If necessary, this shall be achieved by the use of hydrant risers of various heights.

Access

C401.17 PRESSURE REDUCING VALVES

1. Pressure reducing valves shall be of the type as shown on the Drawings.

Type

2. Pressure reducing valves shall be installed with isolating valves to facilitate maintenance.

Installation

PIPELINE CONSTRUCTION

C401.18 GENERAL

1. The Contractor, employees, or subcontractors, engaged in excavations, including tunnelling, are to be accredited for the work. Proof of accreditation constitutes a **HOLD POINT**. The approval of the Superintendent, to the supplied documentation, shall be required prior to the release of the hold point.

Accreditation

HP

2. The Contractor shall not change the pipeline alignment without prior concurrence of the Water Authority. The Contractor shall provide full details, of any proposed changes to the pipeline alignment, to the Superintendent for submission to the Water Authority. This action constitutes a **HOLD POINT**. The Superintendent shall obtain the decision of the Water Authority 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 Drawings. The pipelines shall be laid to grades and locations shown on the Drawings and to tolerances in the WATER RETICULATION CODE unless directed otherwise by the Superintendent (WSA 03 Part 4, section 11). The Contractor shall confirm the locations immediately prior to construction. (WSA 03 Part 4, sections 3, 5).

**Pipe Laying
Method**

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: (WSA 03 Part 3 WAT -100)

**Minimum
Cover**

(a) 750mm in embankments

(b) 600mm in roadways and commercial areas

(c) 450mm elsewhere

2. Lesser cover may be provided where special protection of the pipelines has been shown on the Drawings or directed by the Superintendent.

**Special
Protection**

3. Greater cover may be provided where special situations occur, where there is conflict with other services or to meet grading requirements.

Special Needs

4. The maximum cover 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 Drawings, under the control of any Authority, the Contractor shall carry out the work in accordance with the requirements of that Authority. The Contractor shall provide written notification to the Authority of the intention to carry out the work, and pay the appropriate fees. (WSA 03 Part 4, sections 3.3, 9.10 - aqueducts). The Contractor shall obtain the written approval from the Authority prior to commencement of work. Such written approval shall be supplied to the Superintendent if requested. This action constitutes a **WITNESS POINT**. The Superintendent shall advise at the time of notification by the Contractor whether the option to request the written approval is to be exercised.

Contractor's Responsibility

WP

2. Where shown on the Drawings, the Contractor 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. (WSA 03 Part 4, section 9.9).

Existing Road Crossings

3. The Contractor 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 Drawings. 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 Contractor shall fill the annular space between the carrier pipe and the encasement pipe with suitable grout or cementitious grout filler.

Grouting

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

C401.22 EARTHWORKS

1. The Contractor shall carry out all excavations for structures and pipelines to the lines, grades and forms shown on the Drawings or as directed by the Superintendent within the specified tolerances. The Contractor 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 Part 4, section 6).

Contractor Responsibility

- 2. The Contractor 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 Contractor shall install safety fencing to Statutory requirements along the edges of open excavations to isolate them from the public. The Contractor 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
- 4. The Contractor shall locate, protect and repair, as necessary, all services affected by the Works at the Contractor's expense.

Access to Property
- 5. The Contractor shall carry out erosion and sedimentation control at all construction sites in accordance with the Specification for CONTROL OF EROSION AND SEDIMENTATION – C211.

Existing Services
- 6. The Contractor shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open. (WSA 03 Part 4, section 6.2).

Erosion Control
- 6. The Contractor shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open. (WSA 03 Part 4, section 6.2).

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	400	350
150	450	400
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 Drawings 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 Superintendent, so as to provide a neat straight line free from broken ragged edges.

Minimum Disturbances
- 3. The Contractor 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 Contractor 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 Drawings. **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 Contractor shall adequately support all excavations to Statutory requirements as the Works proceed. When withdrawing supports, the Contractor shall exercise every precaution against slips or falls. (WSA 03 Part 4, section 6.5) **Precautions Against Slips or Falls**
- 2. The Contractor 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 Contractor shall obtain the Superintendent's approval prior to commencing pipe laying, jointing and bedding.
- 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 Contractor can demonstrate that its use will not impede repair operations. (WSA 03 Part 4, section 8). **Crusher Screenings**
- 3. Pipes (excluding PVC/PE pipes) may be laid directly on other than rock foundation. The Contractor shall provide non-cohesive granular bedding, having a minimum thickness of 75mm 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 sands classification described in WSA 03 Part 3 WAT-400 Soil Classification Guidelines, either loose clean sand and /or medium dense clean sand. **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 75mm 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, except that where the materials cannot be reasonably sourced from within the vicinity, the Contractor may use materials satisfying the classification in paragraph 2 above provided also that the material meets the requirements for passing sieve sizes 9.5mm and 6.7mm shown in Table C401.2 : **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	1/4 inch	90 - 100
425 µm	No. 36	40 - 90
150 µm	No. 100	0 - 10
	3/8 inch	
	1/4 inch	
	No. 36	
	No. 100	

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

5. All mains laid on grades steeper than 50 per cent shall be encased in concrete as detailed on the Drawings.

**Grades
Greater Than
50%**

C401.27 LAYING AND JOINTING OF PIPES

1. Unless detailed otherwise in this Specification, the Contractor shall install pipes in accordance with AS 2032, AS 2033, AS/NZS 2566.1 or AS 3690 as appropriate. (WSA 03 Part 4, sections 4.26, 4.27, 4.28, 9, WAT-200 to 202).

Installation

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

Examination

3. The Contractor 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 Contractor 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 Drawings, 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 Contractor 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 Superintendent 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 hand saw and mitre box. For field cuts of ductile iron or steel, the Contractor shall ensure that fire fighting equipment, in working order, is on the site prior to the field cuts being made. If the Contractor proposes to use a petrol engine pipe cutter in an excavation, the Contractor shall ensure that a safe atmosphere is maintained in the excavation at all times.

Pipe Cutting

9. The Contractor shall prepare the ends of any pipes cut in the field to the manufacturer's written instructions, or as directed by the Superintendent.

**End
Preparation**

10. Where pipes are cut in the field, the Contractor 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 Contractor shall not use PVC/PE pipes with scored witness marks. Where the same manufacturer does not make spigots and sockets, the Contractor 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**

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| <p>12. The Contractor shall conform with the relevant Statutory and OH&S requirements when cutting and disposing of asbestos cement pipes.</p> | <p>Existing AC Pipe</p> |
| <p>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 Contractor 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.</p> | <p>Joint Deflection</p> |
| <p>14. The maximum angle of deflection between adjacent pipes shall be limited to 2° or 0.035 radian in areas subject to mine subsidence or slippage.</p> | <p>Limit of Joint Deflection</p> |
| <p>15. Unless otherwise directed by the Superintendent, the Contractor shall lay pipes on continuously rising grades from scour valve to air release valve, notwithstanding any minor irregularities in the ground surface.</p> | <p>Grade</p> |
| <p>16. Detectable identification tape shall be laid along the line of non-metallic mains within 150mm of the finished surface. (WSA 03 Part 2, section 14.1).</p> | <p>Detectable Tape</p> |

C401.28 TRENCH STOPS

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| <p>1. Where a pipe is laid on bedding at a grade of 5 per cent to 15 per cent, the Contractor shall construct, as below, trench stops consisting of bags filled with clay, or sand or cement stabilised sand and sealed: (WSA 03 Part 3 WAT-103 and Part 4, section 9.4)</p> <p>(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 150mm below finished surface level.</p> <p>(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.</p> | <p>Grade 5% to 15%</p> |
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| <p>2. The distance between trench stops shall be determined by the following formula:</p> | <p>Spacing</p> |
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$$D = \frac{100}{G}, \text{ whereby}$$

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

C401.29 CONCRETE BULKHEADS

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| <p>1. Where a pipe is installed at a grade of 15 per cent to 30 per cent, the Contractor shall construct concrete bulkheads. Where a pipe is installed at a grade 30 per cent to 50 per cent, the Contractor shall construct concrete bulkheads integral with concrete encasement. Bulkheads shall be of 20MPa concrete complying with the Specification for MINOR CONCRETE WORKS – C271, 150mm minimum thickness as follows: (WSA 03 Part 3 WAT-103 and Part 4, section 9.5)</p> <p>(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</p> | <p>Grade 15% to 30% and 30% to 50%</p> |
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sidewalls a minimum of 150mm. The bulkhead shall extend to 150mm below finished surface level or such other level as directed by the Superintendent.

- (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 **Spacing** formula:

Concrete bulkhead

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

Concrete encasement (continuous) and concrete bulhead

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

$$L = 80 \times \text{Pipe length, m}$$

$$= 450 \text{ m max}$$

if $L > 100$ m use intermediate trenchstops at spacing $< 100/G$

D = Distance between bulkheads in m

G = Grade of pipe expressed in percentum

C401.30 VALVE AND HYDRANT CHAMBERS

- 1. The Contractor shall construct around each valve and hydrant a chamber of the **Type** and to the details shown on the Drawings. (WSA 03 Part 4, section 10).
- 2. The concrete shall comply with the Specification for MINOR CONCRETE **Concrete** WORKS – C271.
- 3. Valve and hydrant chamber covers shall be painted with yellow pavement **Colour** marking paint **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 Contractor 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 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 **Finish** 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.

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| 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 Drawings or as directed by the Superintendent. | 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 Superintendent, 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 Contractor shall take care to avoid lateral movement, cracking and subsidence when installing plastic covers and frames. | Plastic Covers |

C401.32 SERVICE CONNECTIONS

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| 1. | The Contractor shall provide service connections in accordance with the WATER RETICULATION CODE (WSA 03 Part 3 WAT-302 and WAT-303). | Provision |
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C401.33 THRUST AND ANCHOR BLOCKS

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| 1. | Thrust and anchor blocks shall be constructed where shown on the Drawings to the dimensions depicted therein or as otherwise directed by the Superintendent. 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 Part 3 WAT -203 and Part4, section 9.3). | Location |
| 2. | The Contractor shall provide permanent thrust blocks of 20MPa concrete, complying with the Specification for MINOR CONCRETE WORKS – C271, 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 directed by the Superintendent. | Thrust Blocks |
| 3. | The Contractor shall provide permanent anchor blocks of 20MPa concrete, complying with the Specification for MINOR CONCRETE WORKS – C271, of a volume not less than that directed by the Superintendent. | Anchor Blocks |
| 4. | The Contractor shall provide temporary anchorages adequate to restrain the pipe when under test. The cost of providing such anchorages shall be deemed to be included in the rates tendered for laying and jointing rising mains. | Temporary
Anchorage |
| 5. | The Contractor shall obtain the consent of the Water Authority 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

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| 1. | Where pipes have less than 450mm of cover above the top of the pipe barrel, or where directed by the Superintendent, they shall be encased in concrete. Concrete shall be 20MPa complying with the Specification for MINOR CONCRETE WORKS – C271 and | Location |
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have the following minimum dimensions: (WSA 03 Part 3 WAT -101, WAT -102, WAT -105, WAT -106, and Part 4, sections 4.13, 4.14, 8.2)

- (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: 150mm 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 face of each coupling.

Contraction Joint

3. Reinforcement in concrete encasement shall be as shown on the Drawings.

Reinforcement

C401.35 WRAPPING OF PIPELINES

1. Where shown on the Drawings, the Contractor shall enclose a pipeline or a section thereof, in layflat polyethylene sleeving. (WSA 03 Part 4, section 9.6).

2. The materials to be used shall be high impact resistance polyethylene sleeving, of minimum thickness 0.2mm polyethylene film approved by the Superintendent 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 Superintendent. The Contractor 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 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-metre intervals. Bends, tapers and similar fittings shall be covered by polyethylene sleeving as specified for the pipes. The Contractor 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 Contractor 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 Contractor 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 Superintendent, consisting of synthetic fibre open weave cloth impregnated with saturated hydrocarbons applied in accordance with the manufacturer's recommendations or as directed by the Superintendent. 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 Contractor shall pressure test mains to detect leakage and defects in the pipeline including joints, thrust and anchor blocks. This action constitutes a **WITNESS POINT**. The Superintendent shall advise at the time of notification by the Contractor whether the option to inspect the testing is required.

WP

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

- (a) If so specified, or if the Contractor 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 Superintendent; and
- (b) The pressure testing shall not be commenced earlier than seven 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 Superintendent.

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 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 Contractor shall clean it to the satisfaction of the Superintendent and fill it slowly with water, taking care that all air is expelled. Purging of air from rising 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. The hydrostatic test pressure, which shall be applied to each section of the pipeline, shall be equivalent to the pressure rating of the pipe specified.

Test Pressure

9. The Contractor shall maintain the specified test pressure as long as required by the Superintendent while the Contractor examines the whole section. In any case, the specified test pressure shall be maintained for not less than 8 hours. For the purpose of determining the actual leakage losses, the Contractor shall carefully measure and record the quantity of water added in order to maintain the pressure during the period of testing.

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:

$$Q_1 = 0.0105 D.L. (H)^{0.5}$$

where:

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

11. Any failure, defect, or visible leakage which is detected during the pressure testing of the pipeline or during the Defects Liability Period shall be made good by the Contractor at the Contractor's expense, provided that where a thrust block or an anchor block fails, and such thrust block or anchor block has been constructed in accordance with the Drawings, and the failure is not, in the opinion of the Superintendent, the fault of the Contractor, the cost of strengthening or reconstruction of such thrust block or anchor block and the cost of retesting shall be paid as a Variation to the Contract at such rates as are determined in accordance with the provisions of the General Conditions of Contract.

Rectification

12. Alternatively, the main may be tested by the use of compressed air. In this case, the Contractor shall provide details of the alternative method proposed, for approval by the Superintendent, prior to its use.

Alternative Test

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 Contractor shall make arrangements with the Water Authority 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 Superintendent shall be given five (5) working days notice of such arrangements. (WSA 03 Part 4, section 14).

Time of Least Interference

C401.39 DISINFECTION OF PIPELINES

1. The Contractor shall disinfect all water mains after satisfactory testing in accordance with this Specification. (WSA 03 Part 4, section 13).

After Testing

2. The Contractor shall adopt procedures for the disinfection of the mains with the concurrence of the Water Authority.

Procedures

C401.40 BACKFILL AND COMPACTION

1. After laying and jointing of a pipeline has been completed the Contractor shall present the laid and jointed pipes for inspection by the Superintendent prior to the commencement of trench backfilling. (WSA 03 Part 4, sections 4.1 to 4.5, 7, 12). This action constitutes a **HOLD POINT**. The Superintendent's approval to 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 Superintendent 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 AS1289.5.7.1.

Side Support and Overlay

4. The Contractor shall backfill the remainder of the excavation and compact the backfill in layers of not more than 150mm thick as follows: (WSA 03 Part4, section 4.4).

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 Part 4, section 4.4, 4.5)

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 AS1289.5.4.1 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 AS1289.5.7.1, 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 AS1289.5.7.1

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 AS1289.5.4.1 for cohesionless materials or 98 per cent of the standard maximum dry density of the material when determined in accordance with AS1289.5.7.1 for cohesive materials.

- 5. The Contractor 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 contractor shall carry out compaction tests 75mm to 100mm below the level being tested.

Compaction Tests

- 7. The Contractor 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 MARKING PLATES

- 1. The Contractor shall clearly mark the position of each stop valve, scour valve, air valve and hydrant on completion of backfilling in a manner and position as approved by the Superintendent. The marking shall be made by one of the following methods but the location of the mark or peg shall be consistent with the method(s) in use by the Water Authority. (WSA 03 Part 4, section 9.11).

Valve and Hydrant

- 2. Where, in the opinion of the Superintendent, a valve or hydrant is at too great a distance from any existing wall, fence, kerb face, or post, the Contractor 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. Wooden posts are not to be used where there is evidence, by rotting or termite activity, that the integrity of the posts will be affected.

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 painted with 2 coats of white enamel for exterior use.
4. The Contractor shall fix marking plates as soon as practicable after each valve or hydrant is installed. However, the Contractor shall temporarily cover marking plates for hydrants using masking tape or other approved cover which the Contractor shall remove on satisfactory completion of the pressure testing of the pipeline. **Fixed After Installation**
6. In addition to the marking plates, the Contractor shall affix two-way reflective raised pavement markers to the road pavement and kerb, where available, in accordance with the WATER RETICULATION CODE (WSA 03 Part 3 WAT –207, WAT –300 and WAT –301). **Pavement Markers**
- C401.42 RESTORATION OF SURFACES**
1. The Contractor 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 Contractor 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 Superintendent. (WSA 03 Part 4, section 15). **Original Condition**
2. The Contractor 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 Contractor 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 Contractor 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 Contractor 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 Superintendent, the removal of temporary restoration. **Temporary Pavement Restoration**
4. In other than roadways, the Contractor 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 Contractor. Where dry weather conditions have persisted after the original backfilling, including during the defects liability period, the Contractor 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 Superintendent, 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 Superintendent in **Disposal of Surplus Material**

such a way as to avoid future erosion of the backfill and adjacent ground surfaces. The Contractor shall maintain the backfill and adjacent ground until the expiry of the Defects Liability Period.

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

Settlement

7. The Contractor shall immediately restore any damaged or disturbed private property and services.

Restoration

8. Should the Contractor 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 Contractor 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 Contractor 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

DESCRIPTION	MATERIAL
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 Contractor shall provide a written warranty from the Manufacturer of the equipment. This action constitutes a **HOLD POINT**. The Superintendent'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 Work under the Contract.

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 Contractor shall apply sufficient anti-seize/anti-galling material to the threads of all stainless steel fasteners. The material shall be Polytetrafluoroethylene (PTFE), either tape to AS 1272, dipped or sprayed, or molybdenum disulphide.

Anti-Galling, Anti-Seize

C401.44 PRESSURE GAUGES

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| <p>1. The Contractor 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.</p> | Compliance |
| <p>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.</p> | Calibration |
| <p>3. Each gauge shall be supplied with the nominally sized metric equivalent of three of the following bronze fittings: gate valve, union, nipple and reducing nipple.</p> | Inclusions |
| <p>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 Drawings, the Contractor shall install a ball valve to allow removal of the gauge.</p> | Installation |
| <p>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.</p> | Gauge Range |

C401.45 ELECTRICAL COMPLIANCE

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| <p>1. The Works shall be in accordance with the Electrical Services Minimum Requirements contained in MEW E101 except where this Specification or the Drawings indicate otherwise. The technical requirements detailed on the Drawings shall take precedence over the requirements of this Specification should clauses be in disagreement.</p> | Standards |
| <p>2. MEW E101 covers the general requirements for materials, workmanship, and methods of installation as follows:</p> <ul style="list-style-type: none"> (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 | DPWS Requirements |
| <p>3. Except where MEW E101 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.</p> | Compliance |
| <p>4. The Contractor shall supply proof of compliance with a standard or specified test. Such proof shall comprise a test certificate from an approved independent testing authority.</p> | Proof of Compliance |
| <p>5. The Contractor shall submit all designs and material to each Authority having jurisdiction for approval. The Contractor shall arrange for each Authority having jurisdiction to inspect the Works. The Superintendent 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 Superintendent shall advise at the time of notification by the Contractor whether the option to attend the inspections is to be exercised.</p> | Approval |

WP

C401.46 SWITCHGEAR AND CONTROL GEAR ASSEMBLY (SCA)

- | | | |
|-----|--|----------------------------------|
| 1. | The Contractor shall supply and install the SCA designed and assembled by a manufacturer approved by the Superintendent. | 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 Drawings. | Terminals |
| 6. | The Contractor shall liaise with the electricity supply authority to supply a lock barrel for the metering equipment, at the Contractor's expense. The Superintendent shall supply standard lock barrels for use on the SCA at no cost to the Contractor. | Lock Barrels |
| 7. | The electrical characteristics of the SCA shall be:

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 the Water Authority)
Earthing (M.E.N. system) | Characteristics |
| 8. | All cables shall enter the SCA from below. | Cable Entry |
| 9. | The Contractor shall supply data from the switchgear supplier confirming Type "2" co-ordination between contactors, motor protection relays and corresponding circuit breakers, to the Superintendent. | 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 Contractor shall carry out factory tests in the presence of the Superintendent's Representative and in accordance with Schedule MEW E101 and the results shall comprise all routine Tests specified in AS 3439. | Factory Tests |
| 12. | Functional tests referred to in Schedule MEW E101 shall include electrical function tests as defined in AS3439. | Functional
Tests |
| 13. | The Contractor shall ensure, after approval has been given by the Superintendent, 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 Contractor shall be responsible for any damage that may occur during transit and unloading at site. | Damage |

- 15. The Contractor 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 Contractor shall supply spare parts in accordance with the schedule supplied by the Superintendent. **Spare Parts**
- 17. The Contractor shall supply and install control equipment that is compatible with the existing equipment. **Pump Control**

C401.47 ELECTRICAL INSTALLATION

- 1. The Contractor shall liaise with the Supply Authority for the electricity supply to the pump station site. **Liaison**
 - 2. The Contractor 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. **Contractor's Responsibility**
 - 3. The Contractor shall supply and install all cabling including consumer mains, motor, control and flow meter cables, conduits and electrical pits. **Cabling**
 - 4. The Contractor 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 Contractor 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 Contractor shall route all underground cabling with the approval of the Superintendent. 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 Superintendent's approval of the route of all underground cabling is required prior to the release of the hold point. **Route**
- HP**
- 7. The Contractor shall determine the Points of Attachment on site and the Contractor 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 Drawings.

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

10. In addition to the requirements of the Supply Authority and MEW E101 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 50mm² cable and a Type 4 pit for larger cable.

**Earthing
Conductor**

11. The Contractor 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 I.

**Surge
Diverters**

12. The Contractor shall bond the pump station metallic pipework to the main earth.

Pipework

13. The Contractor 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 Contractor 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 Contractor 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 Contractor 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 Contractor shall test and/or inspect all materials, equipment, installation and workmanship to prove compliance with the Specification requirements. The submission to the Superintendent of satisfactory test results constitutes a **HOLD POINT**. The approval of the Superintendent 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 Contractor shall conduct pre-commissioning in a logical sequence in accordance with the programme prepared by the Contractor and approved by the Superintendent.

Sequence

6. The Contractor shall prepare pre-commissioning record sheets for each item of

Record Sheets

equipment to ensure results of tests are satisfactorily recorded and that all necessary checks or tests have been performed.

- 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 Contractor shall certify compliance of each item and submit a signed copy to the Superintendent prior to commissioning.

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

 - 9. The Contractor shall furnish the Superintendent with one signed copy of each completed Pre-commissioning Record Sheet countersigned by the Superintendent'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 Contractor shall give five (5) working days notice of the Contractor's intention to undertake commissioning and supply to the Superintendent the copies of each of the pre-commissioning record sheets and three copies of the operational and maintenance manuals at the time that notice of commissioning is given. This action constitutes a **WITNESS POINT**. The Superintendent shall advise at the time of notification by the Contractor whether the option to attend the commissioning is to be exercised. **Notification**
- WP**
- 12. The Contractor shall conduct commissioning in a logical sequence in accordance with a programme prepared by the Contractor and approved by the Superintendent. **Sequence**

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

 - 14. The Contractor shall provide continuous supervision by personnel experienced in the operation of the equipment and shall have qualified personnel in attendance to carry out all necessary adjustments and/or remedial work during the commissioning tests. **Supervision**

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

 - 16. The Contractor 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 MEW E101. **Final Testing**

17. The Contractor 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 Contractor shall fulfil the following requirements before the Certificate of Practical Completion is issued:

Certificate

- (a) Receipt by the Superintendent 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 Superintendent of Operating and maintenance manuals.
- (d) Receipt by the Superintendent of as-built drawings of the pump station.

C401.50 TELEMETRY

1. The Contractor shall make provision for equipment to link the pump station to the existing telemetry network to be provided by the Water Authority at the Contractor's expense.

**Contractor's
Cost**

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

Operation

C401.51 OPERATION AND MAINTENANCE MANUALS

1. Manuals shall contain the following information:

Information

- a) Contractor'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 Contractor shall submit to the Superintendent work-as-executed Drawings showing the actual location and alignment of pipelines, and all pump station details together with operating and maintenance manuals. (WSA 03 Part 4, section 16). **Main Requirements**
2. Details shall include the size, type, levels of pipelines, valve and hydrant chamber types and cover details, easement requirements for maintenance, pump details, switchboard equipment details and station structural details. **Additional Detailed Requirements**
3. The Contractor shall ensure that a Registered Surveyor certifies the plans showing location and alignment. **Survey**
4. The Contractor shall provide records, for the Water Authority's Asset Register, to the Superintendent at the time of practical completion of the Contract. The records are to be in a form consistent for inputting into the Asset Register as directed by the Superintendent. **Asset Register**

SPECIAL REQUIREMENTS

C401.53 RESERVED

C401.54 RESERVED

C401.55 RESERVED

AUS-SPEC #1

MEASUREMENT AND PAYMENT

C401.56 RESERVED



AUS-SPEC #1

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