Water, Sewer and Relining Specification

For more information contact
Shoalhaven Water

City Administration Centre
Bridge Road (PO Box 42)
Nowra NSW Australia 2541
P: (02) 4429 3214
F: (02) 4429 3170
water@shoalhaven.nsw.gov.au
www.shoalwater.nsw.gov.au

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For more information contact Shoalhaven Water
City Administrative Centre
Bridge Road (PO Box 42), Nowra NSW Australia 2541
P: (02)4429 3214 F: (02) 4429 3170
water@shoalhaven.nsw.gov.au www.shoalwater.nsw.gov.au

Contents

1 SECTION A – GENERAL PROJECT REQUIREMENTS

1.1 This Specification

This specification document *Shoalhaven Water – Water, Sewer and Relining Specification* consists of the following key Sections:

- Section A – General Project Requirements;
- Section B – Water Project Requirements;
- Section C – Sewer Project Requirements; and
- Section D – Relining Project Requirements.

This Specification shall be read in conjunction with the following documents in regard to undertaking all aspects of the Works in respect of materials, work methods, workmanship, performance, quality, testing, and the like:

- Project Contract Documents (Volumes 1 – 4); and
- Water Services Association of Australia Water and Sewer Codes (Regional New South Wales Edition where applicable) available from https://www.wsaa.asn.au/ (External Suppliers are required to purchase their own copies of the Codes); and
- The following Shoalhaven Water Plans and Standards available via https://www.shoalwater.nsw.gov.au/Building-and-renovating/Information-and-resources/Guides-resources-and-standards#section-4:
    - Shoalhaven Water Standard Markings for Water Mains SOP010;
    - Shoalhaven Water Wastewater Reticulation System Colour procedure WWD20;
    - Shoalhaven Water Survey Plan Preparation & Work As Executed Standard;
    - Shoalhaven Water Standard for SCADA Installations;
    - Shoalhaven Water Guidelines for CCTV Inspection of New Developer Works; and
    - Shoalhaven Water Standard for Electrical Installations.

1.2 Works to Be Carried Out by Shoalhaven Water

Unless otherwise specified, the following will be undertaken by Shoalhaven Water:

- All electrical and telemetry works; and
- All connections to the existing water supply system (refer Section 2.4.15); and
- All connections to the existing sewerage system (refer Section 3.4.9).

1.3 Protection of Private Property

In undertaking the Works, the Contractor shall be responsible for any damage caused to private property by the Contractor, its subcontractors, agents, and suppliers. The Contractor shall make good any damage and bear any compensation cost arising from the damage.

The Contractor shall take appropriate precautions when compacting near existing residences and structures to prevent any damage from vibration occurring.

Where private property is damaged, the Contractor shall immediately notify the relevant owner and the Superintendent, and all charges, fees and costs arising from damage caused to private property shall be paid by the Contractor.

The Contractor shall rectify all disruption to private service connections immediately.

1.4 Asbestos Cement Pipe Removal

Disused asbestos cement pipe shall be removed only by a licensed asbestos removal Contractor and disposed of in accordance with WorkCover guidelines and Shoalhaven City Council OH&S system – Procedure for Legal Disposal of Asbestos.

1.5 Ground Conditions

Refer to the Volume 4 – Document for Information of the Contract Document for any available specific information in relation to geotechnical investigation, Acid Sulfate Soils and contaminated soils.

1.5.1 Acid Sulfate Soils (ASS)

ASS will be managed by the Contractor in accordance with the State Planning Policy 2/02 Planning and Managing Development with Acid Sulfate Soils. Treatment of ASS/PASS material is to be in accordance with the Acid Sulfate Soils Investigation Team Guidelines. Sampling and analysis methodologies will be detailed in the (Construction Environmental Management Plan (CEMP) ASS Management Sub Plan developed by the Contractor and approved by the Principal.

1.5.2 Contaminated soils

The Contractor shall note the potential for contaminated soils along the alignment. Any contaminated soils encountered will require the Contractor to develop a site-specific management sub plan.

1.6 Preliminaries and Site Establishment

1.6.1 Setting Out

The Contractor shall be responsible for setting out the Works from the information shown on the Drawings. Where necessary, the Contractor shall carry out surveys to locate/reinstate any survey marks required for setting out. The cost of all necessary surveys shall be included in the Lump Sum Price.

1.6.2 Physical Confirmation of Existing Services

The services shown on the Drawings have been prepared from a collation of Dial Before You Dig information, advice from utilities on location of services, survey and potholing. No warranty is provided that all services have been shown on the Drawings or are in the locations indicated.

The Contractor shall locate and pothole all services in advance of at least 500 m of pipeline trenching. The Contractor shall give the Superintendent at least 5 working days notice of any services that will impact the designed alignment or grading of the pipeline.

The Contractor shall measure, record, and submit to the Superintendent the following information about services located on or in close proximity to the pipeline alignment:

- Type of service encountered;
- Size of service encountered;
- Coordinates of service location (if the service crosses the pipeline the coordinates of the intersection of the service with the pipeline shall be measured and recorded);
- Angle of service alignment stated in degrees clockwise from the direction of flow;
- Surface level (in Australian Height Datum (AHD)) at service location; and
- Depth of service.

The tolerances for level of accuracy for service locations are to be provided to the Superintendent.

The Contractor shall record the information about all existing services on the “Work As Executed” Drawings.

1.7 Work in Service Corridors / Easements

1.7.1 Construction Activities

Prior to commencing construction, the Contractor shall liaise with the Relevant Authority and obtain the requirements of the Relevant Authority in writing for the specific site and conditions. The Contractor shall submit two copies of all such written requirements to the Superintendent for its use at least two weeks prior to undertaking any work governed by such written requirements.

1.7.2 Traffic Control

The Contractor shall provide for continuous operation of normal traffic along all roads and pedestrian and vehicular access to properties included in or intersected by works. The Contractor shall, where necessary, provide side-tracks which shall be constructed, signposted, lit and maintained to the satisfaction of the Superintendent and the owner of the road.

The Contractor shall prepare Temporary Traffic Management (TTM) in accordance with the NSW Roads and Maritime Services (RMS), Traffic Control at Work Sites Manual unless otherwise specified by the approval authority and obtain the necessary approvals for undertaking works in a public road reserve and pay any fees.

Approval Authority for the Traffic Control Plans and ‘Direction to Restrict Speed’ (if a temporary speed restriction is required) are:

- Princes Highway and Moss Vale Road – RMS; and
- All of the other roads that may be crossed by the pipeline – Shoalhaven City Council.

Copies of the approved TTMs shall be provided to the Superintendent at least 5 working days before commencing work in a public road reserve.

1.7.3 Supervision of Works by Relevant Authorities

Where the Relevant Authority requires supervising such works within its easement / corridor, the Contractor shall:

- Provide the Relevant Authority and the Superintendent with written notice of its intent to commence work within the relevant easement / corridor or as required by the Authority; and
- Pay all costs in relation to the relevant Authority supervising the works within its easement / corridor.

1.7.4 Roads and Highways

The Contractor shall gain approval under Section 138 of the Roads Act 1993 prior to commencing construction within all road reserves.

The Contractor shall obtain an approved Road Occupancy Licence from RMS when works impact the Princes Highway or Moss Vale Road.

The Contractor shall comply with the Relevant Authority’s approved Traffic Management Plan and its conditions of approval.

With regards to trenchless excavation within easements of roads and mariyime infrastructure, the Contractor shall comply with the NSW Government's Geotechnical Technical Direction GTD 2018 002 (RMS 18.906 – 25 July 2018), or any subsequent update of this document.

1.7.5 Railway Corridor

The authority for the railway easement is Australian Rail Track Corporation (ARTC).

The Contractor shall make an "Application to Enter ARTC Property" prior to undertaking work in the railway corridor.

When working within a rail corridor the Contractor shall comply with the written requirements of the ARTC and in particular:

- AS 4799-2000 In respect of rail under bores;
- ARTC Standard ETG 17-01 In respect of rail under bores; and
- ARTC Safety Policy SP-05-02 In respect of entering rail corridors.

1.7.6 Gas Pipeline Easements

The Contractor shall comply with Jemena procedures in undertaking works in or in close proximity to any gas pipeline easement. The Contractor shall liaise with Jemena via the Superintendent with regard to provision of site supervision by Jemena field staff during on site activities. All requests for Jemena approval shall be made in accordance with the appropriate Jemena procedures and protocols, and with at least 14 days' notice.

1.7.7 Power Line Easements

All work undertaken within the easement area is required to comply with the NSW WorkCover Code of Practice 2006 "Work Near Overhead Power Lines".

No metallic installations or metallic underground services (i.e. pipeline) shall be installed within 20 metres of a transmission line structure.

Site offices, containers, buildings or other substantial structures or parts thereof shall not be erected within the power line easement area.

Minor structures, plant or equipment or fences (including temporary fences) shall not be erected or installed within the easement area without the prior written approval of the Energy authority.

Obstructions of any type shall not be placed in the easement area within 15 metres of any part of a transmission line structure.

The height of any plant, machinery or equipment that may be brought onto or operated within the easement is limited to types that have a maximum extendable height of 4.3 metres.

Any spoil stockpiled within the power line easement, shall be no higher than 2.5 meters.

1.7.8 Telecommunications

The Contractor shall give Telstra and the Superintendent prior written notice of its intention to undertake works in or in close proximity to its fibre optic cables. The Contractor shall liaise with Telstra with regard to provision of site supervision by Telstra field staff during on site activities.

1.8 Excavation

1.8.1 Safety

The Contractor shall conduct a site hazard and safety assessment prior to commencement of any excavation to identify all potential hazards. Excavation shall be made safe by providing necessary fencing and barriers as well as trench support systems.

Refer to the recent version of the NSW WorkCover Excavation Work Code of Practice, a practical guide to achieving the standards of health, safety and welfare required under the WHS Act and the *Work Health and Safety Regulations.*

1.8.2 Drainage, Diversion, and Dewatering

The Contractor shall keep the works in as dry a condition as possible during construction including; excavation, laying and jointing of pipes, construction of chambers, backfilling; until such time as the pipeline has been successfully inspected and tested.

The Contractor shall provide install, operate and maintain all equipment and facilities necessary for dewatering the Works of inflowing water, whether arising from springs, surface drainage, or other cause. The Contractor shall comply with the requirements of the CEMP for disposal of water.

The Contractor shall not discharge any polluted water from the site into any drain or watercourse. The Contractor shall provide, install, operate and maintain all equipment and facilities necessary to remove oils, greases, liquid fuels, sands, silts and/or other contaminants in accordance with the CEMP.

The Contractor shall undertake sediment and erosion control in accordance with the CEMP.

1.8.3 Excavation Profile

1.8.3.1 Water Projects

The Contractor shall prepare excavations to the dimensions shown on the Drawing WAT-1201 Embedment and Trenchfill Typical Arrangement from WSA 03 2011-3.1 Water Supply Code of Australia (Regional New South Wales Edition), unless otherwise shown on the Drawings.

If the excavated trench width exceeds the minimum width by more than 100 mm, then the provisions of Section 1.8.4 for over excavation shall apply.

The Contractor shall excavate trenches to a depth not less than the required depth as shown on the Bedding Details Drawing and not more than 50 mm below that depth. If the excavated trench depth exceeds the Depth shown on the Bedding Details Drawing by more than 100 mm, then the provisions of Section 1.8.4 for over excavation shall apply.

1.8.3.2 Sewer Projects

The Contractor shall prepare excavations to the dimensions shown on the Drawing SEW-1201 Embedment and Trenchfill Typical Arrangement from *WSA 02: 2014-3.1 Gravity Sewerage Code of Australia (Regional New South Wales Edition)*, unless otherwise shown on the Drawings.

If the excavated trench width exceeds the width shown on the embedment details drawing by more than 100 mm, then the provisions of Section 1.8.4 for over excavation shall apply.

The Contractor shall excavate trenches to a depth not less than the required depth as shown on the Embedment and Trenchfill Typical Arrangement Drawing and not more than 50 mm below that depth.

If the excavated trench depth exceeds the depth shown on the Embedment and Trenchfill Typical Arrangement Drawing by more than 100 mm, then the provisions of

Section 1.8.4 for over excavation shall apply.

1.8.4 Over Excavation

Where a portion of any excavation is:

- Outside the tolerances permitted by this Specification; or
- Beyond that required as shown on the Drawings; or
- The consequence of any scouring, siltation, injudicious working, slips, falls, blasting or any other cause then:
    - the Contractor shall fill the over excavation to the correct lines, levels, depths using compacted crushed rock or 6% by mass cement stabilised crushed rock or concrete; and
    - The Contractor shall obtain approval in writing from the Superintendent before using any materials to rectify over excavation **(Hold Point)**.

1.8.5 Ground Support

Provide supports throughout the excavation for excavation depths of 1.5 m or greater and for excavations shallower than 1.5 m where necessary to support the ground.

Excavation supports shall be provided to ensure:

- A safe working environment within the excavations;
- Security of the ground surrounding the excavation against movement;
- Prevention of any building, other structures, road or road surfaces over and adjacent to the line of the Works from settling, cracking, being shaken, slipping or from falling into the excavation; and
- Prevention of any portion of the floors, sides, roofs and end faces of excavations outside the dimensions required by the Drawings, from slipping, falling, running in or being forced through joints and open spaces in the ground support system members.

The ground stabilisation system used shall be maintained in a satisfactory condition during its use. The ground support system shall not be removed where its withdrawal would:

- Be impractical; or
- Endanger the safety of the Works, buildings, structures, street, and other surfaces over and adjacent to the line of the Works.

Where supports are not removed, cut the supports to a minimum of 600 mm below the finished ground surface.

When removing supports, ensure that pipe bedding is not disturbed. Voids left by the withdrawn ground support shall be filled with bedding material or other approved material.

1.8.6 Excavation in Unsuitable Material

If any foundation is unsuitable due to the possible presence of expansive or unstable soils or the bearing capacity possibly being less than 50 kPa, the Contractor shall obtain a written instruction from the Superintendent on the means of providing a satisfactory foundation.

1.8.7 Storage and Disposal of Topsoil and Excavated Material

Storage and disposal of topsoil excavated material shall be undertaken in accordance with the CEMP.

1.8.8 Blasting

1.8.8.1 5.3.1 General

All blasting shall be carried out in accordance with the NSW Explosives Regulation 2013 and AS 2187, and the Australian and New Zealand Environment Council (ANZEC) Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990).

1.8.8.2 Approvals

Blasting is prohibited within 50 metres of existing pipelines and underground services, buildings, and other structures unless approved in writing by the Superintendent and the Relevant Authority prior to undertaking any such blasting.

If blasting is required in the vicinity of overhead power lines, the written approval of the Superintendent and the Relevant Authority shall be obtained prior to any blasting and the requirements of the Relevant Authority shall be complied with.

Where the Superintendent and the Relevant Authority approve the use of explosives the Contractor shall obtain the approval of NSW WorkCover and comply with the provisions of all relevant Acts and Regulations.

Blasting shall only be carried out by a holder of a 'Permit to Use Explosives' conforming to the blasting explosive and detonation system used.

Blasting shall be carried out in accordance with the Blasting Plan approved by NSW WorkCover.

Blasting will only be allowed during working hours specified in the Contract Documents.

1.8.8.3 Storage and Handling

Storage and handling of explosive shall comply with the requirements of AS 2187 and the relevant local government ordinance.

1.8.8.4 Notice

The Contractor shall give the Superintendent 14 days notice of intention to commence drilling and blasting. The Contractor shall also give property owners located within1,500 metres of the blasting site 14 days notice of intention to commence drilling and blasting. Notices shall provide details of the proposed drilling and blasting techniques and the indicative location of the blasting works.

1.8.8.5 Signage

During blasting operations the Contractor shall erect approved warning signs and sound audible warnings as specified in AS 2187.2, Clause 8.1.

1.8.8.6 Particle Velocity

The Contractor shall take all reasonable measures to prevent materials from being thrown or driven out of the excavation / blasting location.

The Contractor shall use controlled blasting techniques such as pre-split techniques to avoid open seams, cracking or damage to rock outside the excavation limits.

The maximum acceptable peak particle velocity (PPV) in material shall be as specified in the Australian and New Zealand Environment Conservation Council (ANZECC) Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990). This guideline recommends the following noise and vibration limits as below.

Table 1 Recommended ANZEC 1990 Blasting Limits

Air Blast Overpressure	Ground Vibration
115 dB (lin peak)	5 mm/s PPV
The level of 115 dB may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 120 dB (lin) peak.	The level of 5 mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 10 mm/s.

No blasting shall be carried out within 60m of any area covered by or being covered by concrete.

1.8.8.7 Vibration Monitoring

The Contractor shall monitor vibrations where blasting is used near concrete structures or installed pipes and fittings. Monitors shall be located on the nearest structure, and shall be bonded securely to the concrete using an epoxy bonding material or bolts.

1.8.8.8 Blasting Records

The Contractor shall prepare and maintain complete records of all blasting using Forms A and B of Appendix A of AS 2187.2. A copy of these records shall be submitted to the Superintendent within 5 working days of completing each day's blasting activity.

1.9 Concrete Works

1.9.1 Concrete Formwork

1.9.1.1 General

1.9.1.1.1 Standard

Formwork design and construction to AS 3610.

1.9.1.2 Quality

1.9.1.2.1 Inspection Witness Points

Give sufficient notice so that inspection may be made of the following:

- Completed formwork and reinforcement installation before concrete placing;
- Concrete during placement;
- Evaluation of the finish; and
- Used formwork, after cleaning and before reuse.

1.9.1.2.2 Contractor's Submissions

- Design: Have the design of the formwork undertaken by a qualified structural engineer.
- Certification: Submit certification by a qualified structural engineer who is engaged by the formwork contractor for all formwork where required by the relevant safety regulations.

1.9.1.3 Execution

1.9.1.3.1 Formwork

General: Design and construct formwork so that the concrete, when cast in the forms, will have the required dimensions, shape, profile, location and surface finish. Allow for dimensional changes,

deflections and cambers resulting from the application of prestressing forces, applied loads, temperature changes and concrete shrinkage and creep.

1.9.1.3.1.1 Openings

In vertical forms provide form openings or removable panels for inspection and cleaning.

1.9.1.3.1.2 Cleaning

Remove free water, dust, debris and stains from the forms and the formed space before placing concrete.

1.9.1.3.1.3 Stripping of formwork

To AS 3600 where these requirements are more stringent than the relevant requirements of AS 3610.

1.9.1.3.1.4 Reshoring

Do not reshore.

1.9.1.3.1.5 Release Agent

Before placing reinforcement, apply a release agent compatible with the contact surfaces, to the interior of the formwork, except where the concrete is to receive an applied finish for which there is no compatible release agent. Clean the reinforcement to remove all traces of release agent.

1.9.1.3.1.6 Defective Formwork

Remove rejected concrete, form construction joints, reconstruct the formwork and recast the concrete.

1.9.1.3.1.7 Permanent Loading

Do not place permanent loads, including masonry walls, on the concrete structure while it is still supported by formwork.

1.9.1.3.2 Dimensional Tolerances

Dimensional tolerances for concrete are to accord with the requirements of AS 3610 clause 3.4 as applicable for formed surfaces and the table below and otherwise to AS 3600 clause 19.5. Note that the maximum deviation specified in the Position Tolerances Table 2 refers to the absolute position.

Table 2 Position Tolerances Table

Surface finish class to AS 3610	1	2	3	4	5
Maximum deviation from correct position (mm)	10	15	20	25	40

1.9.1.3.3 Formed Surface Finish

1.9.1.3.3.1 Visually Important Surfaces

For concrete of surface finish classes 1, 2 or 3, set out the formwork to give a regular arrangement of panels, joints, bolt holes, and similar visible elements in the formed surface. Form 45° bevels, 25 mm on the face on corners and angles.

Table 3 Formed Surfaces Schedule

Surface finish class to AS 3610	Concrete element or surface	Integral finish	Form lining type	Bolt hole filling

1	NA			
2	Exposed surfaces and edges required to interface with other elements	NA	Not specified	Recessed
3	Surfaces concealed from general view	NA	Not specified	Recessed
4	NA			
5	NA			

1.9.1.3.4 Form Tie Bolts

1.9.1.3.4.1 Removable Bolts

Remove the bolts without causing damage to the concrete.

1.9.1.3.4.2 Cover

Position formwork tie bolts left in the concrete so that the tie does not project into the concrete cover.

1.9.1.3.4.3 Bolt Hole Filling

General: Use material matching the surface colour.

Recessed filling: Fill or plug the hole to 6 mm below the surface.

1.9.1.3.4.4 Form tie bolts for water resisting elements

Where concrete elements are to resist water penetration such as retaining walls and the like, use 'snap off' type form tie bolts or other types of form tie bolts that do not provide a path for water through the concrete element. Alternatively use a waterproof plug.

1.9.2 8.2 Concrete Reinforcement

1.9.2.1 General

1.9.2.1.1 Standard

Steel reinforcing materials: To AS/NZS 4671.

1.9.2.2 Quality

1.9.2.2.1 Inspection Witness Points

Give sufficient notice so that inspection may be made of the following:

- Reinforcement fixed in place; and
- Cores and embedment fixed in place.

1.9.2.2.2 Inspection Hold Points

- Reinforcement fixed in place.

1.9.2.2.3 Contractor's Submissions

1.9.2.2.3.1 Tests

Certificate of compliance: Submit either the manufacturer's certificate of compliance with the relevant standard, or an independent testing authority's test certificates demonstrating compliance of reinforcement with AS/NZS 4671.

1.9.2.2.3.2 Execution

Changes: Submit proposed changes, if any, in the reinforcement shown on the drawings, including additional splicing.

Mechanical splices: If mechanical bar splices are proposed or required submit details and test certificates for each size and type of bar to be spliced.

Damaged galvanising: If repair to AS 1650 Appendix F is intended, submit proposals.

1.9.2.3 Materials and Components

1.9.2.3.1 Reinforcement Generally

1.9.2.3.1.1 General

Extent: Provide reinforcement, including tie wires, support chairs, spacers and accessories. Ductility grade: To AS/NZS 4671 Class N.

Identification: To AS/NZS 4671 Section 9.

Surface condition: Free of loose mill scale, rust, oil, grease, mud or other material that would reduce the bond between the reinforcement and concrete.

1.9.2.3.1.2 Welding

General: Give notice before welding reinforcement. Do not weld reinforcement within 75mm of a section that has been affected by bending or re-bending.

Standard: To AS 1554.3.

1.9.2.3.1.3 Dowels

Standard: To AS/NZS 4671 grade 250N, hot dip galvanised.

General: Provide each dowel in one piece, straight, with square cut ends free from burrs. Apply 2 coats of bitumen emulsion to half the length of the dowel at one end. Embed the unpainted half of the dowels in the concrete placed first. All dowels to be hot dip galvanised.

Tolerances:

- Location: half the diameter of the dowel; and
- Alignment: 2 mm in 300 mm.

1.9.2.3.1.4 Tie Wire

General: Annealed iron 1.25 mm diameter (minimum). External and corrosive applications: Galvanized.

1.9.2.3.1.5 Bending

General: To AS/NZS 4671 Section 7, and AS/NZS 3600 Section 17.

1.9.2.3.1.6 Fabrication Tolerances

General: To AS/NZS 4671 Section 7, and AS/NZS 3600 Section 17.

1.9.2.4 Protective Coated Reinforcement

1.9.2.4.1.1 Unencased Reinforcement

General: Provide protection for starter bars and other items projecting from cast concrete for future additions, and exposed to the weather.

Protection method: Exposed bars to be galvanised.

1.9.2.5 Execution

1.9.2.5.1 Reinforcement Supports

1.9.2.5.1.1 Support Types

General: Provide purpose-made concrete, metal or plastic supports, adequate to withstand construction and traffic loads, and in the form of chairs, spacers, stools, hangers and ties.

Exposure classification A1: Provide a protective coating to ferrous metal supports which extend to the surface of the concrete.

Exposure classifications more severe than A1: Use either

- Plastic supports of adequate strength and of a shape appropriate to the location; or
- Concrete supports of the same concrete quality as the concrete element.

1.9.2.5.1.2 Supports Over Membranes

Prevent damage to waterproofing membranes or vapour barriers. Place a metal or plastic plate under each support to prevent puncturing.

1.9.2.5.1.3 Support Spacing

Bars: not more than 60 diameters or 900 mm whichever is least. Fabric: not more than 750 mm.

1.9.2.5.2 Fixing Reinforcement

1.9.2.5.2.1 Fixing Requirements

General: Secure the reinforcement against displacement by tying at intersections with either annealed iron 1.25 mm diameter (minimum) wire ties, or clips. Bend the ends of wire ties away from nearby faces of forms so that the ties do not project into the concrete cover.

Mats and walls: For bar reinforcement in the form of a mat, secure each bar at alternate intersections, and at other points as required.

Beams: Tie ligatures to bars in each corner of each ligature. Fix other longitudinal bars to ligatures at 1 m maximum intervals.

Columns: Secure longitudinal column reinforcement to all ligatures at every intersection.

Bundled bars: Tie bundled bars together so that the bars are in closest possible contact. Use tie wire at least 2.5 mm diameter at centres not more than 24 times the diameter of the smallest bar in the bundle.

1.9.2.5.2.2 Concrete Cover

General structures: As specified on the drawings or to AS 3600. Structures for retaining liquids: To AS 3735.

1.9.2.5.2.3 Provision for Concrete Placement

Notice: If spacing or cover of reinforcement does not comply give notice.

1.9.2.5.2.4 Welding

General: Do not weld reinforcement unless shown on the drawings.

1.9.3 In Situ Concrete

1.9.3.1 General

1.9.3.1.1 Standards

Materials and construction: To AS 3600. Concrete: To AS 1379.

Concrete structures for retaining liquids: To AS 3735.

1.9.3.1.2 Concrete colour

No special requirements for specific colour but concrete exposed in the completed structure shall be of uniform colour and subject to colour control to AS 3610.

1.9.3.2 Quality

1.9.3.2.1 Inspection Witness Points

Give sufficient notice so that inspection may be made of the following:

- Base or subgrade before covering;
- Membrane or film underlay installed on the base;
- Completed formwork, tendons and reinforcement, cores and embedments fixed in place;
- Commencement of concrete placing; and
- Surfaces or elements to be concealed in the final work before covering.

Minimum notice required: 48 hours.

1.9.3.2.2 Inspection Hold Points

- Base or subgrade before covering; and
- Completed formwork, tendons and reinforcement, cores and embedments fixed in place.

1.9.3.2.3 Rejection

Remove rejected concrete from the site.

1.9.3.2.4 Concrete Tests

1.9.3.2.4.1 Concrete Testing Methods

Sampling and testing: To AS 1012. Sample the concrete on site, at the point of discharge from the agitator.

1.9.3.2.4.2 Test Authority

Carry out testing and assessment of concrete and concrete materials using an authority registered with the National Association of Testing Authorities Australia (NATA) to perform the specified testing.

1.9.3.2.4.3 Test Records

For each required test maintain the records and reports of test results required by AS 1012, or similar information for tests not covered by AS 1012. Submit a copy of each test report.

1.9.3.2.4.4 Performance Tests

General: Sample, test and assess the concrete for compliance. The concrete shall be subject to project assessment.

Standard: To AS 1379.

Strength grade/Characteristic compressive strength: Spread the site sampling evenly throughout the pour. The frequency of sampling shall be as per the Sampling Frequency Table except that for concrete in columns and bearing walls, take one sample per batch. Use at least 3 specimens from each sample: one tested at 7 days and two tested at 28 days. Specimen size shall be 200 x 100 mm diameter but, if aggregate size exceeds 20 mm, 300 x 150 mm diameter.

Table 4 Sampling Frequency Table

Number of batches for each type and grade of concrete per day	Minimum number of samples
1-5	1
6-10	2
11-20	3
each additional 10	1 additional

Slump: Test at least one sample from each batch before placing concrete from that batch in the work. Take samples at the point of discharge on site.

1.9.3.2.5 Contractor's Submissions

1.9.3.2.5.1 Subcontractors

Submit names and contact details of proposed ready mixed concrete suppliers, and alternative source of supply in the event of breakdown of ready mixed or site mixed supply.

1.9.3.2.5.2 Design Loading

Submit calculations to justify the adequacy of the structure to sustain any construction loads.

1.9.3.2.5.3 Shop Drawings

Fixings and embedded items: If the locations of embedded items are not shown or are shown diagrammatically, submit shop drawings showing the proposed locations, clearances and cover.

Refer also to concrete formwork section of this specification document.

1.9.3.2.5.4 Material Tests

Before supplying concrete submit test certificates based on samples from the most recent production or from stockpiles for the project, for the materials and properties listed in the Material tests schedule. Submit additional certificates at the scheduled frequency during the course of the works.

Dissemination of production information: Submit copies of the reports. Embedded pressure pipes: Submit the results of leak tests.

1.9.3.2.5.5 Materials

General: Submit details of proposed sources of materials.

Curing Compounds: If it is proposed to use a liquid membrane-forming curing compound submit the following information:

- Certified test results for water retention to AS 3799 Appendix B;
- Evidence that an acceptable final surface colour will be obtained;
- Evidence of compatibility with applied finishes, if any; and
- Methods of obtaining the required adhesion for toppings and render. Note that curing compounds are not to be used during hot weather.

1.9.3.2.5.6 Execution

General: Submit proposals for mixing, placing, finishing and curing concrete including the following:

- Handling, placing, compaction and finishing methods and equipment.
- Temperature control methods;
- Curing and protection methods;
- Target strength, slump and proposed mix for each type and grade of concrete.
- High early strength cement;
- Cutting or displacing reinforcement, or cutting hardened concrete;
- Sequence and times for concrete pours, and construction joint locations.

Sawn Joints: Submit proposed methods, timing and sequence of sawing joints.

1.9.3.3 Materials

1.9.3.3.1 Polymeric Film Underlay

1.9.3.3.1.1 General

Under internal slabs on ground including integral ground beams and footings, provide a vapour barrier or, in areas prone to rising damp or salt attack, a damp-proofing membrane.

1.9.3.3.1.2 Standard

Vapour barriers and damp-proofing membranes: 0.2mm high impact resistant polyethylene film complying with AS 4347.6 for impact resistance.

1.9.3.3.1.3 Base Preparation

According to base type, as follows:

- Graded stone base: Blind with sufficient sand to create a smooth surface free from hard projections. Wet the sand just before laying the underlay; and
- Concrete working base: Remove projections above the plane surface, and loose material.

1.9.3.3.1.4 Installation

Lay over the base, lap joints at least 200 mm and seal the laps and penetrations with waterproof adhesive tape. Face the laps away from the direction of concrete pour. Take the underlay up vertical faces as far as the damp proof course where applicable, and fix at the top by tape sealing. Locate vertical laps only on vertical or inclined surfaces. Patch or seal punctures or tears before pouring concrete.

1.9.3.3.2 Concrete Materials

1.9.3.3.2.1 General

Cementitious materials: Dry and uncontaminated.

Aggregate: Unsegregated and uncontaminated.

Admixtures: No deterioration.

1.9.3.3.2.2 Bagged Cement

Standard: To AS 3972.

Type: GP.

Age: Less than 6 months old.

1.9.3.3.2.3 Chemical Admixtures

Contents: Free of chlorides, fluorides and nitrates.

1.9.3.3.3 Concrete

1.9.3.3.3.1 Concrete Performance

General: Mix must work readily into corners and angles, and around reinforcement, without segregation or excess free water on the surface, producing sound concrete, with minimal plastic settlement and shrinkage cracking.

1.9.3.3.3.2 Ready Mixed Supply

Method: Use the batch production process. Deliver in agitator trucks.

Concrete for common elements (e.g. Floor Plates) or to groups of related elements (e.g. Columns and walls in the same lift) is to be sourced from the same batching plant.

Minimum Cement Content: 320 kg/m3. Water/Cement Ratio: 0.5 max.

Admixtures: Do not use admixtures containing significant chlorides.

Entrained air: Add air entraining agent (AEA) for all exposed concrete in accordance with AS 3600, Clauses 4.8 (b).

Addition of water: Do not add water at the site.

Plastic cracking: Design the concrete mix to minimise plastic settlement and shrinkage cracking.

1.9.3.3.3.3 Elapsed Delivery Time

Elapsed time between the wetting of the mix and the discharge of the mix at the site must not exceed the criteria in the Elapsed Delivery Time Table.

Table 5 Elapsed Delivery Time Table

Concrete temperature at time of discharge (°C)	Maximum elapsed time (hours)
< 24	2.00
24 – 27	1.50
27 – 30	1.00
> 30	0.75

1.9.3.3.3.4 Site Mixed Supply

Do not use site mixed concrete.

1.9.3.3.4 Concrete types

1.9.3.3.4.1 Concrete Generally

The 28 day concrete strength shall be:

- Valve pits 40 MPa (unless noted otherwise)
- Maintenance holes 32 MPa
- Concrete paving 32 MPa
- Thrust blocks and all other concrete 25 MPa
- Blinding concrete 20 MPa

1.9.3.3.4.2 Grout

Standard: To AS 3600 clause 17.1.8

Maximum shrinkage: 1% by volume after 24 hours.

Maximum water cement ratio: 0.45 (by weight).

Minimum compressive strength: (75 mm cube): 70 MPa at 28 days.

1.9.3.4 Cores, Fixings and Embedded Items

1.9.3.4.1 Adjoining Elements

For adjoining elements to be fixed to or supported on the concrete, provide for the required fixings. Where applicable provide for temporary support of the adjoining elements during construction of the concrete.

1.9.3.4.2 Structural Integrity

Fix cores and embedded items to prevent movement during concrete placing. In locating cores, fixings and embedded items, do not cut or displace reinforcement, or cut or core hardened concrete. Ensure that embedded pipes and conduits do not adversely affect structural integrity.

1.9.3.4.3 Placement

Maximum deviation from correct positions:

- Cores and embedded items generally: ± 10 mm.
- Fixings including anchor bolts: ± 3 mm.
- Anchor bolt groups for structural steel: To AS 4100.

Water tracking: Ensure fixings do not allow water to track to reinforcement.

1.9.3.4.4 Inserted Fixings

Methods: Do not insert fixings using drilling (including masonry anchors), or using explosive tools, as an alternative to embedding in the concrete.

1.9.3.4.5 Protection

General: Grease threads. Cover and protect embedded items against damage. Corrosion: Hot dip galvanise inserts, anchor bolts and embedded fixings.

Capping: Cap hollow embedded items to avoid them being filled with concrete or grout.

1.9.3.5 Placing and Curing

1.9.3.5.1 Concrete Working Base

1.9.3.5.1.1 Material

N120concrete. Lay over the base or subgrade and screed to the required level.

1.9.3.5.1.2 Thickness
Minimum 50 mm.

1.9.3.5.1.3 Finish
Membrane support: Wood float finish or equivalent.

1.9.3.5.1.4 Surface Tolerance
± 5 mm from the correct plane, ± 5 mm from a 2 m straight edge.

1.9.3.5.2 Placing and Compaction
1.9.3.5.2.1 Placing
General: Use placing methods which minimise plastic settlement and shrinkage cracking. Avoid segregation. Avoid loss of materials. Between construction joints, maintain a plastic concrete edge.

Layers: Place concrete in layers ≤ 300 mm thick, such that each succeeding layer is blended into the preceding one by the compaction process.

Placing slabs and pavements: Place concrete uniformly over the width of the slab so that the face is generally vertical and normal to the direction of placing.

Construction joints: Thoroughly roughen hard concrete joint surfaces. Remove loose or soft material, foreign matter and laitance. Dampen joint surface using clean water and coat with neat cement slurry.

1.9.3.5.2.2 Horizontal Movement
Use suitable conveyors, clean chutes, troughs or pipes. Do not use water to facilitate the movement.

1.9.3.5.2.3 Vertical Movement
In vertical elements, limit the free fall of concrete to 1500 mm per 100 mm element thickness, up to a maximum free fall of 3000 mm, using enclosed chutes or access hatches in forms. As far as practicable keep chutes vertical and full of concrete during placement, with ends immersed in the placed concrete.

1.9.3.5.2.4 Rain
Do not expose concrete to rain before it has set, including during mixing, transport or placing.

1.9.3.5.2.5 Sequence of Pours
Minimise shrinkage effect by pouring the sections of the work between construction joints in a sequence such that there will be suitable time delays between adjacent pours.

1.9.3.5.2.6 Compaction
General: Remove air bubbles and fully compact the mix.

Methods: Use immersion and screed vibrators accompanied by hand methods as appropriate.

Vibrators: Do not allow vibrators to come into contact with partially hardened concrete, or the reinforcement embedded in it. Do not use vibrators to move concrete along the forms. Avoid over-vibration that may cause segregation.

The Contractor shall ensure that at least one vibrator in working order is held in reserve at all times.

1.9.3.5.2.7 Placing Records

Keep on site and make available for inspection a log book recording each placement of concrete, including the following:

- Date;
- The portion of work;
- Specified grade and source of concrete;
- Slump measurements; and
- Volume placed.

1.9.3.5.3 Cold Weather Placing

1.9.3.5.3.1 General

Maintain the temperature of the freshly mixed concrete within the limits shown in the Cold Weather Placing Table. "Outdoor" air temperature applies to the air temperature at the time of mixing and to the predicted or likely air temperature at any time during the subsequent 48 hours.

Table 6 Cold Weather Placing Table

Outdoor Air Temperature	Temperature of Concrete	
	Minimum	Maximum
≥ 5°C	10°C	32°C
< 5°C	18°C	32°C

1.9.3.5.3.2 Additives

Do not use calcium chloride, salts, chemicals or other material in the mix to lower the freezing point of the concrete.

1.9.3.5.3.3 Frozen Materials

Do not allow frozen materials or materials containing ice to enter the mixer, and keep free of frost and ice any forms, materials, and equipment coming in contact with the concrete.

1.9.3.5.3.4 Frost on Reinforcement and Formwork

Do not place concrete if there is frost on the reinforcement or formwork including profiled steel formwork. Remove frost by hot air blowers or other means before placing concrete.

1.9.3.5.3.5 High Early Strength Cement

Use in severe weather conditions to enable the concrete to develop sufficient strength to permit formwork removal within the specified time. Do not use as a substitute for the heating of materials or for adequate protection of placed concrete against low temperatures. Do not use high alumina cement.

1.9.3.5.3.6 Heating

General: Heat the concrete materials, other than cement, to the minimum temperature necessary to ensure that the temperature of the placed concrete is within the limits specified.

Maximum temperature of water: 60°C when it is placed in the mixer.

1.9.3.5.4 Hot Weather Placing

1.9.3.5.4.1 Mixing

Surrounding outdoor shade temperature > 38°C: Do not mix concrete.

Surrounding outdoor shade temperature > 25°C: Observe the following precautions.

1.9.3.5.4.2 Handling

Prevent premature stiffening of the fresh mix and reduce water absorption and evaporation losses. Mix, transport, place and compact the concrete as rapidly as possible.

1.9.3.5.4.3 Placing

Before and during placing maintain the formwork and reinforcement at ≤ 32°C using protection, cold water spraying, or other effective means. When placed in the forms, the temperature of the concrete must not exceed the criteria in the Hot Weather Placing Table.

Table 7 Hot Weather Placing Table

Concrete Element	Temperature Limit
Normal concrete in footings, beams, columns, walls and slabs	35°C
Concrete in large mass concrete sections; or concrete of strength 40 MPa or greater, in sections exceeding 600 mm in thickness, white concrete in any element	27°C

1.9.3.5.4.4 Temperature Control Methods

Select one or more of the following methods of maintaining the specified temperature of the placed concrete:

- Use chilled mixing water;
- Spray the coarse aggregate using cold water;
- Cover the container in which the concrete is transported to the forms; and/or
- Cool the concrete using liquid nitrogen injection before placing.

1.9.3.5.5 Placing Under Water

1.9.3.5.5.1 Standard

Placing by tremie: To AS 2159.

1.9.3.5.5.2 General

Condition: Do not place under water if placing in the dry is practicable by pumping or other means of dewatering.

Minimum cement content for the mix: Increase by 25%.

1.9.3.5.6 Compaction

General: Remove air bubbles and fully compact the mix.

Methods: Use immersion and screed vibrators accompanied by hand methods as appropriate.

Vibrators: Do not allow vibrators to come into contact with partially hardened concrete, or reinforcement embedded in it. Do not use vibrators to move concrete along the forms. Avoid over-vibration that may cause segregation.

1.9.3.5.7 Curing

1.9.3.5.7.1 General

Protection: Protect fresh concrete, during the curing period, from premature drying and from excessively hot or cold temperatures. Protect fresh concrete from physical and thermal shock, from

traffic likely to damage the surface, and from rain. If temperature of surrounding air is > 35°C, protect from wind and sun until the concrete can be covered. Maintain at a reasonably constant temperature with minimum moisture loss, during the curing period. Prevent rapid drying out at the end of the curing period.

Curing period: Cure continuously from initial set until the total cumulative number of days or fractions of days, during which the air temperature in contact with the concrete is above 10°C, is at least the following:

- Fully enclosed internal surfaces/Early high-strength cement concrete: 7 days.
- Other surfaces/Ordinary Portland cement concrete: 7 days.

Curing Compounds: all curing compounds (if used) shall comply with AS 3799.

1.9.3.5.7.2 Curing Methods

Acceptable methods of curing include the following:

- Ponding or continuous sprinkling with water (moist curing);
- An impermeable membrane;
- An absorptive cover kept continuously wet;
- Steam curing; or
- An approved curing compound. Do not use curing compounds if the ambient temperature is likely to exceed 25oC; use other methods as described above.

1.9.3.5.7.3 Curing Compounds

Standard: To AS 3799.

Type: Chlorinated rubber based complying with ASTM C309 and shall be approved for use with potable water.

Application: Provide a uniform continuous flexible coating without visible breaks or pinholes, which remains unbroken at least 7 days after application.

1.9.3.5.7.4 Hot Weather Precautions

If the ambient air temperature exceeds 25°C , do not use curing compounds. After placement, either

- Immediately cover the concrete using an impervious membrane, or hessian kept wet, until curing begins by one of the above methods; or
- If the temperature exceeds 25°C or if not protected against drying winds, protect the concrete using a fog spray application of evaporation retardant, until curing begins by one of the above methods.

1.9.3.5.8 Protection

1.9.3.5.8.1 Loading

Do not load the concrete structure until the concrete has achieved its 28 day strength. Do not load the concrete structure in excess of its design load.

Notice: Give notice before loading the concrete structure.

Protection: Protect the concrete from damage due to load overstress, heavy shocks and excessive vibrations, particularly during the curing period. Do not place construction loads on structures which will overstress them.

1.9.3.5.8.2 Surface Protection

Protect finished concrete surfaces from damage.

1.9.3.6 Joints

1.9.3.6.1 Construction Joints

1.9.3.6.1.1 Location

Do not relocate or eliminate construction joints, or make construction joints not shown on the drawings. This includes emergency construction joints made necessary by unforeseen interruptions to the concrete pour.

1.9.3.6.1.2 Joint Preparation

Roughen and clean the hardened concrete joint surface, remove loose or soft material, free water, foreign matter and laitance. Dampen the surface just before placing the fresh concrete.

1.9.3.6.2 Movement Joints – Concrete

Movement Joint Types (Definitions):

Dowel joint: A reinforced joint with a bond breaking coating separating the concrete joint surfaces.

Contraction Joint: An unreinforced joint with a bond-breaking coating separating the concrete joint surfaces.

Expansion Joint: An unreinforced joint with the joint surfaces separated by a compressible filler.

Control Joint: A weakened plane contraction joint created by forming a groove, extending at least one quarter the depth of the section, either by means of a grooving tool, by sawing, or by inserting a pre-moulded strip.

Isolation Joint: A joint without keying, dowelling, or reinforcement, which imposes no restraint on movement in any plane.

Sealing of movement joints: For all types of movement joints seal with flexible sealant.

1.9.3.6.3 Movement Joints – materials and sealants

1.9.3.6.3.1 Jointing Materials

Type: Use jointing materials compatible when used together, and non-staining to concrete in visible locations.

Foamed materials (in compressible fillers): Closed-cell or impregnated types which do not absorb water.

Bond breaking: Use back-up materials for sealants, including backing rods, which do not adhere to the sealant. They may be faced with a non-adhering material.

1.9.3.6.3.2 Joint Filling

Preparation: Before filling, dry and clean the joint surfaces, and prime.

Joint filling: Fill with jointing materials. Finish visible jointing material neatly flush with adjoining surfaces.

Watertightness: Apply the jointing material so that joints subject to ingress of water are made watertight.

1.9.3.6.4 Dowels

1.9.3.6.4.1 Joint Dowels

Provide galvanised steel reinforcing rod dowels in expansion and contraction joints, where required. Embed dowels normal to the plane of the joint, so that half the dowel lies on each side of the joint. Heavily grease or bitumen coat one half and fit an expansion cap to that end.

1.9.3.7 Waterstops

As shown on drawings.

1.9.3.8 Joint Fillers

Joint fillers shall be approved self-expanding resin bonded cork fillers complying with the requirements of ASTM D1752-84 for Type III fillers. The material shall not contaminate potable water.

The Contractor shall submit samples of joint fillers for approval. The submission shall include details of the resin used as bonding agent in the filler.

1.9.3.9 Joint Sealant

Joint sealants shall be non-toxic, two-part polysulphide based, or non-toxic polyurethane based. Sealants shall be approved for use with potable water.

1.9.3.10 Epoxy Paste

Epoxy paste shall comply with the following requirements:

MATERIAL: Moisture tolerant (adherence to damp concrete), solventless epoxy paste, such as Hilti CA273 or Epirez 633. Mixing ratio shall be 1:1. Addition of fillers is not accepted.

1.9.3.11 Concrete Finishes General

Concrete finishes to AS3610 and ASTM E1155M-96.

1.9.3.11.1 Finishes General

1.9.3.11.1.1 Tolerance Classes

Determine tolerance classes using a straight edge placed anywhere on the surface in any direction.

Table 8 Tolerance Class Table

Class	Measurement	Maximum Deviation (mm)
A	3 m straight edge	3
B	3 m straight edge	6
C	600 mm straight edge	6
D	ASTM E1155-96	FF35/FL25

1.9.3.11.2 Integral Finishes

1.9.3.11.2.1 Unformed Surfaces

1.9.3.11.2.1.1 Screeding

Finish slab surfaces to finished levels.

1.9.3.11.2.1.2 Finishing Methods

Scored finish: After screeding, give the surface a coarse scored texture using a stiff brush or rake drawn across the surface.

Machine floated finish: Finish the screeded surface to a uniform smooth texture using a machine float. Hand float in locations inaccessible to the machine float.

Steel trowelled finish: Use steel hand trowels to produce the final finish free of trowel marks and uniform in texture and appearance.

Wood float finish: Produce the final finish using a wood float.

Broom finish: After floating use a broom to produce an even textured slip-resistant surface.

1.9.3.11.2.2 Schedule

Table 9 Integral Finishes Schedule

Location	Floor slabs	External Hardstand
Tolerance class	A	A
Finish	Machine float	Broom Finish
Non-slip finish	N/A	N/A
Surface modifier	N/A	N/A

Take particular care to protect steel trowel finish concrete from damage from construction activities and rain.

1.9.3.12 Concrete Plinths

General: Provide galvanised steel surround at least 75 mm high and 1.6 mm thick, fixed to floor with masonry anchors. Fill with concrete.

Reinforcement: Single layer of SL82 fabric.

Concrete: Grade N20.

Finish: Steel float flush with the surround.

1.10 Reinstatement

The Contractor shall make good at his own cost all fencing, roads, footpaths, lawns, driveways, and surfaces generally, which may be disturbed by cartage or other operations of the Contractor.

The Contractor shall restore all work sites and areas adjacent thereto to as good a state of repair as they were in before the Works commenced and to the satisfaction of the Superintendent prior to leaving the site, unless otherwise directed by the Superintendent.

All places where, in the opinion of the Superintendent, residents have provided care and maintenance to areas of substantial grass coverage are to be reinstated with turf. Where the Contractor has not adequately separated topsoil from general spoil the Contractor is to provide replacement topsoil.

All resurfacing of road pavements, reinstatement of footpaths, kerbs, channels and the like shall comply with the requirements of the relevant roads authority.

All rubbish, debris and waste resulting from the Works and the activities of the Contractor must be removed from the site by the Contractor.

1.11 Commissioning and decommissioning

1.11.1 General

Commissioning shall be carried out in the following sequence:

- Pre-commissioning of equipment, including off-site / factory tests;
- Commissioning; and
- Practical Completion and handover.

The Contractor shall demonstrate successful completion of each stage of commissioning prior to proceeding with the next stage.

The Principal shall have the right to be present at any stage during formal tests, commissioning runs, etc. The Contractor shall provide a minimum 5 days notice of all formal tests and inspections.

The Contractor shall complete all required pre-commissioning tests and complete ITPs before handing over equipment to the Superintendent for commissioning. The Superintendent will not accept equipment for commissioning unless the equipment has been fully tested and ITPs have been submitted to Superintendent's commissioning staff.

1.11.2 Pre-commissioning

The Contractor shall pre-commission all equipment and systems and shall provide additional staff where necessary to prevent interrupting the main program of work.

Testing and inspection at this stage should, as a minimum, include the following:

- Completion of all factory testing and completion of all documentation;
- Completion of all required tests and completion of all required ITPs;
- Provide fully documented test of commissioning records including the result of all measurements and settings of all new adjustable and/or programmable devices/instrumentation supplied under the Contract; and
- On completion of the pre-commissioning tests, the Contractor shall notify the Superintendent that the installations are ready for commissioning.

1.11.3 Commissioning

Unless otherwise stated, the Contractor will be responsible for site commissioning. Shoalhaven City Council shall be responsible in the verification of the RTU and SCADA operation.

The Contractor shall submit a detailed Commissioning Plan for the whole works and a program schedule for approval prior to the commencement of any commissioning activities.

The Superintendent shall be on-site throughout the commissioning of all equipment and systems **(Witness Point)**.

1.11.4 Decommissioning

The Contractor shall provide all documentation, labour, materials and equipment necessary for safe decommissioning. The Contractor shall inspect all work areas with the Superintendent prior to commencing any work to confirm the extent of decommissioning work required to be performed in the area.

All decommissioning works shall be undertaken in accordance with AS 2601.

The Contractor shall prepare a decommissioning work plan for approval of the Superintendent. Decommissioning work shall not commence until the decommissioning work plan has been approved by the Superintendent **(Hold Point)**.

The Superintendent shall be on-site throughout the decommissioning activities **(Witness Point)**. The decommissioning work plan shall include the following information:

- Locations and details of necessary service deviations and terminations; and
- If removal of asbestos or of material containing asbestos is required, include information to be supplied to the Licensed Asbestos Removalist.

The decommissioning and disposal of all asbestos and asbestos related products are to be carried out in accordance with NSW Work Cover requirements Occupational Health and Safety Regulation 2001 and the National Code Practice for the Safe removal of Asbestos [NOHSC 2002 (1988)].

1.12 Information to be submitted by the Contractor

1.12.1 “Work As Executed” Drawings

“Works As Executed” (WAE) Drawings shall include the updated Contract Drawings and updated Drawings specified to be submitted by the Contractor. All cross-references on the Drawings shall be updated.

The WAE Drawings must be completed for presentation to, and approval by the Superintendent, prior to Pressure Testing and the issue of the Certificate of Practical Completion/Certificate of Compliance. The Contract Drawings shall be, modified as necessary to include all ”As Constructed” and “As Installed” information , in A1, A2 or A3 format (A3 preferred), as appropriate, on heavy paper. The Drawings shall also be submitted in electronic format.

The WAE Drawings shall be prepared, as stated below:

- The WAE documentation shall include the full set of the Contract Drawings. A WAE notation in the revision table located on each drawing shall be added to indicate that it is a Work As Executed even if no other changes have been made to the Contract Drawings;
- All relevant information relating to the Contract work shall be entered on to working Drawing prints immediately after the work has been carried out, particularly work concealed from sight, such as underground services;
- The information shall include actual measured dimensions and levels from site;
- Specially manufactured fittings and installations should be identified by make and brand names on the Drawings and other relevant documents should be provided, so that future references are facilitated;
- The Contractor shall include an individual AutoCAD circuit diagram Drawing for each equipment item – i.e. one Drawing per plant item;

- The documentation shall proceed as each section of the work is completed. The Superintendent shall be allowed to inspect the progress of these Drawings on request;
- Working Drawings can be used to prepare the WAE Drawings. The WAE information shall be marked clearly in red;
- The WAE Drawings shall be prepared in accordance with the latest version of the Shoalhaven Water Survey, Plan Preparation & Work as Executed Standard available via https://www.shoalwater.nsw.gov.au/Building-and-renovating/Information-and-resources/Guides-resources-and-standards#section-4;
- The accepted WAE Drawings shall bear the signature of the Contractor and the date of acceptance by the Superintendent; and
- The Contractor shall supply not less than three (3) copies of the WAE Drawings.

1.12.2 Operations and Maintenance Manuals

Contractor to provide O&M manuals for special valves where indicated in the Schedule of Technical Data.

1.12.3 Pump Commissioning & Alignment

Contractor shall complete pump commissioning and alignment activities to ensure that the equipment is installed and operating at its optimum efficiency and is fully in line with the project design parameters and manufacturers technical datasheets. All works should be completed by an experienced and competent person, who understands the systems and has the correct qualifications. The following testing shall be completed in consultation with Shoalhaven Water's Operational Team and witnessed by the Superintendent's nominated representatives:

- Alignment Check
- Rotation Check
- Electrical Emergency Stop
- Closed Head Test
- Full Flow Test

Test 1: Pump Alignment

Pump alignment is required to be completed prior to the equipment being run for an extended time and will ensure that:

- The equipment is installed and meets the manufacturers requirements
- There is no stress on the shafts
- Vibration is reduced

The alignment should be completed by a competent person, usually, the pump manufacturer, with a full report and documentation provided that can be included within the pump commissioning report/final documentation.

The alignment of the pumps shall be undertaken via Laser alignment.

Test 2: Rotation Check

A direction of rotation check is needed to ensure that the pump impeller spins in either its designed clockwise direction or counter-clockwise direction. Ensure the pump is run for as short a time as possible [10 seconds max].

Complete the following steps:

- Turn the pump on
- Check pressure gauges to ensure water is flowing correctly
- Turn pump off

Test 3: Emergency Stop Test

In order to ensure that the pump will stop immediately under emergency conditions, even during the testing, the emergency stop button protection device should be checked for operation.

Complete the following steps:

- Turn the pump on
- Allow pump to run for a few seconds
- Hit/press emergency stop button
- Pump stops

Test 4: Conduct a Closed Head/Dead Head Test

This test is conducted to ensure that the pump is operating correctly and that there are no potential issues lurking within the pump itself.

It should be noted that this is a closed head test for a Centrifugal Pump, and the time of running the pump should be kept to a few seconds only so as not to damage it.

Complete the following steps:

- Pump off
- Attach calibrated pressure gauges to the discharge & suction side of the pump [usually replace the existing gauges temporarily]
- Get the correct pump curve related to the model testing and pen to note the details required
- Ensure that the seals for the pump are rated for a dead head test
- Turn pump on
- Slowly close the pump discharge valve 100%
- Once fully closed, quickly read and note the discharge and suction pressures at the gauges [few seconds]
- Turn pump off
- Open discharge valve

Once the reading is taken, review the information obtained against the manufacturer's pump curve to ensure there are no issues.

Test 5: Conduct a full pump test

During the full pump test, the contractor shall measure the start and running currents of the motor and complete a full flow rate test.

Test 5a: Pump motor start and running currents

With the pump off, set the discharge valve to 50% open.

Turn the pump on measure the motor start current and ensure at full design speed/Hz.

Record the running currents of the motor.

Test 5b: Pump full flow test

From Test 5a, open the discharge valve, slowly, to 100% open, ensuring that the running amps do not exceed the full load current of the motor.

If it approaches or goes over then reduce the speed or restrict the water flow.

The objective here is to demonstrate that the pump flow rate can meet the design requirements with a tolerance of [+10%/-0%].

With the pump at full flow and the electrical current within the operational limits of the motor, complete the following measurements and document:

- Suction pressure [psi]
- Discharge pressure [psi]
- Electrical running current [amps]
- Flow rate [l/s] or [m3/s]
- Pump rotational speed [rpm]
- Pump power [KW]

1.13 Backflow Prevention

Backflow is the unwanted flow of potentially contaminated water that poses a risk to public health being drawn back into the drinking water supply. It can occur in two ways:

- Back siphonage from a negative pressure in the main, or
- Backpressure from downstream pressure becoming greater than upstream pressure.

A backflow prevention device is a device that prevents the reverse flow of water from a potentially polluted source into a potable water supply system. A backflow prevention device may be an air gap, break tank or mechanical device designed to prevent the unplanned reversal of flow of water or contaminants into a water service and is either testable or non-testable.

All backflow prevention devices shall be installed in accordance with the Shoalhaven City Council's current Backflow Prevention and Cross-Connection Control Policy available from https://doc.shoalhaven.nsw.gov.au/LinkGeneratorAPI/record/7731484/preview_latest_final_version_pdf.

In accordance with Shoalhaven City Council's current Backflow Prevention and Cross-Connection Control Policy a qualified and certified person must undertake a survey for a backflow device for site containment (as defined in the National Construction Code 2022 Volume 3) and the results of the survey must be lodged with, and acknowledged by, Shoalhaven Water.

Lodge the survey for backflow with Shoalhaven Water via email:
SWRegulatory@shoalhaven.nsw.gov.au

Contact Shoalhaven Water Regulatory and Trade Waste Team, (02) 4429 3125, for further information, if required.

2 SECTION B – WATER PROJECT REQUIREMENTS

2.1 Shop Drawings

The Contractor shall prepare and submit 3 copies of all shop drawings and other documents for review by the Superintendent. All Drawings shall be in the form of AutoCAD Release 2014, provided in hard and digital format.

Do not commence fabrication until receipt of an endorsed copy of the Drawings.

The Superintendent's review is for compliance with plans and Specification and does not extend to dimensional accuracy of fit. The Contractor shall correct any Drawings not complying and re- submit for further review before fabrication.

2.2 Hold and Witness Points

The Contractor shall notify the Superintendent at least 2 business days in advance when a Hold or Witness Point is to be reached, so that the Superintendent can make arrangements to witness and/or review the work process or test undertaken by the Contractor.

Hold points and witness points are to be scheduled between 9 am and 5 pm, Monday to Friday. If the Superintendent is required at other times, the Contractor shall be liable for all additional costs that might be incurred including the cost of additional supervision incurred by the Superintendent.

The Hold and Witness Points shall include but not be limited to those shown in Table 1. The Hold and Witness Points shall be included in the Works Program, where applicable, and those included in the site specific scope of works.

Table 10 Water Project - Hold and Witness Points

Requirement	Hold/Witness Point
Concrete construction	
Inspection of reinforcement and formwork	Hold
Placing of concrete	Witness
Inspection of Contractor's concrete tolerances and irregularities measurement record after stripping of formwork	Witness
Earthworks and Roadworks	
Details of source of pavement material, modified dry density etc.	Hold
Road opening Permit	Hold
Setout of construction zone	Hold
Testing of subgrade and pavement material for roads	Witness
Use of materials to rectify over excavation	Hold
Excavation in Rock – notification	Hold
Support Structures/Shoring design	Hold
Sheet Piling Design	Hold
Backfilling and Compaction testing	Witness
Inspection of foundation preparation	Hold
Inspection of road pavement prior to bitumen sealing	Witness
Notification of spoil disposal sites	Hold
Pipeline construction	
Details of existing services affected by construction	Hold

Details of bedding materials and methods of compaction	Hold
Pipelaying Methodology	Hold
After installation of under-road conduits prior to backfilling	Hold
Excavation to depth	Witness
Foundation excavation	Witness
Inspection of compaction of bedding in trenches	Witness
Inspection of pipe installation before backfilling	Witness
Disinfection of pipeline	Hold
Compaction of fill to 300 mm above pipe	Witness
Prior to pouring of thrust blocks	
Inspection of valve fittings after application of corrosion protection & thrust blocks	Hold
Metalwork	
Inspection at commencement of surface preparation prior to protective coating	Hold
Load rating certificates for weight bearing fixtures	Hold
Mechanical	
Submission of Drawings	Hold
Test Certificates	Witness
Manufacturer's Warranty on performance	Witness
Site testing of installed mechanical equipment	Witness
Hydrostatic Testing	
Hydrostatic testing of pipelines	Hold
Training and commissioning	
Pre-commissioning Checklists	Hold
Completed Pre-commissioning Checklists	Hold
Operators Training	Hold
Submission of draft O&M manuals	Hold
Commissioning of equipment	Hold
Commissioning of entire works on completion	Hold
Final inspection	
Submission of Work-As-Executed documentation	Hold
Inspection at Completion	Hold
Video Record (if required)	Hold
Warranties and Certificates	Hold
Decommissioning	
Submission of Decommissioning Plan (if applicable)	Hold

2.3 Pipe Materials Supply

2.3.1 Scope

The Works covered by this section includes the supply of all pipe, fittings, and valves as shown on the Drawings and/or as specified herein.

2.3.2 Warranty

The Contractor is deemed to warrant or guarantee that, notwithstanding that any part of the equipment or the materials supplied has been satisfactorily factory tested and/or inspected before delivery to site, if after installation or incorporation into the Works, any item or part thereof fails to perform its specified function under test or during the Pipeline Construction Contract Defects Liability

Period, then all costs of replacing all such faulty equipment, materials or parts thereof shall be borne by the Contractor.

Unless otherwise specified or agreed, warranties or guarantees shall name the Principal as warrantee and shall be supplied by the Contractor to the Superintendent.

2.3.3 Proprietary Products and Brands

When a proprietary product or brand has been specified, an alternative proprietary product or brand may be used if approved in writing by the Superintendent. Such approval will be subject to the Contractor demonstrating in writing that the proposed product or brand is of equal function and quality to the specified product.

2.3.4 Pipe Supply

Pipes, fittings and valves supplied under the Contract shall conform to the requirements of WSA 03 2011-3.1 Water Supply Code of Australia (Regional New South Wales Edition).

Pipe materials for water pipelines shall be generally as follows or as stated in the Drawings: Ductile Iron (DI), Mild Steel, Polyvinyl Chloride (PVC), Polyethylene (PE) or Glass Reinforced Plastic (GRP).

The Contractor shall submit to the Superintendent for approval the name of the manufacturer, technical details and certificates of compliance including testing reports indicating conformance to the relevant standards.

2.3.4.1 DI Pipes and Fittings

Purchase Specification: WSA PS – 200 (Pipe); WSA PS – 201 (Fittings); WSA PS – 202 (Pipe and fittings – Metric).

DICL pipes and fittings shall be manufactured in accordance with AS/NZS 2280. Minimum pressure rating to be used shall be PN35 unless noted otherwise on the Drawings.

Fittings shall be coated internally and externally with Fusion Bonded Epoxy, Rilsan or equivalent.

All buried ductile iron pipes and fittings shall be protected upon pipelaying with an overwrapping of green polyethylene sleeving or sheet. Details of this overwrap shall be to the requirements of AS 3680 and the manufacturer.

2.3.4.2 Mild Steel Pipes and Fittings

Purchase Specification: WSA PS – 203 (Pipe); WSA PS – 204 (Fittings).

Steel pipes and fittings shall comply with the requirements of AS 1579. Cement mortar lining shall comply with the requirements of AS 1281.

Unless otherwise stated in the Drawings, external coating shall be fusion-bonded medium density polyethylene to AS 4321. Steel pipes encased in concrete may be uncoated externally.

Mild Steel pipe specials shall be supplied with welding collars, flange gaskets and flange bolts. The Contractor shall prepare and submit shop drawings of each item to the Superintendent for acceptance prior to fabrication.

2.3.4.3 PE Pipes and Fittings

Purchase Specification: WSA PS – 207.

The use of polyethylene pipeline systems shall generally be in accordance with WSAA Code of Practice WSA-01 – Polyethylene Pipeline Code.

All polyethylene (PE) pipe lines shall be installed in accordance with the recent version of AS/NZS 2566.2 Minimum pressure rating to be used shall be PN16 unless noted otherwise on the Drawings.

PE pipe compound shall be PE100 and shall comply with AS/NZS 4131. PE fittings shall comply with AS 2129.

Jointing shall be by butt fusion welding method unless noted otherwise on the Drawings.

2.3.4.4 PVC Pipes and Fittings

Purchase Specification: WSA PS – 211 (uPVC); WSA PS – 209 (PVC-M); WSA PS – 210 (PVC-O).

The installation of PVC pipeline systems shall in general be in accordance with AS 2031.

PVC pipes shall not be deflected by more than the minimum bending radius specified by the product manufacturer. Minimum pressure rating to be used shall be PN16 unless noted otherwise on the Drawings.

- PVC pressure pipes and fittings for pressure applications shall be Series 2 – Cast Iron Outside Diameter (CIOD) series complying with the requirements of AS 1477.
- PVC-O pipes shall be Material Class 450, Series 2 – Cast Iron Outside Diameter (CIOD) series complying with the requirements of AS 4441.
- PVC-M pipes shall be Series 2 – Cast Iron Outside Diameter (CIOD) series complying with the requirements of AS 4765.

2.3.4.5 6.4.5 GRP Pipes and Fittings

Purchase Specification: WSA PS – 205 (Pipe) and WSA PS – 206 (Fittings).

Glass reinforced plastic (GRP) pipes shall comply with the requirements of AS 3571.2. Minimum pressure rating to be used shall be PN16 unless noted otherwise on the Drawings.

GRP fittings shall not be used without the approval of the Superintendent. Pipe joints shall be rubber ring.

Internal lining shall comply with AS/NZS 4020 Testing of products for use in contact with drinking water.

2.3.4.6 Joints

Rubber ring and mechanical couplings shall be made using elastomeric gaskets and O-rings to effect the pressure seal.

Flanges shall be manufactured and drilled to the requirements of AS 4087. Gaskets shall comply with the requirements of AS 1646 and WSAA specification WSA 109.

The Contractor shall furnish drawings of the joints to the Superintendent showing material type, dimensions and tolerances. The Contractor shall also submit details of any necessary testing reports certifying the performance of the proposed jointing system.

2.3.5 Valves

All Ductile Iron valves, fittings and bends shall be Nylon or Fusion Bonded Epoxy (FBE) coated to AS/NZS 4158. Minimum pressure rating for all valves shall be PN16, non-rising spindle, clockwise closing, resilient seated and manufactured to AS 2638 unless noted otherwise on the Drawings.

2.3.5.1 Gaskets

One gasket shall be supplied for each flange of all flanged valves. Gaskets shall be in accordance with AS 4087 – Appendix C and WSA 109.

Gaskets shall be suitable for either full face or raised face to suit the valve/fitting type.

Gaskets shall be rated for the maximum test pressure of the flanged joint and shall be suitable for use with the narrowest of the raised face widths on the valve or fitting flanged joint.

Gaskets shall be provided from a reputable supplier, complete with batch release inspection and test reports and shall be provided with certification to state compliance with the specified standards.

2.3.5.2 Flanges and Drilling

Unless otherwise specified, flanges shall conform in all respects with the requirements of AS 4087. Bolt holes on all valves DN 375 mm and larger shall be back spot-faced to provide a machined bearing surface for nuts and bolt heads. Bolts on valves smaller than DN375 mm shall be provided with washers.

All flanged fittings are to be fastened with Marine Grade (316) Stainless Steel nuts, bolts and washers.

2.3.5.3 Bolts and Nuts

Stainless steel bolt sets will be required to be fitted with insulation washer kits where they are in contact with dissimilar metals.

The Contractor shall supply bolts and nuts for both flanges of all flanged valves. All buried flange connections shall be protected from corrosion by wrapping with an approved petrolatum- based protection system.

Where the Contractor supplies valves having flange thicknesses greater than those required by AS 4087, then the bolt shank lengths shall be increased by at least the amount by which the flange thickness exceeds the specified thickness.

2.3.5.4 Lifting capability

All valves ≥ 25kg shall have lifting points provided to enable the valves to be lifted via cranage, using slings or other equivalent lifting methods. All lifting facilities provided shall ensure safe handling and protection of valves and ancillary equipment and shall comply with AS 3777, AS 4797, AS 4991 and other standards and regulations as applicable.

2.3.5.5 Name plates

Valves shall have name and data plates which show the manufacturer's and applicable standards information. Minimum size of the name plate shall be 100 mm x 40 mm.

Name plates shall be stainless steel with stamped or engraved text.

2.3.5.5.1 Manufacturer and Standards Labels

Valve labels shall specify, at minimum the manufacturer's name, valve model, valve size, class or pressure rating and the applicable standards that the valve is manufactured and tested to, unless otherwise scheduled. Where the valve is independently tested by a recognised testing authority, the valve shall bear the inspection stamp of the recognised testing authority.

2.3.5.6 Gate Valves - General

Purchase Specification: WSA PS – 260.

2.3.5.6.1 General

All gate valves shall comply with AS 2638.2 (Resilient Seated Gate Valves) with the exception of Table 2.1 (all fasteners shall be SS316) and the following requirements:

- Gate valves shall be of heavy-duty design and shall be of the non-rising stem type except for isolating valves for air relief valves, which shall be rising stem type, unless otherwise scheduled;
- The gate shall be fully encapsulated with synthetic rubber which is bonded to the wedge, including the guides. The copper alloy stem nut shall be rigidly enclosed in the wedge to maintain alignment;
- End connections for the valves shall be double flanged, in accordance with AS 4087, unless otherwise specified;
- Non-rising spindle valves shall be supplied with valve spindle caps. Local position indicators are required near the spindle for valves over DN450; and
- All valves shall bear the inspection stamp of a recognised testing authority.

2.3.5.6.2 Materials

All gate valve materials shall comply with AS 2638.2 (Resilient Seated Gate Valves) and the following requirements:

- Valve body and bonnet shall be ductile cast iron (spheroidal graphite C.I.);
- Non-rising spindle shall be stainless steel grade 431;
- All valves shall be fitted with O-ring stem seals;
- Valves shall be coated internally and externally as specified above; and
- Fasteners shall be as specified above.

2.3.5.7 Butterfly Valve

Purchase Specification: WSA PS – 263.

2.3.5.7.1 Butterfly Valve

All butterfly valves shall comply with AS 4795 – Butterfly valves for Waterworks Purposes and the following requirements:

- Designed, manufactured, tested and supplied in accordance with AS 4795.2 2011 (Double-flanged butterfly valves for waterworks purposes);
- Resilient seal type, with seal-on-disc or seal-in-body;
- Single, double or triple offset disc to provide an uninterrupted 360-degree seating edge for seal-on-disc or seal-in-body valves;
- Long-body design with double flanged ends faced and drilled in accordance with AS 4087 PN21;

- Long-body butterfly valves shall have a face-to-face dimension in accordance with EN 558 - Series 14,
- Integral lifting lugs and foot mounting points;
- Seal in either direction to the specified pressure rating;
- The valves shall be rated to operate under negative pressure. The seat material shall be adequately bonded and retained to the valve body for the seal-on-body or seal-in-body type, and the seal shall be capable of sealing under vacuum; and
- The butterfly valve shall be installed with the shaft in horizontal position and seals shall be replaceable with the valve installed in the pipework.

2.3.5.7.2 Materials of Construction

All butterfly valve materials shall be in accordance with AS 4795 and the following requirements:

- Valve bodies shall be ductile iron to AS 1831 or equivalent;
- All stainless steel materials shall be minimum grade 316 unless stated otherwise, and alternative corrosion-resistant materials shall have pitting corrosion resistance at minimum equivalent to fully passivated grade 316 stainless steel. All stainless steel materials shall be fully cleaned, descaled and passivated in accordance with ASTM A380;
- For seal-in-body or seal-on-disc type valves, valve discs shall be coated ductile iron, aluminium bronze or stainless steel;
- Discs shall be attached to the valve shafts using stainless steel pins which are fully sealed against water ingress;
- Shafts and drive keys shall be stainless steel and in accordance with AS 4795;
- Seal retaining ring and fasteners shall be stainless steel; and
- Fasteners shall be as specified above.

2.3.5.7.3 Seals

- Seal-on-disc and seal-in-body seals;
- The seal-on-disc and seal-in-body seals shall be of EPDM or NBR in accordance with AS 4795, suitable for water or sewage service. The seals shall be recess mounted and mechanically retained in the valve disc or body by means such as a seat retaining ring;
- The seals shall be replaceable with the body in line without disassembly of the disc and shafts;
- Seals bonded to valve bodies using adhesives as the primary method for seal retention are not acceptable. The use of fillers to increase seal compression is not acceptable; and
- Valve shaft seals shall be of the O-ring type and shall be of EPDM or NBR in accordance with AS 4795.

2.3.5.7.4 Seats

- Seats shall be suitable for service for the design life of the valve. Pitting corrosion resistance of the seats shall be at minimum equivalent to fully passivated grade 316 stainless steel. All stainless steel seats and materials shall be fully cleaned, descaled and passivated in accordance with ASTM A380;
- Body seats:
  - The seat on the body of the valves shall be mechanically retained CrNi steel inserts or weld-deposited nickel, stainless steel type 309 or approved alternative;
  - The internal coatings of the valve body shall sufficiently cover the interface between the ductile iron body and the seat material to prevent corrosion from

occurring behind the seat (if mechanically fastened) or in the heat effect zone of the weld deposited seat;
  - Where the seats are mechanically retained in the valve body, dissimilar metal corrosion protection shall be provided and shall be sufficient for the design life of the valve;
  - Where the seats are weld-deposited, individual inspection and test certificates of the weld deposited seats shall be provide for each valve; and
  - All seats shall be machined and have a high quality surface finish without pits or defects. For valve delivery seats shall be provided clean, free of contaminants and corrosion and shall be coated with a protective film.
- Disc seats:
  - Seats mounted on iron or steel discs shall be a mechanically fastened ring of minimum grade 316 stainless steel or may be weld-deposited nickel, type 309 stainless steel or approved alternative. Such seats shall be in accordance with the requirements for body seats specified above; and
  - The disc material may be used as the seat material for solid stainless steel discs of minimum grade 316, aluminium bronze or approved alternative materials.
- Bearings:
  - Valve shaft bearings shall be of non-cold-flowing, bronze or PTFE with reinforced backing; and
  - Bearings shall be provided both sides of the disc.
- Protective Coating:
  - The butterfly valve bodies, non-corrosion resistant discs and all ferrous components shall be coated with a tough uniform coating in accordance with AS 4795.

2.3.5.8 Pressure Reducing Valves

Purchase Specification: WSA PS – 268.

The supply of pressure reducing valves (PRV) shall be in accordance with AS 5081 – Hydraulically Operated Automatic Control Valves for Waterworks Purposes.

Minimum pressure rating to be used shall be PN16 unless noted otherwise on the Drawings. End configuration: Flanged Class 250.

PRV shall be supplied with pressure gauges tappings and pressure gauges installed on the inlet and outlet of the valve.

Flow rates and pressure settings for the PRVs shall be shown on the Drawings.

2.3.5.9 Pressure Relief Valves

Refer to valve schedule on the drawings.

2.3.5.10 Non-return Valve

Purchase Specification: WSA PS – 264.

The supply of non-return valves shall be of a short bodied tilting disk type and in accordance with AS 4794.

Tilting disc non-return valves shall be provided with a hinge pin (spindle) extended through the valve body on one or both sides. The extended hinge pin shall be fitted with a lever arm with adjustable counterweight unless the valve is buried.

2.3.5.11 Ball Valve

Purchase Specification: WSA PS – 274.

Ball valves shall be in accordance with the following requirements:

- Stainless steel in accordance with BS ISO 7121 (supersedes BS 5351) or ASME/ANSI B16.34;
- Materials shall be minimum grade 316 stainless steel bodies, solid balls shafts, trim and connections;
- Seats and stem seals shall be PTFE;
- Manually operated, quarter-turn, 2-way ball valves of compact design, unless otherwise specified;
- Full bore single-piece or two-piece;
- Connections at each end shall be female BSP thread; and
- Provided with a label displaying the direction of opening/closing.

2.3.5.12 Hydrants

Purchase Specification: WSA PS – 267.

Shoalhaven City Councils' preferred hydrant is the Spring Hydrant. Spring hydrants shall be in accordance with the following requirements:

- Coating: Nylon or Fusion Bonded Epoxy (FBE) to AS 4158;
- Size: 80 mm nominal bore to AS 3952;
- Material: Cast Iron to AS 1830;
- Flanges: to AS 4087 with Stainless Steel wire springs;
- Fasteners: Stainless Steel Marine Grade 316 to AS 1110, AS 1111, AS 1112, and AS 2837
- Hydrant outlet connections shall be the standard claw type that is suitable for the attachment of a hydrant standpipe;
- All spring hydrants shall be at a depth of no greater than 300 mm below finished ground surface;
- Hydrant risers shall be used where pipe cover exceeds 350 mm. All hydrant risers shall be Nylon or Fusion Bonded Epoxy (FBE) coated to AS 4158. Details of all proposed hydrants and hydrant risers shall be submitted to the Superintendent for inspection and approval, prior to use;
- Hydrant covers shall be installed in an orientation where the nearest oncoming traffic will strike the covers closed, or as directed by the Superintendent;
- Blue 'cats-eye' reflective markers shall be fixed in the centre of roadways pointing to the hydrant location or as directed by the Superintendent; and
- All hydrant and stop valve covers are to be left protruding 50 mm (minimum) above the finished ground surface level to allow for grass growth around the hydrant and stop valve covers.

2.3.5.13 Air Valves

Purchase Specification: WSA PS – 265.

Air valves shall be Large Orifice, Small Orifice, or Combination air valves as shown on the Drawings with AS 47956 – Air Valves for Water Supply.

Minimum pressure rating to be used shall be PN16 unless noted otherwise on the Drawings.

Valves shall have fusion-bonded epoxy coated steel raised face flanged end connections in accordance with AS 4087 for the applicable pressure class unless otherwise scheduled. For valves up to and including size DN100 the connection flanges may be fitted with studs.

Valves shall be supplied with an isolating valve and all necessary gaskets, nuts, bolts, washers and other jointing accessories. The isolating valve shall be as per Section 6.5.6.

All wetted stainless steel components and threaded fittings shall be minimum grade 316, and other materials shall be in accordance with WSA 106.

All threaded fittings shall have a pressure rating greater than or equal to the pressure rating of the valve.

Air valves shall be factory tested prior to shipment. A test certificate shall be provided. All relief valves shall be fitted with a lifting lug capable of supporting the full weight of the valve.

2.3.5.14 Gaskets

One gasket shall be supplied for each flange of all flanged valves.

Unless otherwise specified, valves up to 900 mm nominal diameter shall be provided with full face gaskets manufactured from 3 mm fabric reinforced neoprene.

2.3.6 Flowmeters

Flowmeters shall be in accordance with the following requirements:

- Electromagnetic flowmeter with remote transmitter for transmitting the flow data to the Shoalhaven City Council monitoring centre via the local RTU; The flow direction shall be displayed by the remote transmitter;
- Supplied with earth rings;
- Supplied with and calibrated for the length of cable specified on the Drawings. The cable potted into the sensor by the manufacturer before being shipped to site; and
- Flanges designed to stand for test pressure and be to the drilling pattern specified and
- Should have a protective coating to the manufacturer's specification.

2.3.7 Dismantling Joints

As supplied or recommended by the pipe manufacturer.

2.3.8 Copper Tubes

Copper tube shall be manufactured in accordance with AS 1432, Type C.

Where the installed copper tubing is exposed including in pits it shall be insulated with a flexible, closed-cell elastomeric insulation in tubular form, FR/Armaflex or equal.

Material shall meet the fire performance requirements of the Building Code of Australia, as per specifications A2.4 and C1.10, and tested in accordance with AS/NZS 1530.3.

All exposed insulation shall be protected with Armatuff self-adhesive tape or a black-coloured polypropylene facing-tape that has multi-directional scrim reinforcement.

All joins shall be made with Armaflex® 520 Adhesive or a contact adhesive approved by the insulation supplier that is suitable for creating a complete vapour seal. Butt joints must be fitted under compression, and all seams and butt joints must be glued in their entirety to create a continuous vapour seal. Adhesive must be suitable for the operational temperature of the system.

2.3.9 Testing and Certification

Provide a copy of the test certificates of all mechanical equipment such as valves, pumps, etc. If requested by the Superintendent, provide a copy of manufacturer's licence and certification to AS/NZS ISO 9001.

2.4 Pipe Installation

2.4.1 Standards

All the pipework, including its components such as valves, flowmeter, thrust blocks, etc. shall be constructed in accordance with the latest version of the WSA 03 2011-3.1 Water Supply Code of Australia (Regional New South Wales Edition).

2.4.2 Installation

Pipes shall be installed in accordance with the manufacturer's guidelines.

The Contractor shall provide to the Superintendent the proposed work method statement for pipe installation upon request.

2.4.3 Weld pre-qualification

Pre-qualification of welding technique shall be obtained from Shoalhaven City Council prior to commencement of works. The following information shall be submitted to Shoalhaven City Council or the Superintendent for acceptance:

2.4.3.1 Steel Pipes

All welding for the installation of the mild steel pipeline shall be in accordance with AS/NZS 1554 Part 1 - *Welding of Steel Structures and AS 1579 – Arc-welded steel pipes and fittings for Water and Wastewater* where appropriate.

All welders, welding procedures and consumables shall be qualified in accordance with the requirements of AS 1554.1. Obtain satisfactory evidence that the welders are suitably qualified to carry out the welding procedures on which they will be employed prior to commencing welding **(Hold point)**.

Refer to the Superintendent for the weld pre-qualification requirements.

2.4.4 Internal Debeading

The Contractor shall debead the inside of all butt fusion welded pipeline(s) where nominated in the Contract (including drawings and technical specifications) or where directed by the Superintendent.

2.4.5 Pipework penetrating structural elements

Pipework penetrating structural elements shall ensure no leakage and make adequate allowances for differential settlement.

The Contractor shall ensure the pipework penetrating structural elements from soil include flexible joints that allow articulation. Generally one flexible joint shall be within 300 mm of the structure and the second flexible joint shall be approximately a further 600 mm away.

Puddle flanges shall be provided on all pipes that penetrate reinforced concrete walls unless shown otherwise on the drawings. The puddle flange shall be located centrally in the wall.

2.4.6 Insulation

All exposed pipes including valve and fittings of less than 50 mm diameter and conveying liquids shall be insulated to protect against freezing of the liquid in the pipe.

2.4.7 Trench stops and bulkhead

Construct trench stops and concrete bulkheads with trench drainage at locations indicated on the Drawings.

2.4.8 Thrust Blocks

Thrust blocks shall be installed as shown on the Drawings and in accordance with the WSA 03 2011-3.1 Water Supply Code of Australia (Regional New South Wales Edition) Code.

Each block shall bear directly on undisturbed ground. Any over-excavation shall be backfilled with concrete of the same properties as the thrust block.

For buried pipes, at least 7 days shall elapse after the concrete is placed before the blocks are subjected to pipe thrusts.

2.4.9 Buoyancy Control

The Contractor shall take all reasonable care and use construction methods to preclude floatation of the pipeline and/or structures due to water charged ground.

The Contractor shall bring any floatation / movement of the pipeline and/or structures to the attention of the Superintendent and shall remedy such floatation / movement as directed by the Superintendent.

2.4.10 Pipes Laid in Enveloper Conduits

Pipes to be encased in conduits and the encasing conduits shall be installed at the locations and for the extent detailed on the Drawings.

Flexible jointed carrier pipes shall be positioned and/or the encasing conduits positioned such that the flexible joints of the carrier pipe shall be located within 300 mm of each end of the encasing conduit.

The Contractor shall prepare a Method Statement for placing the carrier pipe in the enveloping pipe and supporting it in place while placing the flowable fill, 5 days prior to commencing the installation of the pipeline within enveloping pipes.

2.4.11 Cement Stabilisation

Cement stabilised sand shall be manufactured from aggregate, cementitious material and water. The cementitious content of the cement stabilised sand shall not be less than 5% by weight of the total mix excluding water. Fly ash shall not comprise more than 50% by weight of the total fly ash plus Portland cement portion of the mix.

The mix designs for cement stabilised sand shall be such that when placed and compacted around the pipe it will provide equivalent support to that provided by granular backfill. Refer Drawings.

Cement stabilised sand shall be placed and compacted with vibration around the pipe such that no voids remain within the backfill and between the backfill and the pipe.

2.4.12 Geotextile Filter

Where shown on the Drawings, and / or as directed by the Superintendent, where there is a possibility of migration of fines between the native soil and the embedment zone, the embedment zone shall wrapped with a geotextile filter. The trench type is shown on the Drawings as 'Trench with Geotextile Filter'.

The geotextile filter shall comply with Appendix J of AS/NZS 2566.2.

2.4.13 Electrical Safety of Metallic Pipelines

2.4.13.1 Electrical Safety of Pipelines

Adequate precautions shall be taken against the electrical hazards associated with steel and ductile iron pipe laying as per AS 4853. The Contractor shall undertake risk assessments and the following shall be included (without limitation):

- Direct contact and flashover in air due to plant approaching too closely to high voltage conductors,
- Dangerous step and touch potential that can arise in the vicinity of a pipeline of material capable of conducting electrical current across pipeline joints due to:
  - Inductive coupling;
  - Capacitive coupling;
  - Earth return currents; and
  - Lightning strikes.
- The effect of lightning that can extend along electrical transmission lines for many kilometres; and
- Well coated, electrically continuous, unearthed, large diameter steel/ductile iron pipelines, which provide very little attenuation of potential, thus creating dangerous situations anywhere along the pipeline.

2.4.13.2 Electrical Safety of Water Meters

Adequate precautions shall be taken against electrical hazards associated with working on water meters and as a minimum must comply with or exceed the requirements of Shoalhaven Water's Standard Operating Procedure "Electrical Safety Procedures for Changing Water Meters" (PRD14/194 – SOP027).

Working on water meters includes but is not limited to:

- Replacement of the water meter;

- Replacement of any metal fitting in the water meter assembly; and
- Installation or removal of temporary water supply connected directly to any metal fitting within the water meter assembly.

2.4.14 Pipeline Markers and Signs

2.4.14.1 Marker Tape

Approved plastic marker tape shall be installed in the trench above the pipe at all road crossings in accordance with construction Drawings, except where such crossings are installed by boring. At locations where concrete slabs are installed, marker tape shall also be supplied and installed, placed at least 300 mm below the surface.

Detectable marker tape shall be provided on top of the pipe embedment material or 1000 mm below the finished surface level, whichever is higher. Detectable tape shall be green or blue in colour with the words “CAUTION – WATER MAIN BURIED BELOW”, 100 mm wide PE tape with 316 stainless steel wire insert.

The tracer wire is to be connected such that tracing can be undertaken. Marker tapes shall be provided for all pipes, both plastic and non-plastic.

2.4.14.2 Signs

Refer to Shoalhaven Water’s Standard Marking for Water Mains.

The Contractor shall verify with the Superintendent the wording of the marker signs prior to the commencement of manufacturing.

2.4.15 Connection to Existing Pipelines and Offtakes

Pipelines shall be pressure tested and disinfected (Refer Section 2.5) prior to connection to existing pipelines.

All connections and “cut-ins” to existing pipelines shall be undertaken by Shoalhaven City Council. The Contractor shall supply all fittings and materials for these works (including plant and supporting labour) as directed by Shoalhaven City Council.

Operations to isolate and dewater existing pipelines for making connections shall be undertaken by Shoalhaven City Council. The existing water supply network shall not be operated by the Contractor.

The Contractor shall give the Superintendent 7 days notice of connection to existing water mains in order for Shoalhaven City Council to schedule isolation and dewatering.

2.5 Hydrostatic Pressure Testing and Disinfection of Pipelines

2.5.1 Hydrostatic Pressure Testing

2.5.1.1 General Requirements

Hydrostatic pressure testing shall be witnessed by the Superintendent.

The Contractor shall undertake hydrostatic pressure testing of each section progressively upon completion of each section.

The Contractor shall not commence hydrostatic pressure testing until all concrete thrust or anchor blocks have developed their design strength.

Test pressures shall be as shown on the Drawings.

2.5.1.2 Maximum Allowable Loss

The maximum allowable loss shall be:

$$\frac{0.14 \times di \times Lp \times H}{1000 \times (\frac{L}{H})}$$

where di – nominal pipe diameter (mm);

Lp – length of water main under test (km); and

H – average test head of section under test (m).

2.5.1.3 Pre-Test Procedure

Initial Filling: The Contractor shall take care to prevent the water filling velocity from exceeding 0.05 m/sec based on the full pipeline internal diameter.

Stabilisation: The Contractor shall allow 3 to 24 hours to stabilise the water temperature and allow air to vent from the system. For cement-lined pipe, the Contractor shall allow a minimum stabilisation period of 24 hours to allow saturation of the pipe lining before commencing the constant pressure test.

2.5.1.4 Pressure Test Procedure

The pipeline shall be hydrostatically pressure tested and reported in accordance with WSA 03 2011-3.1 Water Supply Code of Australia (Regional New South Wales Edition).

Alternatively the pipeline may be hydrostatically pressure tested using a modified testing procedure to WSA 03 2011-3.1 Water Supply Code of Australia (Regional New South Wales Edition), without using a NATA Certified tester, and taking pressure and make-up readings at the end of the third and fifth hours provided that:

- Two pressure gauges are used to measure the pressure in the line and they both read exactly the same;
- All measurements are witnessed by a Shoalhaven Water Representative;
- V_1 is considered to be the water added at the end of the third hour;
- V_2 is considered to be the water added at the end of the fifth hour; and
- Q remains multiplied by 1.

Test sections shall include all connected pipework such as isolating valves and scour valves.

The Contractor shall close all isolating valves for air valves immediately prior to pressure testing.

Flow meters used for hydrostatic pressure tests shall be calibrated to show inflows of water in litres per second (L/s). The flow meters shall have a range of 0 to 100 L/s divided into increments of 5 L/s ± 0.2 L/s.

2.5.1.5 Water for Hydrostatic Pressure Testing

The Principal shall arrange for the supply of water required for hydrostatic pressure testing of pipelines.

The Contractor is responsible for any transportation and pumping costs for the filling of the pipeline.

The Principal will provide water for testing free of charge for the initial hydrostatic test, up to an upper limit of the volume of the section being tested + 10%.

The Contractor is responsible for the cost of water required for retesting of any section of the pipeline which does not pass initial hydrostatic testing.

The Contractor shall filter / screen all water to be used for hydrostatic pressure testing through a 150 micron filter before filling the pipeline.

2.5.1.6 Flushing of Pipelines

After the field pressure testing is satisfactorily completed, flush the new pipelines to the satisfaction of the Superintendent until all discolouration is eliminated.

For the testing and flushing of potable water supply pipelines, use only water provided by the Principal which is suitable for human consumption.

For the testing and flushing of other than potable water pipelines, use approved water which is free from excessive suspended silt, sand or vegetable matter.

2.5.1.7 Water Disposal

The Contractor shall dispose water used for hydrostatic pressure testing in compliance with the approved CEMP, and the directions of the Superintendent.

The Contractor shall obtain approval in writing from Superintendent for the disposal of water prior to undertaking hydrostatic pressure testing.

2.5.1.8 In-test Surveillance

The Contractor shall keep the pipeline under the full test pressure until all leaks detected by the hydrostatic pressure test have been located.

The Contractor shall repeat the hydrostatic pressure test for any test section that fails the initial hydrostatic pressure test.

The Contractor shall provide a continuous record of pipeline pressure from the start of pressurising the pipeline through the whole of the hydrostatic test period to the end of depressurising the pipeline.

The Contractor shall prepare and maintain a comprehensive record of test results for all hydrostatic pressure tests undertaken for the Works.

The hydrostatic pressure test record shall be prepared and submitted to the Superintendent. The hydrostatic test record shall be submitted together with the Work as Executed records at Practical Completion.

2.5.2 Disinfection of Pipelines for Potable Water

Disinfection of the new mains are to be done using the residual chlorine in the potable water supply.

Mains are to be thoroughly flushed and scoured.

Prior to commencing the hydrostatic pressure test the chlorine residual in the water is to be tested. At the completion of the 5 hour hydrostatic pressure test the chlorine residual is to be re-tested. If the chlorine residual is greater than 0.5mg/L prior to the commencement of the hydrostatic test, the main shall be considered disinfected if the chlorine residual at the completion of the hydrostatic test remains greater than 0.5 mg/L. If the chlorine residual is less than (or equal to) 0.5mg/L prior to the commencement of the hydrostatic test, the main shall be considered disinfected if the chlorine residual at the completion of the hydrostatic test is within 10% of the initial reading.

If a section of pipeline is not considered disinfect the main shall be scoured, refilled and re-tested over another 5 hour period. This process is to be repeated as required until the main is considered disinfected.

A Disinfection Certificate shall be produced recording as a minimum:

- The Date the test took place;
- The chlorine residual levels before and after the 5 hour test period;
- Signature of a representative from the company performing the test;
- Signature of a Shoalhaven Water representative witnessing the results; and
- Outcome of the test (is Disinfected / Not Disinfected).

3 SECTION C – SEWER PROJECT REQUIREMENTS

3.1 Shop Drawings

The Contractor shall prepare and submit 3 copies of all shop drawings and other documents for review by the Superintendent. All Drawings shall be in the form of AutoCAD Release 2014, provided in hard and digital format.

Do not commence fabrication until receipt of an endorsed copy of the Drawings.

The Superintendent's review is for compliance with plans and Specification and does not extend to dimensional accuracy of fit. The Contractor shall correct any Drawings not complying and re- submit for further review before fabrication.

3.2 Hold and Witness Points

The Contractor shall notify the Superintendent at least 2 business days in advance when a Hold or Witness Point is to be reached, so that the Superintendent can make arrangements to witness and/or review the work process or test undertaken by the Contractor.

Hold points and witness points are to be scheduled between 9 am and 5 pm, Monday to Friday. If the Superintendent is required at other times, the Contractor shall be liable for all additional costs that might be incurred including the cost of additional supervision incurred by the Superintendent.

The Hold and Witness Points shall include but not be limited to those shown in Table 1. The Hold and Witness Points shall be included in the Works Program, where applicable, and those included in the site specific scope of works.

Table 11 Sewer Project - Hold and Witness Points

Requirement	Hold/Witness Point
Concrete construction	
Inspection of reinforcement and formwork	Hold
Placing of concrete	Witness
Inspection of Contractor's concrete tolerances and irregularities measurement record after stripping of formwork	Witness
Earthworks and Roadworks	
Details of source of pavement material, modified dry density etc.	Hold
Road opening Permit	Hold
Setout of construction zone	Hold
Testing of subgrade and pavement material for roads	Witness
Use of materials to rectify over excavation	Hold
Excavation in Rock – notification	Hold
Support Structures/Shoring design	Hold
Sheet Piling Design	Hold
Backfilling and Compaction testing	Witness
Inspection of foundation preparation	Hold
Inspection of road pavement prior to bitumen sealing	Witness
Notification of spoil disposal sites	Hold
Pipeline construction	
Exposed existing services affected by construction	Hold

Bedding materials	Hold
After installation of under-road conduits prior to backfilling	Hold
Excavation to depth	Witness
Foundation excavation	Witness
Inspection of compaction of bedding in trenches	Witness
Inspection of pipe installation before backfilling	Witness
Compaction of fill to 300 mm above pipe	Witness
Prior to pouring of thrust blocks	
Inspection of valve fittings after application of corrosion protection & thrust blocks	Hold
Metalwork	
Inspection at commencement of surface preparation prior to protective coating	Hold
Load rating certificates for weight bearing fixtures	Hold
Mechanical	
Site testing of installed mechanical equipment	Witness
Hydrostatic Testing	
Hydrostatic testing of pipelines	Hold

3.3 Pipe Materials Supply

3.3.1 Scope

The Works covered by this section includes the supply of all pipe, fittings, and valves as shown on the Drawings and/or as specified herein.

3.3.2 Warranty

The Contractor is deemed to warrant or guarantee that, notwithstanding that any part of the equipment or the materials supplied has been satisfactorily factory tested and/or inspected before delivery to site, if after installation or incorporation into the Works, any item or part thereof fails to perform its specified function under test or during the Defects Liability Period, then all costs of replacing all such faulty equipment, materials or parts thereof shall be borne by the Contractor.

Unless otherwise specified or agreed, warranties or guarantees shall name the Principal as warrantee and shall be supplied by the Contractor to the Superintendent.

3.3.3 Proprietary Products and Brands

When a proprietary product or brand has been specified, an alternative proprietary product or brand may be used if approved in writing by the Superintendent. Such approval will be subject to the Contractor demonstrating in writing that the proposed product or brand is of equal function and quality to the specified product.

3.3.4 Pipe Embedment Materials

Purchase Specification: WSA PS-350 (Compaction Sand) and WSA PS-351 (Processed Aggregates).

Compaction sand or single-size aggregate of nominal sizes 7, 10 or 14 mm shall be accepted for pipe embedment materials.

3.3.5 Pipe Supply

Pipes, fittings and valves supplied under the Contract shall conform to the requirements of *WSA 02: 2014-3.1 Gravity Sewerage Code of Australia (Regional New South Wales Edition)* and WSA-04–2005.

Pipe materials for sewer pipelines shall be generally as follows or as stated in the Drawings: Ductile Iron (DI), Mild Steel, Polyvinyl Chloride (PVC), Polyethylene (PE), Acrylonitrile Butadiene Styrene (ABS), Glass Reinforced Plastic (GRP), Polypropylene (PP) or other material as specified on the drawings.

The Contractor shall submit to the Superintendent for approval the name of the manufacturer, technical details and certificates of compliance including testing reports indicating conformance to the relevant standards.

3.3.5.1 DI Pipes and Fittings

Purchase Specification: Gravity Pipes: WSA PS – 234.

Pressure Pipes: WSA PS – 200 (Pipe); WSA PS – 201 (Fittings); WSA PS – 202 (Pipe and fittings – Metric).

DI pipes and fittings shall be manufactured in accordance with AS/NZS 2280. Minimum pressure rating shall be PN20 unless noted otherwise on the Drawings.

Fittings shall be coated internally and externally with Fusion Bonded Epoxy, Rilsan or approved equivalent.

All buried ductile iron pipes and fittings shall be protected upon pipelaying with an overwrapping of green polyethylene sleeving or sheet. Details of this overwrap shall be to the requirements of AS 3680 and the manufacturer.

3.3.5.2 Mild Steel Pipes and Fittings

Purchase Specification: WSA PS – 203 (Pipe); WSA PS – 204 (Fittings).

Steel pipes and fittings shall comply with the requirements of AS 1579. Minimum pipe thickness shall be 5 mm.

Cement mortar lining shall comply with the requirements of AS 1281.

Unless otherwise stated in the Drawings, external coating shall be fusion-bonded medium density polyethylene to AS 4321. Steel pipes encased in concrete may be uncoated externally.

Pipe joints shall be as specified in the Drawings.

The Contractor shall prepare and submit shop drawings of each MS pipe special item to the Superintendent for acceptance prior to fabrication.

3.3.5.3 PVC Pipes and Fittings

The installation of PVC pipeline systems shall in general be in accordance with AS/NZS 2032.

3.3.5.3.1 Gravity Pipes

Purchase Specification: WSA PS – 230 (PVC-U).

- PVC-U pipes shall comply with AS/NZS 1260; and
- PVC-U pipes shall be stiffness class SN8 (for DN150 and above) and SN 10 (for DN100).

3.3.5.3.2 Pressure Pipes

Purchase Specification: WSA PS – 211 (PVC-U); WSA PS – 209 (PVC-M); WSA PS – 210 (PVC-O).

- PVC-U pressure pipes and fittings for pressure applications shall be Series 2 – Cast Iron Outside Diameter (CIOD) series complying with the requirements of AS 1477;
- PVC-O pipes shall be Material Class 450, Series 2 – Cast Iron Outside Diameter (CIOD) series complying with the requirements of AS 4441; and
- PVC-M pipes shall be Series 2 – Cast Iron Outside Diameter (CIOD) series complying with the requirements of AS 4765.

PVC pipes shall not be deflected by more than the minimum bending radius specified by the product manufacturer. Minimum pressure rating to be used shall be PN12 unless noted otherwise on the Drawings.

3.3.5.4 PE Pipes and Fittings

Purchase Specification: WSA PS – 207.

The use of polyethylene pipeline systems shall generally be in accordance with Water Services Association of Australia Polyethylene Pipeline Code (WSA-01).

PE pipe compound shall be PE100 and shall comply with AS/NZS 4131. PE fittings shall comply with AS 4129. Minimum pressure rating to be used shall be PN16 unless noted otherwise on the Drawings.

All polyethylene (PE) pipe lines shall be installed in accordance with the recent version of AS/NZS 2566.2

Jointing shall be compression or electrofusion type for pipe sizes up to and including DN90 and fusion buttwelding or electrofusion for pipes larger than DN90.

3.3.5.5 Acrylonitrile Butadiene Styrene (ABS)

Purchase Specification: WSA PS – 238.

ABS pipes and fittings for non-pressure applications shall comply with the requirements of WSA 117:2004. Minimum stiffness class shall be SN8 for pipes and SN6 for fittings.

3.3.5.6 Glass reinforced plastic (GRP)

Purchase Specification: WSA PS – 205 (Pipe) and WSA PS – 206 (Fittings).

Glass reinforced plastic (GRP) pipes shall comply with the requirements of AS 3571.2. Minimum pressure rating to be used shall be PN16 unless noted otherwise on the Drawings.

GRP fittings shall not be used without the approval of the Superintendent. Pipe joints shall be rubber ring.

3.3.5.7 Polypropylene (PP)

Polypropylene ribbed construction pipes and fittings for non-pressure applications shall comply with the requirements of AS/NZS 5065. Minimum stiffness class to be used shall be SN10 unless noted otherwise on the Drawings.

Pipe joints shall be rubber ring.

3.3.6 Valves

Minimum pressure rating for all valves (except knife gate valves) shall be PN16. Isolating valves shall be non-rising spindle, clockwise closing and metal seated.

All ductile iron valves shall be Nylon or Fusion Bonded Epoxy (FBE) coated to AS/NZS 4158.

3.3.6.1 Knife Gate Valves

Purchase Specification: WSA PS –266.

Knife gate valves shall be stainless steel body, metal seated, non-rising stem with bonneted cap to accept valve key, stainless steel gate, featuring non-clogging full port design with full unrestricted bore and protected seat.

Knife gate valves shall have no hand wheel, shall have no pockets to avoid sedimentation accumulation potential and be equivalent to offerings from Bray Controls, Emerson or approved alternate.

Pressure Rating: Not less than PN10.

3.3.6.2 Reflux or Non-return Valve

Purchase Specification: WSA PS – 264 (Swing check).

The supply of non-return valves shall be of swing check type with counterweight and in accordance with AS 4794.

A 10 mm BSP tapping with stop cock shall be installed on both sides of the valve to permit the installation of a testing ferrule for pressure gauge attachment.

3.3.6.3 Sluice/Gate Valves

Purchase Specification: WSA PS – 260.

3.3.6.3.1 General

All gate valves shall comply with AS/NZS 2638.1 (Metal Seated Gate Valves) with the exception of Table 2.1 (all fasteners shall be SS316) and the following requirements:

- Gate valves shall be of heavy-duty design and shall be of the non-rising stem type except for isolating valves for air relief valves, which shall be rising stem type, unless otherwise scheduled;
- End connections for the valves shall be double flanged, in accordance with AS/NZS 4087, unless otherwise specified;
- Non-rising spindle valves shall be supplied with valve spindle caps. Local position indicators are required near the spindle for valves over DN450; and
- All valves shall bear the inspection stamp of a recognised testing authority.

3.3.6.3.2 Materials

All gate valve materials shall comply with AS/NZS 2638.1 (Metal Seated Gate Valves) and the following requirements:

- Valve body and bonnet shall be ductile cast iron (spheroidal graphite C.I.);
- Non-rising spindle shall be stainless steel grade 431;
- All valves shall be fitted with O-ring stem seals;

- Valves shall be coated internally and externally as specified above; and
- Fasteners shall be as specified above.

3.3.6.4 Air Valves

Purchase Specification: WSA PS – 265.

Supply air valves as shown on the Drawings. Sewage air valves can be single acting, double acting or triple acting air valves.

Double acting (combination) air valves which comprise a small orifice air valve and a large orifice air valve combined in one assembly.

Minimum pressure rating to be used shall be PN16 unless noted otherwise on the Drawings.

Valves shall have fusion-bonded epoxy coated steel raised face flanged end connections in accordance with AS/NZS 4087 for the applicable pressure class unless otherwise scheduled. For valves up to and including size DN100, the connection flanges may be fitted with studs.

Valves shall be supplied with an isolating valve and all necessary gaskets, nuts, bolts, washers and other jointing accessories. The isolating valve shall be as per Section 3.3.6.3.

All wetted stainless steel components and threaded fittings shall be minimum grade 316, and other materials shall be in accordance with WSA 106.

All threaded fittings shall have a pressure rating greater than or equal to the pressure rating of the valve.

Air valves shall be factory tested prior to shipment. A test certificate shall be provided. All relief valves shall be fitted with a lifting lug capable of supporting the full weight of the valve.

3.3.6.5 Ball Valves

Purchase Specification: WSA PS – 274.

Ball valves shall be in accordance with the following requirements:

- Stainless steel in accordance with BS ISO 7121 (supersedes BS 5351) or ASME/ANSI B16.34;
- Materials shall be minimum grade 316 stainless steel bodies, solid balls shafts, trim and connections;
- Seats and stem seals shall be PTFE;
- Manually operated, quarter-turn, 2-way ball valves of compact design, unless otherwise specified;
- Full bore single-piece or two-piece;
- Connections at each end shall be female BSP thread;
- Provided with a label displaying the direction of opening/closing; and
- Valves shall have clockwise direction of closure.

3.3.6.6 Name plates

Valves shall have name and data plates which show the manufacturer's and applicable standards information. Minimum size of the name plate shall be 100 mm x 40 mm.

Name plates shall be stainless steel with stamped or engraved text.

3.3.6.6.1 Manufacturer and Standards Labels

Valve labels shall specify, at minimum the manufacturer's name, valve model, valve size, class or pressure rating and the applicable standards that the valve is manufactured and tested to, unless otherwise scheduled. Where the valve is independently tested by a recognised testing authority, the valve shall bear the inspection stamp of the recognised testing authority.

3.3.6.7 Extension spindles

Purchase Specification:

- For Gate Valves: WSA PS –262, Other than Gate Valves: WSA PS –269.

Extension spindles shall be provided where the distance from the surface to the valve spindle exceeds 350 mm.

3.3.6.8 Flanges and Drilling

Unless otherwise specified, flanges shall conform in all respects with the requirements of AS/NZS 4087. All flanges shall be PN16 minimum unless noted otherwise.

Bolt holes on all valves DN375 and larger shall be back spot-faced to provide a machined bearing surface for nuts and bolt heads. Bolts on valves smaller than DN375 shall be provided with washers.

3.3.6.9 Bolts and Nuts

All flanged fittings are to be fastened with Marine Grade (316) Stainless Steel nuts, bolts and washers.

Stainless steel bolt sets will be required to be fitted with insulation washer kits where they are in contact with dissimilar metals.

The Contractor shall supply bolts and nuts for both flanges of all flanged valves. All buried flange connections shall be protected from corrosion by wrapping with an approved petrolatum- based protection system.

Where the Contractor supplies valves having flange thicknesses greater than those required by AS/NZS 4087, then the bolt shank lengths shall be increased by at least the amount by which the flange thickness exceeds the specified thickness.

3.3.6.10 Gaskets

One gasket shall be supplied for each flange of all flanged valves. Gaskets shall be in accordance with AS/NZS 4087 – Appendix C and WSA 109.

Gaskets shall be suitable for either full face or raised face to suit the valve/fitting type.

Gaskets shall be rated for the maximum test pressure of the flanged joint and shall be suitable for use with the narrowest of the raised face widths on the valve or fitting flanged joint.

Gaskets shall be provided from a reputable supplier, complete with batch release inspection and test reports and shall be provided with certification to state compliance with the specified standards.

3.3.6.11 Lifting capability

All valves ≥ 25 kg shall have lifting points provided to enable the valves to be lifted via cranage, using slings or other equivalent lifting methods. All lifting facilities provided shall ensure safe handling and protection of valves and ancillary equipment and shall comply with AS 3777,

AS 4797, AS 4991 and other standards and regulations as applicable.

3.3.7 Flowmeters

Flowmeter installations include the supply and installation of the flowmeter, electrical connections, conduits etc. Flowmeters shall be in accordance with the following requirements:

- Flowmeter shall be suitable for sewage application;
- Electromagnetic flowmeter with remote transmitter for transmitting the flow data to the Shoalhaven City Council monitoring centre via the local RTU. The flow direction shall be displayed by the remote transmitter;
- Supplied with earth rings;
- Supplied with and calibrated for the length of cable specified on the Drawings. The cable potted into the sensor by the manufacturer before being shipped to site;
- Flanges designed to stand for test pressure and be to the drilling pattern specified; and
- Should have a protective coating to the manufacturer's specification.

3.3.8 Pressure Transducer

Pressure transducers shall be mounted either on the top or side of the pipe as shown on the Drawings. Tapping on the side is however preferred to avoid sediment and air/gas from affecting the operation of the pressure transducer.

The pressure transmitter shall be equipped with a diaphragm seal to avoid blocking or clogging the transducer and a flushing ring which is sandwiched between the transducer and isolation ball valve flanges to 'flush' the face of the diaphragm. The pressure transducer shall be manufactured by ABB or approved equivalent and shall be supplied with a flushed diaphragm seal.

3.3.9 Pressure Gauges

Install pressure gauges calibrated to read 0 to 150% of the sewer main pressure to an accuracy of ± 2%.

The pressure gauge shall have the following features:

- kPa scale;
- ¼": NPT bottom; and
- Face/dial size shall be 63 mm (2 ½") minimum.

The pressure gauge shall be connected to the pipework via tapping band with threaded offtake and SS316 fittings. A ball valve shall also be provided to allow isolation of the pressure gauge.

3.3.10 Testing and Certification

Provide a copy of the test certificates of all mechanical equipment such as valves, pumps, etc. If requested by the Superintendent, provide a copy of manufacturer's licence and certification to AS/NZS ISO 9001.

3.3.11 Jointing System

3.3.11.1 Mechanical Joints

3.3.11.1.1 Gibault Joints

- Gibault joints comply with WSA 105 and shall be approved by the Superintendent; and
- All bolts shall comply with Section 3.3.6.9 and seals with Section 3.3.11.2.

3.3.11.1.2 Dismantling Joints

- Dismantling joints shall be PN16 minimum, either thrust type or non-thrust type as shown on the Drawings;
- Dismantling joints shall be manufactured from ductile iron in conformance with AS/NZS 2280 and drilled to AS/NZS 4087 and be provided with natural rubber seals and flange gaskets in accordance with Section 3.3.11.2. Bolts shall comply with Section 3.3.6.9; and
- The ductile iron components shall be. Nylon or Fusion Bonded Epoxy (FBE) coated to AS/NZS 4158.

3.3.11.2 Joint Seals

Rubber ring and mechanical couplings shall be made using elastomeric gaskets and O-rings to effect the pressure seal.

Flanges shall be manufactured and drilled to the requirements of AS 4087. Gaskets shall comply with the requirements of AS 1646 and WSAA specification WSA 109.

The Contractor shall furnish drawings of the joints to the Superintendent showing material type, dimensions and tolerances. The Contractor shall also submit details of any necessary testing reports certifying the performance of the proposed jointing system.

3.3.12 Copper Tubes

Copper tube shall be manufactured in accordance with AS 1432, Type C.

Where the installed copper tubing is exposed including in pits it shall be insulated with a flexible, closed-cell elastomeric insulation in tubular form, FR/Armaflex or equal.

Material shall meet the fire performance requirements of the Building Code of Australia, as per specifications A2.4 and C1.10, and tested in accordance with AS/NZS 1530.3.

All exposed insulation shall be protected with Armatuff self-adhesive tape or a black-coloured polypropylene facing-tape that has multi-directional scrim reinforcement.

All joins shall be made with Armaflex® 520 Adhesive or a contact adhesive approved by the insulation supplier that is suitable for creating a complete vapour seal. Butt joints must be fitted under compression, and all seams and butt joints must be glued in their entirety to create a continuous vapour seal. Adhesive must be suitable for the operational temperature of the system.

3.3.13 Maintenance holes

Purchase Specification: WSA PS – 323.

Maintenance holes may be either cast in-situ from special class concrete or constructed from precast concrete components. All manhole bases shall be cast in-situ.

Maintenance holes shall be in accordance with *WSA 02: 2014-3.1 Gravity Sewerage Code of Australia (Regional New South Wales Edition)*.

3.3.14 Maintenance hole covers

Purchase Specification: WSA PS – 290.

Maintenance hole covers shall be in accordance with *WSA 02: 2014-3.1 Gravity Sewerage Code of Australia (Regional New South Wales Edition)*.

3.3.15 Ladders and step irons

3.3.15.1.1 Step irons

Purchase Specification: WSA PS – 314 (Step Irons, Plastic Encapsulated).

Step irons and are to be provided for access to sewer maintenance holes and located as nominated in *WSA 02: 2014-3.1 Gravity Sewerage Code of Australia (Regional New South Wales Edition)*.

3.3.15.1.2 Ladders

Purchase Specification: WSA PS – 315 (FRP Ladder).

Ladders are to be provided for access to valve pits as shown on the drawings.

3.4 Pipe Installation

3.4.1 Standards

All the pipework, including its components such as valves, flowmeter, thrust blocks, etc. shall be constructed in accordance with the latest version of the following codes:

- Water Services Association of Australia, Gravity Sewerage Code of Australia (Regional New South Wales Edition) - WSA 02: 2014-3.1; and
- Water Services Association of Australia Sewerage Code of Australia, the Water Services Association of Australia Sewage Pumping Station Code of Australia (WSA 04), Part 3: Construction.

3.4.2 Weld pre-qualification for steel pipes

Pre-qualification of welding technique shall be obtained from Shoalhaven City Council prior to commencement of works. The following information shall be submitted to Shoalhaven City Council or the Superintendent for acceptance:

All welding for the installation of the mild steel pipeline shall be in accordance with

AS/NZS 1554 Part 1 - Welding of Steel Structures and AS 1579 – Arc-welded steel pipes and fittings for Water and Wastewater where appropriate.

All welders, welding procedures and consumables shall be qualified in accordance with the requirements of AS 1554.1. Obtain satisfactory evidence that the welders are suitably qualified to carry out the welding procedures on which they will be employed prior to commencing welding **(Hold Point)**.

Refer to the Superintendent for the weld pre-qualification requirements.

3.4.3 Internal Debeading

The Contractor shall debead the inside of all butt fusion welded pipeline(s).

3.4.4 Construction method

3.4.4.1 Open Trench Construction

Construct the pipeline by open trench method unless otherwise shown on the Drawings.

3.4.4.2 Bridge Crossings

Construct the pipeline, pipe supports, anchor blocks, and expansion joints on locations shown on the Drawings.

3.4.4.3 Trenchless Construction Methods

Where shown on the Drawings, complete trenchless construction (e.g. thrust bore, directional drill, microtunnel, etc.) beneath roadways, watercourse crossings or other obstructions at a depth equal to or greater than that provided for trenched crossings.

Bore all pipeline sections under driveways and through tree root zones unless otherwise specified or directed by the Superintendent.

Bore all pipeline sections under stream and watercourse crossings in accordance with the Drawings. A Method Statement including environmental control details shall be submitted by the Contractor to the approval of the Superintendent prior to the commencement of the trenchless installation.

Other underboring as deemed necessary by the Contractor for the proper execution of the works may be permitted, and will be subject to first having gained approval from the Superintendent for the use of this method of excavation.

3.4.4.4 Pipes Laid in Enveloper Conduits

Pipes to be encased in conduits and the encasing conduits shall be installed at the locations and for the extent detailed on the Drawings.

Construct bores straight and to the tolerances for pipe grading and alignment, and of the minimum diameter necessary to accommodate the pipe and the encasing conduit selected and approved for this purpose.

Where specified or directed, thrust bore length(s) of either pipeline or enveloping conduit, and completely fill the annular space surrounding the encasing conduit with grout to the approval of the Superintendent.

Seal open ends of the enveloping conduit with foam fill or equivalent. Provide spacers, KwikZIP or approved equivalent, to keep the carrier pipe in place inside the encasing conduit.

Flexible jointed carrier pipes shall be positioned and/or the encasing conduits positioned such that the flexible joints of the carrier pipe shall be located within 300 mm minimum of each end of the encasing conduit.

The Contractor shall prepare a Method Statement for placing the carrier pipe in the enveloping conduit and submit to the Superintendent, 5 working days prior to commencing the installation of the pipeline within enveloping pipes.

3.4.4.5 Pipe Bursting

Pipe bursting shall be carried out by any of the following methods – pneumatic, hydraulic or static bursting, depending on the type of pipe to be replaced, the replacement pipe and ground conditions.

The Contractor shall submit a detailed methodology for the execution of the pipe bursting to the Superintendent for approval 5 working days prior to commencement of works, including but not limited to the following:

- management plans (risk, traffic, safety, environmental, etc.);
- general description of the construction method and sequence of operations;
- type of existing pipe and service reconnection joints used and their relevant specification;
- manufacturer and type of pipe bursting equipment, operating system proposed and capability of equipment chosen;
- existing underground utility services location and special precautions required;
- location, size and depth of the entry and exit pit required;
- hydraulic calculation of bypass pumping (where applicable);
- bypass pumping of existing pipeline services during pipe bursting operations;
- new pipe type and joints to be used;
- programmed daily work hours and duration of operation; and
- details of pipe bursting specialist including relevant competency training records.

The Contractor shall follow the recommended drilling pipe installation procedure and requirements as detailed in the Australasian Society for Trenchless Technology Standard for Pipe Bursting.

The replacement pipe shall be pressure tested in accordance to Section 3.5.

3.4.4.6 Installation

Pipes shall be installed in accordance with the manufacturer's guidelines. Deflect pipes as required up to the limit recommended by the pipe manufacturer.

The Contractor shall provide to the Superintendent the proposed work method statement for pipe installation upon request.

3.4.4.7 Horizontal and vertical separation of crossing pipelines

Maintain minimum horizontal and vertical clearances between sewers and other underground as specified in the *WSA 02: 2014-3.1 Gravity Sewerage Code of Australia (Regional New South Wales Edition)*. Fill the separation with embedment material and compact.

If a service including poles, cables, pits and other pipes is encountered on site which is within the clearances nominated in AS 2566 and has not been identified on the Drawings, inform the Superintendent and await instructions before trenching or laying within 500 metres of the service.

3.4.4.8 Pipework penetrating structural elements

Pipework penetrating structural elements shall ensure no leakage and make adequate allowances for differential settlement.

The Contractor shall ensure the pipework penetrating structural elements from soil include flexible joints that allow articulation. Generally one flexible joint shall be within 300 mm of the structure and the second flexible joint shall be approximately a further 600 mm away.

Puddle flanges shall be provided on all pipes that penetrate reinforced concrete walls unless shown otherwise on the drawings. The puddle flange shall be located centrally in the wall.

3.4.4.9 Insulation

All exposed pipes including valve and fittings of less than 50 mm diameter and conveying liquids shall be insulated to protect against freezing of the liquid in the pipe.

3.4.4.10 Trench stops and bulkheads

Construct trench stops and concrete bulkheads with trench drainage at locations indicated on the Drawings and in accordance with the *WSA 02: 2014-3.1 Gravity Sewerage Code of Australia (Regional New South Wales Edition) Drawing* SEW-1206 Trench Drainage Bulkheads and Trenchstop.

Concrete bulkheads may be used as an alternative to trench stops on mains of grade greater than 10%.

3.4.4.11 Buoyancy Control

The Contractor shall take all reasonable care and use construction methods to preclude floatation of the pipeline and/or structures due to water-charged ground.

The Contractor shall bring any floatation / movement of the pipeline and/or structures to the attention of the Superintendent and shall remedy such floatation / movement as directed by the Superintendent.

3.4.4.12 Cement Stabilisation

Cement stabilised sand shall be a mixture of aggregate, cementitious material and water. The cementitious content of the cement stabilised sand shall not be less than 5% by weight of the total mix excluding water. Fly ash shall not comprise more than 50% by weight of the total fly ash plus Portland cement portion of the mix.

The mix designs for cement stabilised sand shall be such that when placed and compacted around the pipe it will provide equivalent support to that provided by granular backfill. Refer Drawings.

Cement stabilised sand shall be placed and compacted with vibration around the pipe such that no voids remain within the backfill and between the backfill and the pipe.

3.4.4.13 Geotextile Filter

Where shown on the Drawings, and / or as directed by the Superintendent, where there is a possibility of migration of fines between the native soil and the embedment zone, the embedment zone shall wrapped with a geotextile filter. The trench type is shown on the Drawings as ‘Trench with Geotextile Filter’.

The geotextile filter shall comply with Appendix J of AS/NZS 2566.2.

3.4.5 Construction of Pressurised Pipelines

3.4.5.1 Joint Wrapping

Except for welded joints in pipe sections being thrust bored or pipe jacked, following the satisfactory completion of the field pressure test(s) wrap all buried nuts and bolts with Denso 300 Primer and 400 Mastic/440 Cord and then wrap the entire joint in Denso 600 tape (double thickness) and overwrap

with Denso 931 overwrap (minimum 55% overlap) in accordance with the Manufacturer's recommendations. Other approved equivalent products may be used.

3.4.5.2 Thrust and anchor blocks and restrained joints for pressurised mains

Thrust blocks shall be installed as shown on the Drawings and in accordance with WSA 03 2011-3.1 Water Supply Code of Australia (Regional New South Wales Edition).

Each block shall bear directly on undisturbed ground. Any over-excavation shall be backfilled with concrete of the same properties as the thrust block.

For buried pipes, at least 7 days shall elapse after the concrete is placed before the blocks are subjected to pipe thrusts.

3.4.5.3 Valve Pits

3.4.5.3.1 General

Valves shall be installed within the chamber or pit in accordance with the Drawings.

Thrust restraining reinforced concrete valve pits shall be constructed in accordance with the Drawings.

3.4.5.3.2 Pit covers

Install pit covers and frames in accordance with the Drawings.

3.4.5.3.3 Pits in Road Reserves

Unless otherwise directed, place the pit covers to accurately match the surrounding level and slope and where directed in road reserves the future level and slope. Obtain from the responsible road authority the details necessary for compliance.

3.4.5.3.4 Access Ladders

Access ladders shall be installed as shown on the Drawings and shall comply with AS 1657.

Access ladder and retractable hand grips shall be fully enclosed within the pit when the pit cover is closed.

3.4.5.4 Air valve structures for pressurised mains

3.4.5.4.1 General

Air valve structures shall be in accordance with the Shoalhaven Water Standard Drawing No. 25350-48.

3.4.5.4.2 Access Lid

Lid shall be 6 mm aluminium checkplate with four (4) lifting handles and SS316 corner brackets in accordance with the Shoalhaven Water Standard Drawing No. 25350-010.

3.4.5.5 Scours for pressurised mains

Construct gravity and pumped scours of the type, size and locations shown in the Drawings. Scour valve pits shall be located away from the road.

Pumped scours shall be in accordance with the Shoalhaven Water Standard Drawing No. 25350-45.

3.4.5.6 Valve Surface Boxes

All buried sluice valves shall be provided with a cast iron valve box and surround to enable on ground access to the valve spindle cap or extension spindle cap. Valve boxes and lids shall be in accordance with the requirements of Shoalhaven Water Standard Drawing No. 25350-45.

Marking of valve boxes and lids shall comply with Shoalhaven Water Wastewater Reticulation System Colours Procedure accessible via https://www.shoalwater.nsw.gov.au/Building-and-renovating/Information-and-resources/Guides-resources-and-standards#section-4.

3.4.6 Maintenance Holes (MH)

Construct MHs and install covers, surrounds, step irons and ladders in accordance with *WSA 02: 2014-3.1 Gravity Sewerage Code of Australia (Regional New South Wales Edition)*.

3.4.7 Sewer Relining

Refer to Section 4. The Contactor shall submit a detailed pipe relining methodology to the Superintendent for approval 10 working days prior to commencement of works, including but not limited to the following:

- management plans (risk, traffic, safety, environmental, etc.);
- general description of the lining method and sequence of operations;
- type of existing pipe and service reconnection joints used and their relevant specification;
- manufacturer and type of lining system to be used;
- existing underground utility services location and special precautions required;
- location, size and depth of the entry and exit pit required;
- hydraulic calculation of bypass pumping (where applicable);
- bypass pumping of existing pipeline services during pipe bursting operations;
- programmed daily work hours and duration of operation; and
- details of specialist including relevant competency training records.

The relined/rehabilitated sewer shall be pressure tested in accordance to Section 3.5.

3.4.8 Corrosion Protection

3.4.8.1 Polyethylene sleeving for DICL pipelines

All buried ductile iron pipes and fittings shall be protected with polyethylene sleeving complying with the requirements of AS 3680. The application of the sleeving to the pipeline shall be carried out in accordance with AS 3681.

For buried ductile iron flanges including stainless steel bolts, the bolts heads and nuts shall be covered with plastic cover caps filled with an approved corrosion prevention paste, and then the flange shall be sleeved with two layers of polyethylene encasement securely taped to the pipe encasement.

3.4.8.2 Steel pipelines

Steel pipes shall be either fusion-bonded polyethylene coated, or wrapped by an approved corrosion taping system. The application of the wrapping system shall be carried out strictly in accordance with the manufacturer's instructions in regard to surface preparation and the application of primer, mastic filler and tape.

3.4.9 Connection to existing sewerage system

Only undertake connection to existing live sewerage system on completion of all other Works.

Give written notice, including full details of the proposed connection procedures, 10 working days prior to making the connection and comply with any directions regarding the method and timing of the connection which are necessary to meet operational needs of the existing sewerage system. Minimise disruption to the operation of the existing sewerage system and avoid overflow of sewage. If necessary, provide bypass pumping of sewage flows around the point of connection.

A Work Method Statement for connecting to the existing system shall be submitted to the Superintendent for approval prior to the commencement of Works.

Ensure all the necessary materials and equipment are available on site prior to commencement of the connection works.

Notify the Superintendent immediately if spillage occurs. Every effort shall be made to contain any spillage.

Carry out all preparatory and backfilling work, which may include but not be limited to:

- Exposure of an existing pipeline to allow ready access for inserting a junction or division valve;
- Exposure of an existing MH inlet or sewer to allow ready access for the connection to be made or, where specified, construction of a new maintenance structure over the existing sewer;
- Making connection as specified;
- Provision of trench support;
- Supply of authorised trench fill material in the case of road works or where additional compaction is required;
- Traffic control to allow safe passage of pedestrians, vehicular traffic and various plant; and
- Backfilling, compaction and restoration works after completion of the connection.

3.4.10 Ventilation

3.4.10.1 Odour Control System

Provide an odour control system on locations as shown on the Drawings for prevention and control of foul odours.

3.4.10.2 Ductwork

Supply and install ductwork as indicated on the drawings. All ductwork shall present a neat workmanlike appearance and shall be to the Quality Inspector's approval.

All precautions must be taken to ensure a silent air distribution. Sharp edges facing the air stream are to be avoided.

All ducts shall be cleaned internally as duct connections are made.

3.4.10.3 Electrical Safety of Metallic Pipelines

Adequate precautions shall be taken against the electrical hazards associated with steel and ductile iron pipelaying as per AS 4853. The Contractor shall undertake risk assessments and the following shall be included (without limitation):

- Direct contact and flashover in air due to plant approaching too closely to high voltage conductors;
- Dangerous step and touch potential that can arise in the vicinity of a pipeline of material capable of conducting electrical current across pipeline joints due to:
  - Inductive coupling;
  - Capacitive coupling;
  - Earth return currents; and
  - Lightning strikes.
- The effect of lightning that can extend along electrical transmission lines for many kilometres; and
- Well coated, electrically continuous, unearthed, large diameter steel/ductile iron pipelines, which provide very little attenuation of potential, thus creating dangerous situations anywhere along the pipeline.

3.4.11 Pipeline Markers and Signs

3.4.11.1 Marker Tape

Approved plastic marker tape shall be installed in the trench above the pipe at all road crossings in accordance with construction Drawings, except where such crossings are installed by boring. At locations where concrete slabs are installed, marker tape shall also be supplied and installed, placed at least 300 mm below the surface.

Detectable marker tape shall be provided on top of the pipe embedment material or 1000 mm below the finished surface level, whichever is closest to the surface. Detectable tape shall be tan or brown in colour with the words “CAUTION – SEWER MAIN BURIED BELOW”, 100 mm wide PE tape with 316 stainless steel wire insert.

The tracer wire is to be connected such that tracing can be undertaken. Marker tapes shall be provided for all pipes, both plastic and non-plastic.

3.4.11.2 Signs

Refer to Shoalhaven Water Wastewater Reticulation System Colours and Procedure accessible via https://www.shoalwater.nsw.gov.au/Building-and-renovating/Information-and-resources/Guides-resources-and-standards#section-4 .

The Contractor shall verify with the Superintendent the wording of the marker signs prior to the commencement of manufacturing.

3.5 Acceptance Testing

3.5.1 General

Acceptance testing shall be witnessed by the Superintendent.

Testing may be done progressively but must be no earlier than 7 days after completion of the section to be tested. Give 48 hours’ notice before commencement of testing.

Submit written records of all test results as soon as possible after the test is performed. If any test produces an unsatisfactory result, locate and repair the fault and then re-test. Continue to repair and re-test until a satisfactory test result is obtained. Even if testing produces satisfactory test results, repair any structure, pipeline or conduit in which there is a visible or detectable leak or blockage.

Undertake acceptance testing of all sewers, pressure mains and structures in the order shown in Table 12.

Table 12 Order of Acceptance of Civil Items

Order	Inspection and Testing	Gravity Sewers	MHs	Pressure Mains
1	Visual inspection	Y	Y	Y
2	Compaction testing	Y	Y	Y
3	Pressure testing	Y Low pressure air or vacuum or hydrostatic	Y Vacuum or hydrostatic	Y hydrostatic
4	Infiltration testing	Y	Y	N
5	Deflection testing	Y	N	N
6	CCTV inspection	Y	N	N

Unless otherwise specified in this Specification, the Contractor shall carry out acceptance testing of the completed pipeline in accordance with the *WSA 03 2011-3.1 Water Supply Code of Australia (Regional New South Wales Edition), WSA 02: 2014-3.1 Gravity Sewerage Code of Australia (Regional New South Wales Edition), and Sewage Pumping Code of Australia (WSA 04), Part 3: Construction.*

3.5.2 Air pressure and vacuum testing of gravity sewers

The sewers and manholes may be tested either separately or together.

3.5.2.1 Sewers and MHs tested separately

Vacuum or air pressure test all sewers <DN1500 in accordance with Sections 3.5.2.3 or 3.5.2.4. Include external MH drops, property connection sewers, vertical risers, inspection shafts and fittings. Do not include MHs which shall be vacuum tested separately in accordance with Section 3.5.3.

3.5.2.2 Sewers and MHs tested together

Vacuum test all sewers <DN600 in accordance with Section 3.5.3. Include MHs, external MH drops, property connection sewers, vertical risers, inspection shafts and fittings. A maximum of 300 linear metres of the sewer system at a time may be tested by this method.

The following table summarises the pressures used in each test method.

Table 13 Summary of Test Pressures

Initial		Starting Pressure (kPa)	Allowable Pressure Loss (kPa)	
Location	Pressure (kPa)		Rubber ring jointed (VC, PVC, PP, GRP, etc.)	Solvent cement jointed PVC or fusion jointed PE
Sewers (low pressure)	27	23.6	7	7
Sewers (vacuum)	-27	-23.6		
MH (vacuum only)	-37	-33.8	5	

3.5.2.3 Vacuum testing

Vacuum testing may commence after trench filling and compaction and construction of associated pipeline structures has been completed. The testing shall include all pipelines property connections, and any Inspection Shafts. Testing lengths is to be limited to ≤ 250 metres.

Plug all MH pipe inlets and outlets within the sewer test length. Ensure plugs are secure. Apply an initial test pressure (negative pressure) of 27 kPa. Close the valve on the vacuum line and shut off the vacuum pump. Allow the air pressure to stabilise for at least 3 minutes to identify any initial leakage.

When the pressure has stabilised and is at or below the starting test vacuum of 23.6 kPa, commence the test by allowing the gauge pressure to drop to 23.6 kPa and initiate time recording. Record the drop in vacuum over the test period.

At the completion of the test period duration, accept the length of sewer under test if the test vacuum loss is < 7 kPa for RRJ pipes and < 2 kPa for solvent welded or fusion jointed pipes for the relevant time interval specified in WSA 03 2011-3.1 Water Supply Code of Australia (Regional New South Wales Edition).

If the sewer fails the test, rectify all defects prior to conducting any further testing. Re-apply the full test procedure to confirm acceptance of the sewer length under test.

If a visual leak or audible defect is identified by CCTV inspection or other acceptance testing method after vacuum testing has been completed, rectify the fault and retest the sewer test length until a satisfactory test result is obtained. All sewers shall be cleaned before any testing activities are performed.

3.5.2.4 Low pressure air test

Limit testing to sewers <DN1500 and to runs between maintenance structures of < 250 metres. Plug all MH pipe inlets and outlets within the sewer test length. Ensure plugs are secure.

Slowly apply an initial test pressure of approximately 27 kPa, since rapid pressurisation can cause significant air temperature changes that may affect testing accuracy. Where the sewer is below the water table, increase the stated pressure to achieve a differential pressure of 27 kPa but do not exceed 50 kPa actual test pressure.

Close the valve on the vacuum line and shut off the vacuum pump. Allow the air pressure to stabilise for at least 3 minutes to identify any initial leakage.

When the pressure has stabilised and is at or below the starting test vacuum of 23.6 kPa, commence the test by allowing the gauge pressure to drop to 23.6 kPa and initiate time recording. Record the drop-in vacuum over the test period.

At the completion of the test period duration, accept the length of sewer under test if the test pressure is ≤ 7 kPa for the relevant time interval specified in Table 22.4 of the latest version of *WSA 02: 2014-3.1 Gravity Sewerage Code of Australia (Regional New South Wales Edition).*

3.5.3 Vacuum testing of sewer maintenance holes

All sewer maintenance holes shall be subjected to vacuum testing after placement and compaction of embedment, trench fill surround materials and the fitting of the cover and frame.

Vacuum test 20% of all cast in-situ concrete MHs, but not fewer than 1 (one) MH, for the initial test. Vacuum test 100% of all pre-cast/prefabricated MHs for the initial test.

Testing of MHs shall be selected independently of the Contractor (nominated by the Superintendent). The frequency of testing shall be in accordance with the requirements set out in Table 22.5 of the latest version of *WSA 02: 2014-3.1 Gravity Sewerage Code of Australia (Regional New South Wales Edition).*

Plug all pipe inlets and outlets within the MH structure and seal the opening. Ensure plugs are secure. Apply an initial test pressure (negative pressure) of 37 kPa to the top of the MH. Close the valve on the vacuum line and shut off the vacuum pump. Allow the air pressure to stabilise for at least 3 minutes to identify any initial leakage.

When the pressure has stabilised and is at or below the starting test vacuum of 33.8 kPa of mercury, commence the test by allowing the gauge pressure to drop to 33.8 kPa and initiate time recording. Record the time for the vacuum to drop to 30.4 kPa.

At the completion of the test period duration, accept the MH under test if the vacuum reading drop to 33.8 kPa to 30.4 kPa meets or exceeds the relevant time specified in Table 22.6 of the latest version of the *WSA 02: 2014-3.1 Gravity Sewerage Code of Australia (Regional New South Wales Edition).* If the time is less than the minimum specified in the table, re- apply the vacuum to identify any leaks.

If the sewer fails the test, rectify all defects prior to conducting any further testing. Re-apply the full test procedure to confirm acceptance of the sewer length under test.

3.5.4 Hydrostatic pressure test for pressurised sewer mains

3.5.4.1 General Requirements

Hydrostatic pressure testing shall be witnessed by the Superintendent.

The Contractor shall undertake hydrostatic pressure testing of each section progressively upon completion of each section.

The Contractor shall not commence hydrostatic pressure testing until all concrete thrust or anchor blocks have developed their design strength.

Ensure that pipes are clean before any test is performed. Do not pressure test during wet weather.

Test polyethylene pipes in accordance with the latest version of the *Water Services Association of Australia Polyethylene Pipeline Code (WSA 01).*

3.5.4.2 System test pressure

The hydrostatic test pressure is taken as the design pressure and shall not exceed this by more than 25%. Test pressures shall be as shown on the Drawings.

3.5.4.3 Maximum Allowable Loss

The maximum allowable loss shall be:

$$\frac{0.14 \times di \times Lp \times H}{1000}$$

where di – internal pipe diameter (mm);

Lp – length of sewer pressure main under test (km); and

H – average test head of section under test (m).

3.5.4.4 Pre-Test Procedure

Initial Filling: The Contractor shall take care to prevent the water filling velocity from exceeding 0.05 m/sec based on the full pipeline internal diameter.

Stabilisation: The Contractor shall allow 3 to 24 hours to stabilise the water temperature and allow air to vent from the system. For cement-lined pipe, the Contractor shall allow a minimum stabilisation period of 24 hours to allow saturation of the pipe lining before commencing the constant pressure test.

Maximum test length shall be 1,000 metres unless otherwise permitted by the Superintendent.

3.5.4.5 Pressure Test Procedure

Testing shall be carried out using a testing rig which has two calibrated pressure gauges at a range of 0 – 2500 kPa. Use pressure gauges which have been calibrated within three months of the testing and provide calibration certificate to the Superintendent. Both gauges must read within 5% of the test head and 5% of each other. Use the gauge reading the lower of the two readings. Before testing a pipeline section, it should be cleaned and then slowly filled with water, ensuring that air has been completely expelled.

Perform pressure testing as follows:

- Pressurise the line to 75% of the test pressure and leave for a minimum of 12 hours;
- Provided there is no obvious leak in the pipeline, steadily raise the pressure in the pipeline until the specified test pressure is reached;
- Maintain this pressure for a minimum of 5 hours. Measure and record, at 3 and 5 hours, the quantity of water added in order to maintain the pressure during the period of testing;
- During the pressure testing of the pipeline, ensure each valve sustains at least once the full test pressure on one side of the valve closed position with no pressure on the other side for at least 15 minutes; and
- Visually inspect the line for leaks. If a leak is suspected but is not visible use aural or electronic assistance.

3.5.4.6 Satisfactory pressure test

The pressure testing on a section of pipe is deemed to be satisfactory if:

- There is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;
- There is no visible leakage; and
- The average measured leakage rate during the last four hours of the pressure testing does not exceed the maximum loss rate (refer Section 3.5.4.3).

3.5.4.7 Water for Hydrostatic Pressure Testing

The Principal shall arrange for the supply of water required for hydrostatic pressure testing of pipelines.

The Contractor is responsible for any transportation and pumping costs for the filling of the pipeline.

The Principal will provide water for testing free of charge for the initial hydrostatic test, up to an upper limit of the volume of the section being tested + 10%.

The Contractor is responsible for the cost of water required for retesting of any section of the pipeline which does not pass initial hydrostatic testing.

The Contractor shall filter / screen all water to be used for hydrostatic pressure testing through a 150 micron filter before filling the pipeline.

3.5.4.8 Flushing of Pipelines

After the field pressure testing is satisfactorily completed, flush the new pipelines to the satisfaction of the Superintendent. Use approved water which is free from excessive suspended silt, sand or vegetable matter.

3.5.4.9 Water Disposal

The Contractor shall dispose water used for hydrostatic pressure testing in compliance with the approved CEMP, and the directions of the Superintendent.

The Contractor shall obtain approval in writing from Superintendent for the disposal of water prior to undertaking hydrostatic pressure testing.

3.5.4.10 In-test Surveillance

The Contractor shall keep the pipeline under the full test pressure until all leaks detected by the hydrostatic pressure test have been located.

The Contractor shall carry out 2 hydrostatic pressure test for any test section that fails the initial hydrostatic pressure test. If both additional tests pass, accept the section. If one or both of the additional tests fail, rectify the work.

Within 2 weeks of the completion of any rectification work, perform another test on the section deemed to have failed. If the test fails, rectify the work and retest. Rework until all test results are satisfactory.

The Contractor shall provide a continuous record of pipeline pressure from the start of pressurising the pipeline through the whole of the hydrostatic test period to the end of depressurising the pipeline.

The Contractor shall prepare and maintain a comprehensive record of test results for all hydrostatic pressure tests undertaken for the Works.

The hydrostatic pressure test record shall be prepared and submitted to the Superintendent. The hydrostatic test record shall be submitted together with the Work as Executed records at Practical Completion.

4 SECTION D – RELINING PROJECT REQUIREMENTS

This Standard Technical Specification details requirements for the installation of lining systems in existing mains to restore structural integrity, prevent infiltration or exfiltration, reduce root ingress and/or restore hydraulic capacity of the main.

4.1 Design of Liner

Design the liner as a flexible pipe capable of supporting all imposed loading. Ignore any contribution from the original pipe. For design calculations assume the deteriorated host pipe and surrounding soil provide the liner with support equivalent to a soil modulus of no more than:

- 2 MPa; or
- MPa if all voids between the liner and the host pipe and external to the host pipe are to be filled with cementitious grout.

Allow for a design life of the installed liner of at least fifty (50) years. Design the liner to suit each specific location and taking into account ground water pressures, soil pressure, traffic loadings and structural requirements. For structural purposes, assume there is no long-term bond between the liner and the host pipe. Assume groundwater pressures comprise hydrostatic pressure from a water table located at the ground surface unless directed otherwise. Assume vertical earth pressures comprising the maximum height of soil above the pipe, ignoring any reductions due to trench effects.

Calculate live traffic loadings in accordance with Figure 4.1 of AS 2566.1 with the selected intensity consistent with the traffic type and usage.

Design the lining as a flexible pipe in accordance with AS/ANZ 2566.1 to satisfy the critical performance criteria of deflection, strength and buckling. The long-term vertical deflection limit shall be 6%. The value of the limiting value for long-term strain used shall be consistent with the material properties of the lining.

Check all linings for buckling under externally applied groundwater pressures based on the method given in ASTM 1216. The ovality of the existing pipe shall be taken as 2% for linings in cast iron pipes and 5% for all other pipes. Check short-term effects occurring during installation.

Submit copies of design calculations prior to installation of the liner. These calculations shall verify that proposed nominal wall thickness of the liner is greater than or equal to the design thickness **(Hold Point).**

4.2 Hydraulic Requirements

For pipes of 500mm or less diameter, size the lining system to have an internal diameter of at least 90% of the internal diameter of the existing pipe.

For pipes of more than 500mm diameter, size the lining system to have an internal diameter of at least 95% of the internal diameter of the existing pipe.

Any reduction in the sewer's cross-sectional area shall be compensated by the reduced roughness of the liner. The build-up of slime and any defects, which may affect hydraulic performance, shall be considered when determining the flow resistance of the liner.

4.3 Degree of Fit

Design the lining to neatly fit the internal wall and length of the pipe being lined with suitable allowance for longitudinal and circumferential stretching of the lining during installation.

4.4 Submittals

4.4.1 Submittal Procedures

A. The Contractor shall document all correspondence and deliverables required on the project including, but not limited to, submittals required in the Technical Specifications, monthly invoices, photographs/videos, executed drawings, monthly reports, certificates, as-built documents, test results, field or shop test reports, factory witness test reports, coordination drawings, letters, and all other deliverables and correspondence required in the Contract Documents.

B. All submittals shall be provided with one original and 1 copy.

C. Electronic Files

1. Files transferred electronically shall be converted to PDF file format using the full version of Adobe Acrobat Reader, Version 9, and drawing files shall also be in (PDF) file format.
2. When specifically requested by the Superintendent, files shall be made available and transmitted on appropriate electronic media (CD, DVD, external hard drive).

D. Project Forms

1. Council will provide a WinCan template containing CCTV data already populated using WINCAN software for the Contractor's use. Contractor shall utilize the required forms and not change data already populated into the software. Any changes shall be marked up on a hard copy of the report and submitted to Superintendent on a two weekly basis.
2. Contractor to develop other forms required, unless directed otherwise by the Superintendent.

E. Contractor is to develop a Submittal Form to be used on the project and shall be used for each separate submittal that is required. This submittal form shall be submitted for the Superintendent's approval prior to it's use for any submittal.

F. Within fifteen (15) work days after receipt of a submittal, the Superintendent shall return the submittal to the Contractor with comments noted thereon. The review time by the Superintendent or the designated reviewer shall not include delivery time to and from the Superintendent.

G. It is considered reasonable that the Contractor shall make a complete and acceptable submittal on the second submittal.

H. Resubmittals shall be made within five (5) days from the date the submittal was returned to the Contractor unless a written request for extension is made by the Contractor with the reasons why the resubmittal cannot be completed within that time.

I. Upon notification that the submittal is acceptable to the Superintendent, work may proceed.

4.4.2 Submittal Form

A. All submittals shall be accompanied with Submittal Form developed for the project by the Contractor. Any submittal not accompanied by such a form, or where all applicable items on the form are not completed, will be returned for resubmittal.

4.4.3 Submittals

A. Whenever submittals are required, the submittals shall be submitted by the Contractor to the Superintendent in accordance with the Submittal Procedural above.
B. All submittals shall be submitted as a complete package for each specification section separately. Submittals that are not a complete package shall be rejected and returned to the Contractor for correction.
C. All submittals, regardless of origin, shall be stamped and signed with the approval of Contractor and identified with the name and number of this Contract, Contractor's name, and references to applicable specification paragraphs and Contract Drawings.
D. Contractor's approval is a representation to Council that the Contractor accepts full responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalogue numbers, and similar data, and that the submittal has been reviewed or coordinated with the requirements of the Work and the Contract Documents.
E. When catalogue pages are submitted, applicable items shall be clearly identified. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.
F. Council reserves the right to withhold monies due to the Contractor to cover additional costs of the Superintendent's review beyond the second submission.
G. Revisions indicated on submittals or shop drawings shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis of claims for extra work. The Contractor shall have no claim for damages or extension of time due to any delay resulting from having to make the required revisions to submittals or shop drawings.
H. The review of submittals by the Superintendent's designated reviewer will be limited to checking for conformance with the Contract Documents, and shall in no way relieve the Contractor of responsibility for errors or omissions contained therein nor shall such review operate to waive or modify any provision contained in the Contract Documents.
I. Fabricating dimensions, quantities of material, applicable code requirements and other contract requirements shall be the Contractor's responsibility.
J. Resubmittals shall be noted with the original submittal number followed by the letter A, B, etc.

4.4.4 Shop Drawings

A. Wherever called for in the Contract Documents, or where required by the Superintendent, the Contractor shall furnish shop drawings. The term "shop drawing" as used herein shall be understood to include detailed design calculations, fabrication and installation drawings, lists, graphs, etc. Unless otherwise required, said drawings shall be submitted at a time sufficiently early to allow review of same by the Superintendent or his designated reviewer, and to accommodate the rate of construction progress required under the Contract. The Contractor shall allow for a ten (10) business day review period by the Superintendent.

4.4.5 Engineering Data

A. Engineering data covering all fabricated or manufactured materials that will become a permanent part of the Work under this Contract shall be submitted to Superintendent for review. These data shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and operation of component materials and devices; performance characteristics in accordance with referenced standards; and dimensions needed for installation and correlation with other materials and equipment.

4.4.6 Samples

A. Samples are physical examples that illustrate materials, equipment, or workmanship and establish standards by which the Work will be judged acceptable and meeting the requirements of the Technical Specifications.
B. Where samples are required, they shall be submitted by and at the expense of the Contractor. Such submittal shall be made to allow five (5) work days for Superintendent's review and sufficient time after approval to have the materials manufactured and delivered to the job site for incorporation into the Work, in accordance with the Contractor's schedule. Sample review time shall not include delivery time to and from the Contractor.
C. Materials represented by such submittals shall not be manufactured, delivered to the site, or incorporated into any work without such prior review.
D. Each sample shall bear a label showing the Contractor's name, project name, name of the item, manufacturer's name, brand name, supplier's name, and reference to the appropriate drawing, technical specification section and paragraph number, all as applicable.

4.4.7 Certificates

A. Where certificates are required, they shall be submitted by and at the expense of the Contractor. Such submittal shall be made to allow sufficient time after approval to have the materials manufactured and delivered to the job site for incorporation into the Work, in accordance with the Contractor's schedule. Review time shall not include delivery time to and from the Contractor.
B. Certificates shall clearly identify the material being certified and shall include but not be limited to providing the following information: Contractor's name, project name, name of the item, manufacturer's name, and reference to the appropriate drawing, technical specification section and paragraph number all is applicable.
C. All printed certificates shall be submitted as originals. Reproduced materials are not acceptable.

4.4.8 Submittal Schedule

A. At the time the project schedule is submitted, the items of materials and equipment for which submittals are required by the Specifications shall be included. For each required submittal, the date shall be given for intended submission for review and the date required for its return to avoid delay in any activity beyond the scheduled start date. Sufficient time shall be allowed for initial review, correction and resubmission, and final review of all submittals.

4.4.9 Deviations

A. Approval of a submittal, that changes or modifies the Contract Documents, does not constitute approval of those changes or modifications unless all changes or modifications have been specifically identified as a deviation from the Contract Documents. The Contractor shall use a Submittal Deviation Form developed for the project to identify all deviations.
B. If the Contractor submittal shows variations from the Contract requirements, the Contractor shall describe such variations on a Submittal Deviation Form, at the time of submission. If the Superintendent approves any such variation(s), credits may be due to the contract as a result of such deviations. If the variation is minor and does not involve a change in price or in time of performance, a credit may not be required.
C. The Contractor shall be responsible for resultant changes and deviations and all additional costs that the accepted deviation requires in the work and shall effect such changes without additional cost to Council.

4.4.10 Proposed Substitution "Or Equal" Submittal

A. Any request by the Contractor for material substitution of "or equal" item must be received by the Superintendent prior to the Notice to Proceed is issued to the Contractor by Council.
B. Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the naming of the item is intended to establish the type, function, and quality required. If the name is followed by the words "or-equal" indicating that a substitution is permitted, materials or equipment of other Suppliers may be accepted by the Superintendent if sufficient information is submitted by the Contractor to determine that the material or equipment proposed is equivalent or equal to that named. The Contractor may be required to furnish, at the Contractor's expense, additional data about the proposed substitution.
C. Acceptance of a substitute item shall not relieve the Contractor of the responsibility for full compliance with the Contract Documents and for adequacy of the substituted item.
D. The Contractor shall be responsible for resultant changes and all additional costs that the accepted substitution requires in the work and shall effect such changes without additional cost to Council.

4.4.11 Survey Data

A. Survey data shall be prepared in accordance with the latest version of the Shoalhaven Water Survey, Plan Preparation & Work as Executed Standard available via https://www.shoalwater.nsw.gov.au/Building-and-renovating/Information-and-resources/Guides-resources-and-standards#section-4;
B. All original field books, notes, and other data developed by Contractor in performing surveys required as part of the Work shall be submitted to the Superintendent for examination throughout the construction period.
C. Licensed surveyor shall keep neat and legible notes of measurements layout work and calculations made in connection with the layout of the Work. Copies of such data shall be submitted to the Superintendent as defined in Paragraph 1.01 for use in checking the layout. All such data shall be submitted by Contractor with other records weekly or as requested by Superintendent.

4.4.12 Construction Photographs and Videos – Contractor's Dilapidation Survey

Prior to commencing on-site works the Contractor is to submit a comprehensive and detailed Dilapidation Survey. Copies are to be provided to the Superintendent (2 No. hard colour copies, 1 No. Electronic (CCTV via WinCan)).

A. Contractor shall be responsible for the production of intelligible, digital quality construction photographs as required in the Technical Specifications.
B. The Contractor shall prepare a dilapidation survey of the site(s), including preliminary photographs of the entire site(s), or pertinent features thereof. Photographs shall be taken before the commencement of work at the site(s) and promptly submitted to the Superintendent. The dilapidation survey is to cover:
    - The existing built, engineering infrastructure, ground and landscape elements of the site of the works and the adjacent administration building;
    - Land and features to a distance of 10 m surrounding the perimeter of the site of the works;
    - 10 m either side of engineering service routes outside the site of the works, to be installed or connected to by the Contractor;

- Access roads and associated kerb and guttering, street lights and the like to a distance of 30 m from the site of the works; and
- The construction personnel carpark area.

C. All photographs shall be colour photographs of intelligible.
D. Photographs shall be labelled with a description of the view, date, location (surveyed) and project number and submitted to the Superintendent electronically.

4.4.13 Warranties

A. Where required in other sections, original warranties shall be submitted to the Superintendent prior to the start of any work.

4.5 Roads, Hardstands and Traffic Control & Pedestrian Safety

4.5.1 General

This section covers the provision of all materials, plant and labour for the design, supply, construction and testing of access roads and hardstand areas under the Contract, including kerbing, and footpaths and traffic control and pedestrian safety.

Traffic control and pedestrian safety shall meet Australian Standard AS1742.3-2009 and the RTA (Roads and Traffic Authority) specification - traffic control at work sites version 4-2010. All aspects of traffic control and pedestrian safety shall be carried out by the Contractor to ensure the safety of the public. The Contractor is solely responsible for the safety of their employees.

Contractor shall submit Traffic Control and Pedestrian Safety Plan to the Superintendent for consent within 14 days of receipt of Notice of Award of the Contract. Contractor shall obtain Section 138 consent from Council prior to undertaking any work within the road reserve. A period of 10 working days should be allowed to achieve the section 138 consent from Council.

4.5.2 Standards

The following Standards are applicable to this section:

- AS 1289 Methods of Testing Soil for Engineering Purposes AS 1152 Test Sieves;
- AS 3600 Concrete Code;
- AS 2890.2 Parking Facilities - Part 2 – Off-street Commercial Vehicle Facilities; and
- RTA Specifications:
  - RTA Spec. 121 Specification for Control of Traffic at Road and Bridge; Works RTA QA Spec. R71 Unbound Pavement Course (Normal Duty);
  - RTA Form No. R106 Sprayed Bituminous Surfacing;
  - RTA Form no. R116 Asphalt (Dense Graded and Open Graded);
  - RTA Form No. 3051 Unbound and Modified Base and Subbase Materials for Surface Road Pavements; and
  - RTA Form No. 3151 Covered Aggregate for Sprayed Bituminous Surfacing; and RTA QA Spec 3253 Bitumen for Pavements.

4.5.3 Products

Use only approved products per the reference standards above.

4.5.4 Execution

Construct to match pre-existing conditions or better and in accordance with the reference standards above. Prior to any work, which may affect traffic movement, submit for approval a proposal detailing the traffic movement and control methods.

When construction is in progress on roadways or road shoulders, the Contractor shall provide and maintain all signs, lights, barriers and traffic barricades needed to inform drivers of hazards, to guide traffic safely past temporary obstructions and to protect workers.

As a minimum requirement such provisions shall comply with (RTA) Form 121 “Specification for Control of Traffic at Road and Bridge Works” but the Contractor shall erect such additional equipment as may be necessary or as may reasonably be directed by the Superintendent to provide for the safety and convenience of traffic at a particular location both during actual construction and outside normal working hours.

The Contractor shall provide the Superintendent 14 days notice of intention to start any road crossings or which construction is to be in a road shoulder.

Where a pipeline crosses a road or construction of the line involves in any way any other feature under the control of another Authority, the work shall be carried out in accordance with the requirements of that Authority. The Principal shall obtain approval for the work from the Authority concerned but it will be the Contractors responsibility to notify the Authority of his intention to construct and to complete any written notification so required.

The cost of the Contractor’s obligations for conforming to these requirements shall be deemed to be included in the unit rates provided for other work.

4.6 Bypass Pumping / Flow Control

4.6.1 General

This section describes the requirements for temporary bypass pumping and flow control of peak sewage flows. The Contractor shall consult the Superintendent before plugging or blocking sewers.

When flow in a sewer line is plugged, blocked, pumped or bypassed, sufficient precautions must be taken to protect the sewer lines and properties from damage that might result from sewer surcharging. The contractor shall supply and insert sewer line plugs into the lines upstream of the section being worked.

Requirements:

A. Contractor shall provide labour, materials, and supervision to temporarily provide bypass pumping and flow control around the Work in accordance with the specific needs of the inspection, cleaning, or rehabilitation work.
B. For purposes of bypass pumping lateral flows, right of entry onto private property is not permitted until notice is given to the property owner in writing by the Contractor. Contractor is to provide notification template to Superintendent for approval prior to its initial use.
C. No interruption of sewage flow shall be permitted throughout the duration of the project.
D. Bypass Operation: 24 hours per day during the period of Work. The bypassed flow shall be continuously monitored and metered. The Contractor shall provide a weekly report to the Superintendent listing all locations of plugs used for diversion or bypass.

E. Bypass pump operator shall be qualified to both operate and repair any and all problems that may occur with the bypass pumping equipment to ensure proper operation 24 hours a day.

4.6.2 Submittals

A. Project-specific bypass plans shall be prepared by the Contractor and submitted to the Superintendent for review prior to any Work being started on site. Means and methods of accomplishing and maintaining the bypassing shall be the responsibility of the Contractor, but shall be shown in the submittal.

B. Bypass Pumping Plan shall include, but not be limited to, the following:

1. Detailed procedures for handling existing wastewater flow;
2. Schedule;
3. Location;
4. The Contractor is advised that his bypass plans must provide for accessibility to pedestrians and vehicular traffic in accordance with local agency requirements;
5. Clearly-defined drawings (one drawing per bypass) indicating the scheme and location of temporary sewer plugs and bypass discharge lines for each of the project sites, and showing the method and location for discharging the bypass lines;
6. Staging areas for pumps, if bypass pumping is being used;
7. Listing of equipment and capacities:
   a) Sewer plugging method and type of plug;
   b) Number, size, material, location and method of installation of suction piping;
   c) Bypass pump sizes, capacity, number of each size to be onsite, and power requirements;
   d) Standby power generator size and location for electrically driven bypass pumps;
8. Calculations of static lift, friction losses and flow velocity (pump curves showing pump-operating range for selection of bypass pumping pipe size);
9. Downstream discharge plan;
10. Thrust and restraint block sizes and locations;
11. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill;
12. Method of noise control for each pump and generator;
13. Temporary pipe supports and anchoring required;
14. Plans for access to bypass pumping locations indicated on Drawings;
15. Schedule for installation of and maintenance of bypass pumping lines;
16. Plan indicating selection location of bypass pumping line locations;
17. Detailed plans of a redundant backup system;
18. Description of compliance permit conditions;
19. Staffing plan for monitoring and maintaining pumps;
20. Emergency response plan;
21. Spillage clean-up plan; and
22. Odour control plan.

C. If Contractor proposes to connect bypass line to existing structure, detail of connection shall be provided for approval with specific bypass plan.

4.6.3 Products

The plug shall be so designed that:

A. All or any portion of the sewage can be slowly released, if and when required; and

B. Provision is made to adequately secure the plug in position and retrieve the plug when required.

4.6.4 Noise Restrictions

A. Pumps and generators shall be equipped with devices such as (but not limited to) mufflers and/or plywood/Styrofoam noise panels enclosing the engines to keep the noise level within limits specified by local laws; and
B. Contractor shall monitor noise levels of pumps and generators at all times. Superintendent may request to verify noise levels at any time.

4.6.5 Capacity

A. The Contractor shall have generator, standby pumps and pipe on site at all times, manifolded, connected and ready to operate immediately of the bypass system design flow. Standby pumps shall be fuelled and operational at all times.
B. Standby pumping capacity of 50% shall be available at all times. Superintendent reserves the right to request 100% standby pumping capacity on small diameter pipes.
C. The Contractor shall maintain on site a sufficient number of valves, tees, elbows, connections, tools, sewer plugs, piping, and other parts or system hardware to ensure immediate repair or modification of any part of the system as necessary.

4.6.6 Execution

The Contractor shall notify the Superintendent 48 hours prior to bypassing or diverting flow in any of the pipelines or house connection sewers. Implement odour control during bypass pumping operation as directed by the Superintendent. The Contractor shall comply with all requirements of Council's spill prevention and emergency response requirements in the event of a sanitary sewer overflow. Do not release bypass flow/flow diversions until Superintendent has accepted lining or grouting system installations.

4.6.7 Protection

The Contractor shall be responsible for all bypassed flows. The Contractor shall inspect the entire bypass pumping and piping system for leaks or spills on a daily basis. No bypassing to the ground surface, receiving waters, storm drains, or bypassing which results in soil or groundwater contamination or any potential health hazards shall be permitted.

In the event of any sewage spill the Contractor shall be responsible for the prompt clean-up and disinfecting of the spill as called for in bypass plan. The Contractor shall immediately contact Council in the event of a spill, not matter how small. The Contractor shall compensate the Owner for the cost of any fines levied as the result of a spill or unauthorized discharge.

4.6.8 Clean-up

Disturbed Areas: Upon completion of bypass pumping operation, clean disturbed areas, restoring to original condition, including pavement restoration, at least equal to that which existed prior to start of Work.

4.6.9 Scheduling

The bypassing system shall not be shut down between shifts, on holidays or weekends, or during work stoppages. The bypass system shall have a trained and qualified attendant to maintain the bypass pumping system from the start of bypass until the bypassing of the specific pipeline is no longer required.

4.7 Cleaning of Mains

4.7.1 General

This section specifies the requirements for cleaning of the pipes prior to CCTV inspection or lining or grouting or patching. Work for cleaning consists of furnishing all labour and equipment to remove and dispose of the accumulated sediments in pipes and structures located within the project limits.

4.7.2 Requirements

Cleaning is required prior to installation of liners or patch or grout in the existing pipelines. The Contractor shall be qualified or shall have a qualified independent company specializing in main cleaning to clean the lines. In no case shall any chemical additive be used that might be considered hazardous, or considered detrimental to organisms or equipment at the wastewater treatment plant, or detrimental to old or new pipe materials.

The Contractor shall be solely responsible for reviewing available records and assessing the existing facilities to determine the expected quantity of sediments, debris, grease, scale, encrustations, and roots to be removed by the cleaning process selected by the Contractor to comply with the requirements of this Section. Materials collected from cleaning operations shall be disposed off at approved locations as per EPA regulations at Contractor's cost.

The Contractor shall at all times conduct work to prevent any blockage or failure and minimize surcharging in the sewer structures, connecting pipelines, and service laterals. Damage to existing facilities as a result of the Contractor's work shall be promptly repaired in kind at no additional cost to the Council.

The Contractor shall be thoroughly familiar with all phases of pipe and structure cleaning to ensure the completion of this Contract without causing a health hazard or damage to the network system, public, and private properties.

Cleaning shall mean the removal and disposal of all foreign matter, including roots, from the pipelines, branches/junctions and manholes designated for lining (Full or Patch) work. The equipment and methods employed shall be appropriate for the Contractor's particular lining or sealing system.

All materials washed out of the conduits are to be trapped in the downstream manhole and removed. Passing material from manhole section to manhole sections shall not be permitted.

4.7.3 Submittals

Contractor shall submit equipment and methods to remove sediment, debris, grease, scale, encrustations, and roots from the pipes and structures. The submittal shall include:

- Detailed explanation of the cleaning process including removal and disposal of debris;
- Schedule of activities; and
- List of actions planned to mitigate impact to the public during the cleaning operations.

4.7.4 Products

The Contractor, when making selection of the equipment to be used, shall give consideration to the prevailing condition of the conduits. The equipment shall be capable of removing dirt, grease, rocks, sand, surface encrustations, protruding mortar, timber, roots and other materials and obstructions from the conduits, to the downstream manholes.

Anticipated high-velocity, hydro cleaning equipment may include:

- High-Pressure Hose;
- Hydraulically driven hose reel;
- High Velocity Nozzle:
  - Appropriate for the condition of the pipe or manhole to avoid structure failure;
  - Two minimum; and
  - Capable of producing scouring action from 10 degrees to 45 degrees in lines to be cleaned.
- High-velocity Gun: Capable of producing flows ranging from fine spray to long distance solid stream;
- Water Tank: 4 m3 storage minimum;
- Auxiliary engines and pumps;
- Equipment Operating Controls: Locate above ground; and
- Working Pressure: Maximum 17,225 KPa (2,500 psi).

The Contractor, when using cleaning equipment or undertaking any of the associated cleaning activities, must take all necessary precautions to ensure that these activities do not:

- Damage or flood public property; and
- Damage the conduit being cleaned or any associated conduits or structures.

4.7.5 Execution

Traffic control per Section 4.5.

Temporary bypass pumping and flow control per Section 4.6.

The Contractor shall clean conduits, junctions, and manholes as required herein in such a manner to allow condition inspection of mains, installation of the in situ or patch lining systems and sealing of junctions. All live junctions shall be cleaned appropriately up to and including first joint in the House Service Line.

Pipe cleaning shall restore pipe to a minimum of 98 percent of original carrying capacity. No more than 2 percent debris, based on visual observation documented by internal inspection, shall remain in the pipe. When using hydro-cleaning equipment for pipes, make minimum of two passes through pipe segment. During final cleaning, make a minimum of one pass through the pipe segment. Begin pipe cleaning at downstream end of reach and proceed in upstream direction.

Supply water for performing high-velocity hydro cleaning: The Contractor shall obtain any necessary approval from and pay all applicable permit fees to Council prior to commencement of Work. Some junctions may have to have roots removed. Contractor shall remove roots a minimum of 400 mm up along the house service connection lateral from the junction with the main. Root removal at junctions shall only be carried out by the Contractor with a written order by the Superintendent.

4.7.6 Verification of Cleaning

Contractor shall demonstrate to Superintendent results of cleaning effort before any lining or grouting work is started. Visual verification shall be made by the Superintendent to determine acceptance of cleaning. Reclean pipeline segment or manhole if Superintendent determines that cleaning is not adequate. Recleaning will be performed at no additional cost to Council.

4.8 CCTV Inspection of Mains

4.8.1 General

This specification defines the requirements for pre- and post-lining and grouting CCTV inspection of the existing mains. CCTV inspection is required before and after in situ lining and patch lining and grouting installations.

4.8.2 Reference Code

Conduit Inspection Reporting Code of Australia-WSA 05-2008 version 2.2 and Shoalhaven Water Guidelines for CCTV Inspection of New Developer Works.

4.8.3 Requirements

- The Contractor shall be qualified or shall have a qualified independent company specializing in internal inspections to inspect the line interior using a colour camera and providing the required electronic documentation.
- The Contractor shall be responsible for properly inspecting the pipe, or providing approval of the finished inspection records if a subcontractor is used for inspection.
- The Contractor shall ensure that all personnel responsible for operating CCTV camera, identifying and recording defects and preparing CCTV survey reports shall be trained and accredited (organised by WSA or other relevant body approved by the Council) in the defect identification as per the reference codes and shall be fully conversant with picture interpretation, defect coding and classification.
- All CCTV inspection works including CCTV records and reports shall comply with the reference code requirements.
- All junctions are to be logged in WinCan regardless of the status of the junction, defective junctions and or defects house lines are to be recorded in WinCan to the WSA_05_2008_2.2 CCTV Inspection standard.
- Rehabilitation Recommendations:
    1. Preliminary existing internal inspection data will be used by the Contractor to confirm the rehabilitation technique scheduled for pipes to be rehabilitated and for pipes scheduled for CCTV inspection for which the Contractor is to provide rehabilitation recommendations;
    2. In case the conduit does not require the type of lining initially specified in the contract the Superintendent may instruct to carry out with the suitable type of lining, full lining to patch lining, and vice versa. On identification of the scope of work being outside the limits of conduit renewal by installation of liner (e.g. raising of manholes etc.) the matter shall be referred to the Superintendent with the CCTV inspection data and report for approval to proceed with the renewal; and
    3. The Contractor shall view the new CCTV inspection data and assess the condition of each conduit to make recommendations to the Superintendent for rehabilitation of the line with the most cost- effective method providing a minimum of 50 year service life. This CCTV record will also be used and viewed by the Superintendent and other Council staff to locate any particular problem areas and verify the in situ and patch lining recommendations.

4.8.4 Submittals

- Shop Drawings: Catalogue and manufacturer’s data sheets for inspection equipment.

- Field Data Acquisition System: WinCan Version 8.0 or above through a Microsoft Access Project File.
- Quality Control Submittals:
    - Qualification References: Contact names and telephone numbers;
    - List of staff and equipment;
    - Reference code certifications for all staff; and
    - Look-ahead inspection schedules, one week in advance of Work.
- An example of work consisting of one electronic recording of a previous main inspection with associated reports meeting the requirements of the reference code. The submission shall show a variety of structural defects in the lines that are representative of the pipe sizes in this project. Submit no more than two pipe segments. This inspection will be reviewed to determine if the quality of the inspection image is acceptable and if defects were properly identified and documented. The submittal shall be with the same camera, lighting equipment, and software proposed for the work.
- Completed CCTV Inspection records of the previous two (2) weeks following the inspection work. Separate projects for each identified area of inspection and rehabilitation and submit separately.
- Rehabilitation recommendations for completed CCTV inspections of the previous two (2) weeks following the inspection work.

4.8.5 Products

The Contractor shall be responsible for all costs relating to the recovery of or damage to his equipment in the course of the work.

- Camera:
    - Camera shall be certified for a normal sewer environment when gas meter readings of the manhole airspace indicate an LEL less than 10 percent and shall be explosion proof certified for hazardous environment when gas meter readings of the manhole environment indicate an LEL greater than 10 percent;
    - Resolution: 350 lines per inch, minimum, colour image;
    - Pan and tilt unit, with adjustable supports specifically designed and constructed for operation in connection with pipe inspection;
    - 65-degree viewing angle, minimum and automatic or remote focus and iris controls;
    - Self- Propelled Tractor, sized for each pipe diameter; and
    - Automatic or remote-controlled tint and brightness balance adjustments.
- Camera Lighting:
    - Minimize reflection;
    - Sufficient for diameters from 150 to 600 mm;
    - Provide clear view of entire inside periphery of pipe; and
    - Adjustable through range from 100 mm to infinity.
- Remote Reading Footage Counter:
    - Calibration: each day prior to start of work using walking meter, roll-a-tape, or other suitable device; and
    - Accurate to plus or minus 5 mm over 300 m pipe inspected.
- Equipment to operate inside the pipe including, but not limited to, cables, power source, lights, and camera shall be operative in 100 percent humidity conditions.

- Support equipment including, but not limited to, monitor, footage counter, winches, rewinders, and computer, recording instruments located above-ground suitable to inspection work.
- Recording Medium:
    - MPEG-1 format directly recorded to a USB hard drive linked to WinCan Version 8.0 or above through a Microsoft Access Project file (Supplied by the Superintendent).

4.8.6 Execution

- Traffic control as specified in Section 4.5;
- Temporary bypass pumping as specified in Section 4.6;
- Cleaning prior to rehabilitation as specified in Section 4.7;
- The camera shall be positioned to reduce the risk of picture distortion and the lens shall be positioned to look along the axis of the pipe. Set the camera so that axis is as close to centreline of pipe as possible;
- Provide a 360-degree view of the pipe interior when moving forward;
- Keep camera lens clean and clear. If material or debris obscures image and reduces visibility, clean or replace lens prior to proceeding with inspection;
- Camera lens may submerge only while passing through clearly-identifiable line sags (or vertical misalignments);
- Lighting intensity shall be remote controlled and shall be adjusted to minimize reflective glare. Lighting and camera quality shall provide a clear, in-focus image of the inside periphery of the main;
- The system of cabling employed to transport the camera and transmit its signal shall not obstruct the camera's view;
- Pipe defects according to the reference code standards shall be recorded, in addition to any location determined not to be clean or liner defects (including, but not limited to, bumps, folds, tears, dimples, etc.);
- Loss of colour or severe red or green colour will be cause for rejection of inspection.
- Loss of vertical hold will constitute a cause for rejection;
- The CCTV shall be run opposite to flow direction to ensure full view of any branch/HSL joining-in at an acute angle. The CCTV survey shall give a clear view of each internal junctions and house service connections looking along the axis of the lateral;
- The camera and illumination system shall provide a clear, accurate and in-focus record of the conduits internal condition, in colour;
- Distance measurement for conduit inspection, in all instances, shall commence from the face of the manhole;
- Steam and fog shall not be a reason for abandonment of survey. The line has to be ventilated in the case of steam/fog in the line or the lens cleaned in the case of steam/fog on the lens. In each case the survey must be re-started at the Contractor's expense;
- **Always** record pipe identification by upstream manhole first and downstream manhole second, including reverse setups. If report format has starting and ending manhole, always use upstream and downstream manhole instead of starting and ending manhole. Any inspection report that does not provide the manholes in this order will be rejected;
- Line segments shall be televised complete from structure to structure in a continuous run. Image stream must clearly show the camera starting and ending at the upstream and downstream structures, unless a defect(s) does not allow it, in this case use WinCan's

abandoned/return survey function and record the remainder of the line from the opposite manhole back toward where the survey was started;

- Pipe defects shall be recorded, in addition to any location determined not to be clean, part of a proper liner installation, or liner defects (including, but not limited to, bumps, folds, tears, dimples, etc.);
- Project **Hold Point** is required after initial post internal inspection while Superintendent reviews inspection submittal and approves in order to proceed to connection work and post connection sealing internal inspection. Flow bypassing shall be maintained until acceptance of initial post internal inspection submittal by Superintendent;
- Inspection Rate:
    - Maximum rate of travel shall be 10 meters per minute when recording. The camera shall be stopped for a minimum of 5 seconds at each pipe defect when panning.
- Opening Screen Data:
    - At the start of each manhole length, the following additional information shall be electronically generated and displayed:
        - Date of Inspection;
        - Conduit identification number;
        - Start manhole number reference number to finish manhole number;
        - Time of start of inspection;
        - Conduit dimension (mm) (use a measuring device to verify diameter);
        - Liner type; and
        - Plan number.
        - Council will provide a WinCan database to use for inspection purposes.
    - Contractor is to notify the Superintendent immediately if they identify problems with the use of the database for the inspection coding.
- Recording:
    - CCTV recordings shall be supplied by the Contractor.
    - The site Coding Sheets shall be imputed by the Contractor onto an electronic data file using the WinCan software.
    - Recordings shall be in a MPEG-1 format directly recorded to a USB hard drive linked through WinCan Version 8.0 or above through a Microsoft Access Project file and a Rehabilitation Report for each manhole to manhole section.
    - The recording shall be a continuous record with no breaks or jumps in the picture.
    - A data generator shall electronically generate and clearly display on the video recording, a continuous record of data in alpha-numeric form, containing the following minimum information:
        - Automatic update of the cameras position (metres) within the conduit;
        - Conduit dimensions;
        - Manhole/node reference numbers;
        - Defects observed;
        - Depth of manhole invert; and
        - Locations of all house service junctions.
    - The size and position of the data display shall not interfere with the main subject of the picture.
- Inspection Records:
    - All CCTV recordings, photographs, rehabilitation reports (WinCan report in USB hard drive) and Contractor's recommended rehabilitation method (irrespective of the

rehabilitation method proposed in the contract document) shall be submitted to the Superintendent prior to the commencement of any rehabilitation work.

- The USB hard drive provided by the Contractor shall be retained by the Superintendent. However, depending on the memory capacity of the USB hard drive, the Superintendent may return the USB hard drive to the Contractor for future reuse, recommendations and submissions. Contractor must maintain a copy of all information for the project and shall not delete data without approval from the Superintendent.
- All CCTV recordings are required to be documented in sequence with the work carried out in WinCan Version 8 or above through a Microsoft Access Project file.
- Submittals must be accompanied by a hard copy summary of pipe segments being submitted and an indication as to whether the submittal is a new submittal or a revised submittal. Hard copy must indicate the following information:
  - Project title and number;
  - Dates of inspection (from and to);
  - List of pipe segments on the submittal with indication as to whether this is first submittal or revised submittal.
- All photographs shall be clearly marked with the upstream and downstream manhole numbers, direction of survey, chainage, conduit dimensions, defects observed, date and time.
- Digitised photographs are required for the following internal conditions:
  - Condition of conduits after cleaning and prior to full or patch lining;
  - Conditions that might affect the proposed renewal (photographs may be required to demonstrate such cases);
  - Cut-outs of junctions;
  - Post renewal conduit condition;
  - Provide whenever defect is encountered that interrupts completion of inspection (i.e., collapsed pipe, deformed pipe, severe offset joints, heavy debris or roots); and
  - Provide typed label on front of photograph with upstream and downstream identification numbers, footage (if not visible on photograph), and defect type.
- Look-ahead Schedules: Prepare at least one (1) week in advance, identifying areas to be investigated during coming week. Schedules shall include upstream and downstream structure numbers, street locations, pipe size, pipe length, and dates.

- Post Installation CCTV Inspection:
  - Following completion of lining (full or patch) installation, the Contractor shall provide a visual inspection of the internal condition of the lined conduit using CCTV inspection.
  - Post installation CCTV inspection of the relined line shall be carried out 72 hours after the junction reinstatement work carried out on the last junction for that length of sewer. This is to allow sufficient time to stabilise changes in ground water conditions accompanied by the relining work.
  - CCTV recording shall clearly show the lining ends in the access chamber or in the sewer to show the end have been cut and sealed properly and also should show the access chamber rehabilitation work if any work have been performed to the downstream and/or upstream access chambers.
  - All rehabilitated post CCTV shall be recorded in the subsequent layers on the pre CCTV database directly recorded to hard drive of the Wincan data base.

- The hard drive shall be given to the Superintendent in a logical sequence consistent with the work completed to date. The Principal retains full ownership of the physical and intellectual rights to the hard drive and its contents.
-

- Drawing Corrections:
  - Inventories or maps shall be corrected to reflect actual field conditions and corrections shall be provided as part of the weekly submittal.
  - Verify pipe material, diameter and surface lengths between manholes when the pipe length varies 10% (+/-) from the length shown on the drawings or in the inventories provided.
- Quality Assurance:
  - The Superintendent will review inspection data to ensure compliance with the requirements listed of the Contract Documents. If, in the opinion of the Superintendent, the inspection is not acceptable, reinspection will be required by the Contractor at no additional cost to the Council.
  - The Contractor shall be responsible for modifications to his equipment and/or inspection procedures to achieve acceptable quality of the inspection work.

4.9 Manhole Adjustment and Alterations

4.9.1 General

It shall be the responsibility of the Contractor to carry out any manhole adjustments needed to install the liner. Council cannot guarantee the thickness of the manhole concrete bases or surrounds. Council shall not allow the use of jack hammer inside a manhole nor will allow removing concrete below the invert of the manhole channel. Any damage to the manhole benching, bases or any other consequential damage resulting out of the Contractor's work inside the manhole shall be repaired by the Contractor at no cost to Council.

4.9.2 Products

For repair to manhole channels and bases the Contractor will be required to use concrete of a ready mixed type (plant mix) complying with AS1379 Ready Mixed Concrete, from an approved supplier. The specification for this concrete is to be:

- Sydney Water Specification – PS-358 SW.

All concrete in contact within sewage is to be smooth, impervious and have a pock free surface (see Render Section 4.9.3). In addition, the Superintendent will need to be satisfied that bonding of existing concrete to newly-laid concrete is adequate.

4.9.3 Execution

- Render:
  - Where required by the Superintendent, the concrete surface is to be rendered with low heat sulphate resistant cement mortar, 13 mm thick, laid in two coats. Before being rendered, the concrete surface is to be thoroughly wetted and prepared (scrabbled where directed). The first layer shall be well pressed on and scoured to receive the second layer. The second layer shall be evenly and neatly trowelled up.
- Finished surface shall be pock free. That is, it shall be smooth, free from any lumps, bumps or hollows.

4.10 Excavation and Repair of Pipework and House Service Junction

Council will not accept any non-standard junction not reinstated in the Contract or any defective or leaking junctions in the work and shall withhold all payments associated with the line having the defective junction until the defective non-standard junction is corrected by the Contractor.

4.10.1 General

Excavation and repair of pipework and house service junctions or collapsed/broken sections of main shall be repaired prior to lining installation. Contractor is to identify all such locations requiring excavation and repair and submit to Superintendent for approval prior to start of work. Each replacement or repair shall be for a minimum pipe repair length of 1200 mm of collapsed or broken pipe or a standard junction.

4.10.2 Products

The pipes, junctions and/or any other fitting used for replacement or repair shall be polyvinyl chloride (PVC) of the same type and class or equivalent to that of the existing main that is being replaced unless approved otherwise by Superintendent.

All materials used for this work shall conform to manufacturer's recommendations and pertinent AS/NZS, latest edition.

Approved geotextiles for siltation control. Contractor to provide submittal for Superintendent approval.

4.10.3 Execution

- Procedure:
    - The Superintendent instructs the Contractor to carry out the repair based on the information provided by the Contractor using per-installation CCTV inspection data.
    - The Contractor shall be responsible for all activities associated with the repair work which shall include, but is not limited to, the following:
        - Locate precisely (Contractor may use electronic device to locate) on the ground surface the location of the defect to be repaired;
        - Access through excavation using acceptable trench safety methods;
        - Provide siltation control with placement of star pickets at a maximum of 2 metre centres, caps at the top of approved geotextile fabric;
        - Supply all labour and materials to make the repair, complete in place;
        - Removal and disposal of broken pipe or HSC junctions, silt, roots, or debris collected in the main. Dispose at approved sites;
        - Align and join to existing pipe. Adequate care must be taken to maintain the alignment and slope of the adjacent pipes are not disturbed;
        - Store suitable on-site excavation material for use when backfilling;
        - Provide select on-site bedding and backfill. If on-site bedding and backfill is not suitable, provide imported bedding and backfill approved by the Superintendent. All backfilling shall be installed in 200 mm thick layers and compacted to original condition;
        - The Contractor shall ensure a safe working site;
        - The Contractor shall minimise disturbance to the surrounding environment and services during the Work; and
        - Restore site and all services to pre-existing condition or better.
    - Finish:

- The repair of the main sections or HSC junctions shall be free of any defects (i.e. foreign inclusions, bulges, cracks, defects in alignment/slope, or any other defects), which may affect the performance or life of the repaired/replaced section.
- The repaired section shall not leak;
- All jointing material or similar shall be kept out of the pipes; and
- All disturbed services and line connections shall be reinstated so that the services continue to perform as before. The site should be restored to pre-existing condition, or better.

- If an excavation for rehabilitation work has to be performed close to a tree, then the Contractor shall not commence excavation work before completing the following:
  - Consult/employ a Tree Arborist for advise; or
  - Advise Superintendent a minimum of 48 hours prior to the commencement of work with necessary details such as CCTV/photographs of the line and location.
- Access to Dead Ends and Lamp holes:
  - Access to dead ends and lamp holes will include excavating and exposing the required dead ends or lamp holes. The excavation shall be restricted to minimum trench width and depth necessary to achieve access.
- Photographs:
  - Photographs shall be taken at four stages and submitted to the Superintendent within 48 hours of taking the photographs, and include:
    1. Ground surface before any work is started;
    2. On exposing the pipe(s) to be repaired or replaced or dead ends, clearly showing the type and extent of the defects;
    3. On completion of the repair or exposed pipe showing the entire repaired/replaced section or dead end after restoration; and
    4. Ground surface on completion of surface restoration.

4.11 Installation of Main Lining and Patch Lining Systems

4.11.1 General

The Contractor will be required to provide the design and supply all labour, materials, plant and equipment necessary to line the sections of mains identified. All work is to be carried out in a tradesman like manner using best quality material. No lining of any type shall be carried out by the Contractor without approval from the Superintendent.

The scope of works shall include (but not be limited to) the inspection of sewer mains, cleaning of sewer mains, inspection of mains by closed circuit television, location of services, design of lining material, lining of sewer mains, remote cutting and de-rooting of service connections, sealing of joint between liners at service connections.

4.11.2 Technical References

This section contains references to the following standards. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements affording the greatest protection to the Council shall apply, as determined by the Superintendent.

Table 14 Reference Standards

Reference	Title
AS2566.1	Buried Flexible Pipelines
ASTM D570	Standard Test Method for Water Absorption of Plastics
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D695	Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D1042	Standard Test Method for Linear Dimensional Changes of Plastics Under Accelerated Service Conditions
ASTM F1216-09	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by The Inversion and Curing of a Resin-Impregnated Tube
ASTM F1743	Standard Practice for Rehabilitation of Existing Pipelines by Pulled-in-place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)
ASTM F2304	Standard Practices for Rehabilitation of Sewers Using Chemical Grouting
ASTM D2990	Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
ASTM D3574	Standard Test Methods for Flexible Cellular Materials—Slab, Bonded, and Moulded Urethane Foams
SS 201	Linings for Circular Non Man-Entry Pipes, Sydney Water

4.11.3 Submittals

- Liner:
  - Detailed short and long-term properties (including all supporting third-party test data) of all component materials;
  - Structural calculations for each liner, including size and recommended thicknesses;
  - Liner property test data;
  - Liner end seal and connection sealing materials, methods and equipment;
  - Recommendations for material storage and temperature control;
  - Manufacturer's recommended handling, installation, curing, trimming, finishing, and QA/QC procedures for all applications, including resin manufacturer's heating requirements;
  - Detailed method for addressing sampling requirements including location and size of each sample, method of removal, method of liner repair, and chain of custody;
  - Chemical Safety Plan: A safety plan for all hazardous chemicals used or expected to be onsite including resin, catalyst, cleaners and repair agents;
  - Written warranties; and

  - Within two weeks of delivery to the project site, certification from liner manufacturer stating liner has been manufactured in accordance with ASTM F1216 and/or ASTM F1743 and product is suitable for its intended use.
- Gap filler materials and application methods; and
- HSC lateral liner material technical specifications.

4.11.4 Warranty Period

The Contractor shall also provide a two-year written warranty from the liner manufacturer for the entire liner system, including all repair material, defect fillers, primers, and the liner composite.

Liner failure is defined as blistering, excessive wrinkling, cracking, embrittlement, delaminating, or softening.

4.11.5 Products / Material

- The lining shall be composed of a material recognised as suitable for use in the manufacture of sewerage and stormwater pipe. It shall be chemically and biologically resistant to internal exposure to sewage, sewage related gases and mild concentrations of industrial effluent for the service life of the lining.
- The lining shall be comprised of materials that are not be subject to excessive shrinkage, thermal contraction, recovery or reversion affecting the shape or dimensions of the lining following installation. The minimum expected service life of the liner is to be 50 years. The proposed lining and junction sealing system shall meet all of the critical performance criteria and be capable of withstanding without any damage periodic jet cleaning of sewer.
- Chemical resistance shall include:
  - 20% Sulphuric acid
  - 5% Sodium hydroxide
  - 5% Ammonium hydroxide
  - 1% Nitric acid
  - 1% Ferric chloride
  - 1% Sodium hypochlorite
  - 0.1% Soap
  - 0.1% Detergent (linear alkyl benzyl sulfonate)
  - Bacteriological (BOD @ 700 ppm or greater)
- The method of testing shall be in accordance with the current version (September 2009) of “A Guide to the Pickle Jar Test” developed by the Bureau of Engineering, City of Los Angeles, USA.
- The lining shall also be resistant to external exposure to soil bacteria and any chemical attack which may be due to residues remaining on the pipe wall or materials in the surrounding ground.
- If requested by the Principal, technical data confirming the chemical resistance of the lining material shall be forwarded by the Contractor.
- The lining shall be comprised of materials which will not be subject to excessive shrinkage, thermal contraction, recovery or reversion affecting the shape or dimensions on the lining following installation. Residual stresses shall be released during installation process.
- The lining material shall have satisfactory abrasion resistance to the migration of silt, sand and debris along the pipe. It shall be sufficiently robust not to be damaged by pipe cleaning equipment or cleaning process which may be required to remove any future blockage (debris, roots, etc.) following installation of the lining. The Contractor shall provide evidence that the liner will not be damaged as a result of normal cleaning and jetting process throughout its design life.
- The rehabilitation system offered shall be such that all materials shall be chemically resistant to withstand exposure to hydrogen sulphide, carbon monoxide, carbon dioxide, methane, traces of mercaptans, kerosene, saturation with moisture, dilute sulphuric acid, external exposure to

soil bacteria and any chemical attack which may be due to residues remaining on the pipe wall or materials in the surrounding ground.

- The finished lining shall be continuous over the Manhole to Manhole length and shall be free from defects such as foreign inclusions, dry spots, bubbles, pinholes, cracks and delamination. The lining shall be free of any leakage from the pipe to the surrounding ground or from the ground to the inside of the lined pipe. The inner surface shall be free of cracks and crazing and any other defects likely to affect the satisfactory operation of the conduit.

4.11.6 Execution

- Traffic control as specified in Section 4.5.
- Temporary bypass pumping as specified in Section 4.6.
- Cleaning prior to rehabilitation as specified in Section 4.7.
- CCTV inspection as specified in Section 4.8.
- Where a manhole has to be altered by the Contractor to allow lining to take place, it shall be reinstated to the satisfaction of the Superintendent.
- The Contractor shall be responsible for maintenance of services to households during lining operations. The rehabilitation of each line shall be completed within the one shift, with a continuous service being available to the resident. This may require provision of service line pump outs.
- Lining requirements are for pipelines only, no manholes are included in the project.
- Sections of the existing host pipe that have shifted, dropped, or severely deteriorated, shall be ground down, grouted, or otherwise repaired to provide a smooth continuous surface for the liner installation that will not reduce the cross-sectional area of the interior of the relined pipe or reduce wall thickness to less than the minimum specified thickness. Contractor shall clear existing main of obstructions such as solids or collapsed pipe that will prevent the liner installation using spot repairs, or replace sections of pipe, as authorized by the Superintendent.
- The Contractor shall be responsible for control of all material and process variables to provide a finished liner possessing the minimum properties specified in ASTM F1216 and ASTM F1743 and required herein.
- Storage and Delivery:
    - The Contractor shall be responsible for the delivery, storage and handling of all materials for the liner, pre-lining, and connection liners in accordance with the written requirements of the manufacturer; and
    - Contractor shall exercise adequate care during transportation, handling and installation to ensure the material is not torn, cut, or otherwise damaged.
- If any part or parts of the material becomes torn, cut or otherwise damaged before or during installation, it shall be repaired or replaced in accordance with the manufacturer's recommendations before proceeding further and at no additional cost to the Council.
- The Contractor shall provide a delivery manifest for each liner with the following information:
    - Inversion manholes for either end of the installation;
    - Inversion location where the liner will be installed;
    - Contractor-assigned installation number; and
    - Liner diameter, length, and thickness.
- To minimise risk of surcharge in HSC laterals, the length of main allowed to be lined on any given day shall be limited to a length that can be properly installed including being giving the manufacturers specified amount of curing and cool down time prior to and including cutting to reconnect laterals and drop junctions. This time is to allow for movements cause by shrinkage,

thermal contraction, stress recovery, or adjustment in mechanical properties during curing. Contractor shall notify Superintendent prior to 48 hours of any line that cannot be completed in a regular day or night shift that will require overtime so that an inspector may be scheduled.

- All liners shall be sealed at the manhole around the outside of the liner for a minimum length of 300 mm from the manhole and rendered with Max Plug. If the lining system does not result in the resin of the lining system coming in direct contact with the main the use of polyurethane filler for a minimum length of 300 mm from the manhole is required.
- The transition between the liner and the channel in the manhole base shall be rendered smooth (Max Plug) to prevent siltation of the main.
- On completion of the lining and prior to junction restorations (cut-outs) the liner shall be pressure tested in accordance with *WSA 02: 2014-3.1 Gravity Sewerage Code of Australia (Regional New South Wales Edition)*.
- A satisfactory test shall meet the acceptance times for 7 kPa pressure change as set out in Table 22.4 of the WSA Code.
- The Contractor's post cleaning CCTV report and recommendations for the reinstatement must clearly identify the number of junctions to be de-rooted in a given length of main.
- Installation Procedures:
    - The Contractor shall clean the sewer prior to lining. Junctions at the property branch lines and in the sewer shall be cleared of roots, debris, silt etc. Positions of house service lines shall be logged. CCTV inspection shall be used to confirm that the pipe is sufficiently clean to receive the liner.
    - Where an access chamber has to be altered by the Contractor to allow lining to take place, it shall be reinstated to the satisfaction of the Superintendent.
    - The Contractor shall be responsible for maintenance of services to householders during the lining operation.
    - Before proceeding with the liner installation the Contractor must have flow bypass/diversion in place to the satisfaction of the Superintendent. No spilling of any sewage in any situation will be acceptable and the Contractor shall be held responsible and accountable to the Environment Protection Authority (EPA) The Contractor shall be responsible for the cost of all clean up and associated activities that may be required by the EPA, to rectify the effects of the spillage and for any fines that may be imposed as a result of any spillage.
    - The lining shall be installed in a continuous operation. To minimise risk of surcharge in householders' sewers, the length of sewer main allowed to be lined on any given day shall be limited to a length that can be properly installed including being giving the manufacturers specified amount of curing and cool down time prior to and including cutting to reconnect laterals and drop junctions. This time is to allow for movements cause by shrinkage, thermal contraction, stress recovery, or adjustment in mechanical properties during curing.
    - All liners shall be sealed at the access chamber around the outside of the liner for a minimum length of 300mm from the access chamber and rendered with Max Plug. If the lining system does not result in the resin of the lining system coming in direct contact with the main the use of a polyurethane filler for a minimum length of 300mm from the access chamber is required.
    - The transition between the liner and the channel in the access chamber base shall be rendered smooth (Max Plug) to prevent siltation of the sewer.

- The Contractor is solely responsible for the details of the execution and suitability of methods and procedures used to satisfy the particular conditions of the project.
- On completion of the lining and prior to junction reinstatement the liner shall be pressure tested in accordance with *WSA 02: 2014-3.1 Gravity Sewerage Code of Australia (Regional New South Wales Edition)*:
- A satisfactory test shall meet the acceptance times for 7kpa pressure change as set out in table 22.4 of the WSA Code.

- Service Lateral Connection Liner:
  - After the restoration (cut-outs) of the HSCs, existing connections shall be reinstated (relined), see Sections 4.12 and 4.13.
- Finished Liner:
  - The finished liner shall be continuous over the entire length of a manhole-to-manhole section of pipe.
  - Unacceptable defects in the liner shall be repaired at the direction of the Superintendent. Methods of repair shall be proposed by the Contractor and submitted to the Superintendent for approval.
  - Wrinkles in the finished liner that reduce the structural stability of the pipe are unacceptable. Contractor shall repair or replace that section of the pipe at no additional cost to the Council.
  - If a void between the wrinkle and the existing pipe wall exists, the Contractor shall repair or replace that section of the pipe at no additional cost to the Council.
  - Defects such as foreign inclusions, dry spots, lifts, pinholes, delamination, and wrinkling beyond the specification allowances affecting the integrity or strength of the liner, as determined by the Superintendent, or as adversely affecting the hydraulic capacity of the pipe, shall be repaired or replaced. Contractor shall repair or replace that section of the pipe at no additional cost to the Council.
- Acceptance Testing:
  - Contractor shall submit Sampling and Testing Plan to the Superintendent that provides quality control and acceptance of installed liners. The plan shall contain the following information:
    - Chain of Custody procedures.
    - Sampling Frequency: How many samples in how many installations. As a minimum 2.5% of the relined mains (manhole to manhole) must have a test sample taken. The relined mains to be tested shall be selected by the Superintendent.
    - Flat plate sample shall be large enough to provide five sample specimens each for Short Term Flexural (Bending) properties, as per ASTM D790.
    - Sample identification by: Date, Project Name, Location, Size, Thickness, Resin and Catalyst.
  - Contractor shall provide liner test results to the Superintendent within 4 weeks after sample is removed from the installation.
- Clean-up:
  - Following inspection, the Contractor shall clean up the entire project area. All excess material and debris, not incorporated into the permanent installation, shall be disposed off-site by the Contractor at an approved site.

4.12 Internal Restoration of House Service Connections

4.12.1 General

This section covers the requirement to internally restore all house service connections after lining the main. The Contractor shall reinstate all house service connections at the junction with the main.

4.12.2 Products

Use equipment approved by the lining manufacturer.

4.12.3 Execution

- Do not cut house service connection restorations until main liner is fully cured.
- The cutting tool shall leave a smooth, bevelled edge free of any protrusions.
- Care should be taken to reinstate house service connections and not damage the remaining main liner. Damage to liner/junction during the reinstatement process shall be repaired at no cost to Council.
- House service connections shall be reinstated to be fully opened to the limits of the existing connection.
- Do not overcut house service connection.
- Clean large shards of cured liner from the inside surface of the pipe.

4.13 Lining of House Service Connection Lateral

4.13.1 General

Chemical grout for junction reinstatement shall not be acceptable.

Besides the standard slope junction, vitrified clay junctions of different configurations termed as " non-standard junction" (Riley slope junction, Square junction on its side or back, Drop junction Type 1 or Type 2 or junctions which have been cut into the main) can be expected throughout the work.

4.13.2 Products

The junction lining carried out by the Contractor shall be free of defects such as dry spots, bubbles, folds, inadequate seal causing annulus flow on the main, constriction to cause blockage etc. Upon observation of the post CCTV submitted by the Contractor if any of the defects are noticed, the Contractor shall remove the defective seal and replace with a new seal at no cost to council.

House service connection lateral liners shall be compatible with main lining system and recommended by the main lining system manufacturer.

4.13.3 Execution

- The proposed junction reinstatement method shall seal the gap between the liner and the host pipe along the main to prevent annular space flow into the main.
- Sufficient time shall be allowed for any movement of the installed lining relative to the host pipe before finishing the cut outs. This shall include movements caused by shrinkage, thermal contraction, stress recovery, or adjustment in mechanical properties during curing.
- Installation of 2 or more layers of junction re-instatement system required to prevent annular flow at the junction cut out that does not meet Specification shall not be acceptable.
- If a non-standard junction/defective junction could not be sealed by the reinstatement method proposed by the Contractor during the course of the work, The Contractor shall replace the non-standard junction/defective junction by open trench excavation. The Contractor shall then reinstate the replaced junction by the Contractor's proposed method of reinstatement. All

additional costs (cost of excavation, shoring, dewatering, site restoration, flow by-pass, pumping, etc.) incurred by the Contractor to replace the non-standard junction/defective junction and the cost of re-instatement of the replaced junction shall be borne by the Contractor.

4.13.3.1 External Water Pressures

Note that the sections of main under consideration may be subject to external water pressure resulting from fluctuations in the water table.

Should any problems be detected such as leaking junction, defects in the liner, defective junction seal on this inspection the Contractor shall be required to repair the defects.

4.14 Installation of Main Grouting System

The Packer used for grouting shall not be less than 650 mm in length.

4.15 Testing of HSC Junction Reinstatement

The Contractor shall submit a proposal to test sealed junctions (hydrostatic or otherwise). Council requires that some junctions sealed under the contract shall be subjected to test as per the details submitted by the Contractor.

4.16 Defects

The finished lining shall be free of all defects that affect hydraulic performance or structural adequacy. This shall include defects arising from substandard materials, faulty or inaccurate manufacture, inadequate pipe preparation, faulty installation or workmanship, or inadequate curing.

Defects, which are unacceptable in all liners, include, but are not limited to the following:

- under strength finished materials;
- foreign inclusions;
- irregularity in lining caused by inadequate pipe preparation;
- leakage through the lining;
- inadequate material curing;
- inadequate resin impregnation;
- excessive resin loss during installation;
- dry spots, bubbles, cracks or delaminations;
- pinholes;
- leakage through welded, glued or mechanical locked joints;
- poor quality cut outs;
- inadequate seals at access chambers or laterals;
- bulges;
- longitudinal or circumferential wrinkling;
- excessive reduction in cross sectional area; and
- longitudinal or circumferential shrinkage.

The following will be considered as unacceptable defects if they exceed the limits given in brackets below:

- inadequate lining thickness (finished thickness < 90% of nominal lining thickness);

- excessive variation in thickness around the circumference of the lining (variation in minimum or maximum thickness > 20% of mean lining thickness);
- excessive longitudinal or circumferential variation in dimensions after completion of the cut-outs at access chambers or junctions (variation > 1mm in every 2m or 0.05% measured 14 days after installation); and
- excessive longitudinal wrinkling of the lining in straight, non-defective portions of the host pipe (wrinkling > 2.5% of the nominal diameter of pipe).

4.17 Additional Relining Work as Executed Records Requirements

Work as executed records, including drawings shall be developed and presented to the Superintendent in the same format as the detail sheets.

The following information shall be provided in each detail sheet for all main lengths:

1. Manhole length measured between centre to centre of manholes;
2. Location & Junction status of all live, dead or additional junctions - location to be measured from the downstream manhole;
3. Start and finish location of patch liner measured from the downstream manhole; and
4. Main material and diameter.

4.18 Completion of Defect Liability Period

On completion of the defect liability period, inspection of the works completed under this contract shall be carried out by Shoalhaven City Council.

Should any problems be detected such as leaking junction, defects in the liner, defective junction seal on this inspection the Contractor shall be required to repair the defects before the release of any remaining undertakings.