



**DUBBO
REGIONAL
COUNCIL**

TECHNICAL SCHEDULE

DRC-W106

CONSTRUCTION OF SEWAGE PUMP STATIONS

TECHNICAL SCHEDULE DRC-W106 – CONSTRUCTION OF SEWAGE PUMP STATIONS

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DRC-W106: CONSTRUCTION OF SEWAGE PUMP STATIONS

GENERAL

DRC-W106.1 SCOPE

This Specification applies to the construction of Sewage Pump Stations up to and including 200L/s after being designed in accordance with the Principal's design standards and specifications. This Specification is applicable to contracts:

- a) That require construction only; with materials supplied by the Principal.
- b) That require the supply of materials and construction of the works by the Contractor.
- c) That are either Schedule of Rates or Lump Sum payment contracts.

The work required to be performed under this Contract shall comply with the referenced documents in Clause DRC-W106.2, unless specified otherwise herein.

DRC-W106.2 REFERENCED DOCUMENTS

The following documents are referred to in this Specification. The latest version of the document including any published amendments shall apply. Where the drawings or a project specific specification are in conflict or inconsistent with these referenced documents or this Specification, then the details on the Drawings or project specific specification shall apply.

Australian Standards

AS 681	Elastomeric seals – material requirements for pipe joint seals used in water and drainage applications.
AS 1100	Technical drawing.
AS 1102	Graphical symbols for electrotechnical documentation.
AS 1111	ISO metric hexagon commercial bolts and screws.
AS 1112	ISO metric hexagon nuts.
AS 1237	Plain washers for metric bolts, screws and nuts for general purposes.
AS 1260	PVC-U pipes and fittings for drain, waste and vent application.
AS 1289	Methods of testing soils for engineering purposes.
AS 1379	Specification and supply of concrete.
AS 1579	Arc-welded steel pipes and fittings for water and waste-water.
AS 1627	Metal finishing.
AS 1646	Rubber joint rings for water supply, sewerage and drainage purposes.
AS 1741	Vitrified clay pipes and fittings with flexible joints – sewer quality.
AS 2032	Code of Practice for installation of UPVC pipe systems.
AS 2280	Ductile iron pressure pipe and fittings.
AS 2566	Buried flexible pipelines.
AS 2638	Cast iron sluice valves for waterworks purposes.
AS 2758	Aggregates and rock for engineering purposes.
AS 3571	Plastic piping systems – Glass-reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP resin) – pressure and non-pressure drainage and sewerage.

AS 3600	Concrete structures.
AS 3610	Formwork for concrete.
AS 3680	Polythene sleeving for ductile iron pipes.
AS 3681	Application of polyethylene for ductile iron piping.
AS 3879	Solvent cements and priming fluids for PVC (PVC-U and PVC-M) and ABS and ASA pipes and fittings.
AS 3996	Access covers and grates.
AS 4087	Metallic flanges for waterworks purposes.
AS 4130	Polyethylene (PE) pipes for pressure applications.
AS 4198	Precast concrete access chambers for sewerage applications.
AS 4158	Thermal-bonded polymeric coatings on valves and fittings for water industry purposes.
AS 4321	Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings.
AS 4680	Hot dip galvanised (zinc) coatings on fabricated ferrous articles.
AS 4671	Steel reinforcing materials.
AS 4791	Hot-dip galvanized (zinc) coatings on ferrous open sections, applied by an in-line process.
AS 4792	Hot-dip galvanized (zinc) coatings on ferrous hollow sections, applied by a continuous or a specialised process.
AS 4794	Non-return valves – swing check and tilting disc.
AS 4956	Air valves for water supply.
AS 5065	Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications.
AS 6401	Knife gate valves for waterworks purposes.

Works shall also comply with the current versions all other relevant Australian Standards where not specifically listed above.

Water Services Association of Australia Standards

WSA01	Polyethylene Pipeline Code.
WSA02	Gravity Sewerage Code of Australia.
WSA04	Sewage Pumping Station Code of Australia.
N/A	Water Services Association of Australia (WSAA) Product Specifications.
WSA 101	Submersible pumps for sewerage pumping stations.
WSA 113	Industry Standard for Reinforced Concrete Pipes with Flexible Thermoplastic Linings.
WSA 114	Concrete Special Class.
WSA 121	Biofilters for Odour Control.
WSA 132	Access Covers for Water Supply and Sewerage.
WSA 133	Lightweight Macro-Composite Access Covers and Frames.
WSA 137	Maintenance Shafts and Maintenance Chambers for Sewerage.

International Standards

EN 295	Vitrified clay pipe systems for drains and sewers. Requirements for pipes, fittings and joints.
ISO 10467	Plastics piping systems for pressure and non-pressure drainage and sewerage – glass reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin.
ATSM C990M-09	Standard specification for joints for concrete pipe, manholes and precast box sections using preformed flexible joint sealants (metric).

DRC-W106.3 STANDARDS

Construction of the Work Under Contract shall be undertaken in accordance with WSA04-2005 Sewage Pumping Station Code of Australia, Part 3: Construction.

MATERIALS

DRC-W106.4 DELIVERY, TRANSPORTATION, HANDLING AND STORAGE OF MATERIALS

Materials used shall be as specified by the Drawings or Project Specification.

Delivery, transportation, handling and storage of all products and materials shall be undertaken in accordance with the manufacturer's recommendations and clause 20.5 and 20.7 of WSA04-2005.

All pipe, fittings, pumpsets, mechanical equipment and other associated mechanical equipment shall be suitable for the Contact with untreated sewage.

DRC-W106.5 PUMPSETS

Pumpsets shall be of the type, model and have performance and meet the required duty as specified on the drawings. Submersible pumpsets shall be compliant with WSAA Product Specification WSA PS-400 and WSAA Specification WSA 101.

Pumpsets shall be supplied with all pump stools, cabling, guiderails, supports and chains. All guiderails, supports and chains shall be stainless steel grade 316.

DRC-W106.6 POLYVINYLCHLORIDE (PVC) PIPE – NON-PRESSURE

PVC pipes and fittings for non-pressure applications shall be compliant with WSAA Product Specification WSA PS-230 and shall be:

- Unplasticised PVC (PVC-U) pipes for non-pressure applications.
- Manufactured in accordance with AS 1260.
- Minimum stiffness class SN8 for DN150 mm and above.
- Minimum stiffness class SN10 for DN100 mm.
- Either rubber ring jointed complying with AS 1646 or solvent cement jointed complying with AS 3879.
- Installed in accordance with AS 2032.

DRC-W106.7 VITRIFIED CLAY (VC) PIPE AND FITTINGS – NON-PRESSURE

VC pipes and fittings for non-pressure applications shall be compliant with WSAA Product Specification WSA PS-231 and shall be:

- Manufactured in accordance with EN 295 or AS 1741.
- Minimum crushing strength of 34 kN/m for DN150 mm.
- Minimum class 160 for DN200 - 250 mm.
- Minimum class 120 for DN300 mm.
- Rubber ring jointed complying with AS 1646 with root inhibiting compound.

DRC-W106.8 POLYPROPYLENE (PP) PIPE AND FITTINGS – NON-PRESSURE

PP pipes and fittings shall be compliant with WSAA Product Specification WSA PS-240 and shall be:

- Manufactured in accordance with AS 5065.
- Minimum stiffness SN10.
- Rubber ring jointed complying with AS 1646.

DRC-W106.9 POLYETHYLENE (PE) PIPE AND FITTINGS – NON-PRESSURE

PE pipes and fittings shall be compliant with WSAA Product Specifications WSA PS-207 and WSA PS-208 and shall be:

- Manufactured in accordance with AS 4130.
- Minimum pipe Standard Dimension Ratio (SDR) of 17.
- Coloured solid black for gravity sewerage.
- Electrofusion or butt welded jointed.

DRC-W106.10 GLASS REINFORCED PLASTIC (GRP) PIPE – NON-PRESSURE

GRP pipes shall be compliant with WSAA Product Specifications WSA PS-205S or WSA PS-237S and shall be:

- Manufactured in accordance with AS 3571 or ISO 10467.
- Minimum stiffness of SN10,000.
- Rubber ring jointed with approved couplings.

Where GRP pipes are to be installed, using trenchless installation methods, pipes shall be compliance with WSAA Product Specification WSA-PS205J. Pipes shall have a minimum stiffness class as required to withstand the design jacking load as calculated by the Contractor.

DRC-W106.11 DUCTILE IRON PIPE AND FITTINGS - PRESSURE

Ductile iron pipes shall be compliant with WSAA Product Specification WSA PS-200. Ductile iron fittings shall be compliant with WSAA Product Specification WSA PS-201 or WSA PS-212. Ductile iron epoxy lined (DIEL) pipes and fittings shall be:

- Manufactured in accordance with AS 2280.
- Minimum pressure class PN35 (alternatively flange class may be used).
- Rubber ring or flanged jointed.
- Internally coated in accordance with AS 4158.
- Externally coated with a bituminous or synthetic resin coating to AS 2280.
- Externally wrapped in a loose-sleeved polyethylene complying with WSAA Product Specification PS-320, AS 3680 and AS 3681.

DRC-W106.12 POLYETHYLENE (PE) PIPE AND FITTINGS - PRESSURE

PE pipes and fittings shall be compliant with WSAA Product Specifications WSA PS-207, WSA PS-208 and WSA PS-215 and shall be:

- Manufactured in accordance with AS 4130.
- Minimum pressure class PN10.
- Coloured black with white stripes for sewage.
- Electrofusion or butt welded jointed.
- Installed with detectable marker tape to assist with future pipe location.

DRC-W106.13 STAINLESS STEEL PIPEWORK – PRESSURE

Stainless steel (SS) pipes and fittings shall be compliant with WSAA Product Specifications WSA PS-203 and WSA-204 as applicable and shall be:

- Grade 316 unless noted otherwise on the drawings.
- Fabricated in the factory. In general site welding will not be permitted. Restricted site welding may be allowed at the discretion of the Superintendent.

- A minimum pipe wall thickness as per Schedule 10 of ANSI/ASME B36.10 Welded and Seamless Wrought Steel Pipe.

DRC-W106.14 MILD STEEL PIPES AND FITTINGS - PRESSURE

Mild Steel Epoxy Lined (MSEL) pipes and fittings shall be compliant with WSAA Product Specifications WSA PS-203 and WSA-204 and shall be:

- Manufactured in accordance with AS 1579.
- Externally coated with a fusion bonded medium density polyethylene coating system in accordance with AS 4321.
- Internally coated in accordance with AS 4158
- Minimum wall thickness of 5 mm for pipes 300 mm diameter and smaller.
- Minimum wall thickness of 6 mm for pipes larger than 300 mm and all mitre bends and pipe specials.

DRC-W106.15 STOP VALVES

Stop valves shall be resilient seated sluice valves compliant with WSAA Product Specification WSA PS-261 and shall be:

- Manufactured in accordance with AS 2638.
- Minimum pressure class PN16.
- Suitable for buried service.
- Provided with external and internal fusion bonded epoxy coating in accordance with AS 4158.
- Clockwise closing.
- Provided with an extension spindle compliant with WSAA Product Specification WSA PS-269 where required so that the valve can be operated by a key at a depth not exceeding 300 mm from the ground surface.
- Provided with a handwheel where installed within a pit or above ground.

DRC-W106.16 KNIFE GATE VALVES

Knife gate valves shall be in compliance with WSAA Product Specification WSA PS-266 and shall be:

- Manufactured in accordance with AS 6401.
- Stainless steel grade 316.
- Lugged type.
- Minimum pressure rating PN10.
- Clockwise closing.
- Non-rising stem.

DRC-W106.17 AIR VALVES

Air valves shall be in compliance with WSAA Product Specification WSA PS-275 and shall be:

- Dual acting air valves.
- Manufactured in accordance with AS 4956.
- Suitable for use with sewage.
- Installed with an isolation valve.
- Minimum diameter DN80 mm.

DRC-W106.18 NON-RETURN VALVES

Non-return valves shall be compliant with WSAA Product Specification WSA PS-264 and shall be:

- Manufactured in accordance with AS 4794.
- Minimum pressure class PN10.
- Full bodied swing check type.
- Provided with external and internal coating in accordance with AS 4158.

DRC-W106.19 MECHANICAL JOINTS

Mechanical joints such as gibault joints and dismantling joints shall have a minimum pressure class of PN16 and shall comply with the WSAA Product Specification WSA PS-270 or WSA PS-271 as applicable.

DRC-W106.20 FLANGES

All flanges shall be a minimum pressure class of PN16 and comply with AS 4087, unless noted otherwise on the drawings or as necessary to match existing flanges.

DRC-W106.21 FASTENERS

All bolts, nuts and washers shall be stainless steel grade 316. Hexagon bolts shall comply with AS 1111, hexagon nuts shall comply with AS 1112 and washers shall comply with AS 1237.

DRC-W106.22 GASKETS

Elastomeric gaskets for rubber ring jointed pipes and flanges shall be compliant with WSAA Product Specification WSA PS-312 and AS 1646. Gaskets shall be supplied in bags and not supplied directly fitted to the ends of pipes. Gaskets shall be stored in accordance with the manufacturer's recommendations in bags with protection from UV radiation and shall be suitable for outdoor storage for up to two years.

DRC-W106.23 METALWORK

Structural steelwork, ladders, brackets, covers and other metalwork shall be blast cleaned for AS 1627 Class 3 and hot dip galvanised to AS 4680, AS 4791 or AS 4792 as applicable where not in contact with sewage. Where located in contact with sewage metalwork shall be stainless steel grade 316.

DRC-W106.24 ACCESS COVERS

Ductile Iron access covers and frames where specified shall be compliant with WSAA Product Specification WSA PS-290 and WSAA Specification WSA 132. These shall be manufactured in accordance with AS 3996 and shall be greased using an approved sealing grease on all metal to metal seals after installation.

Macro-composite access covers and frames where specified shall be compliant to WSAA Product Specification WSA PS-292 and WSA 133.

Aluminium access covers where specified shall be in accordance with the details provided on the drawings. Aluminium covers shall have sufficient strength and stiffness for pedestrian loading (not traffic) and shall be protected from incurring traffic loading. Aluminium covers shall be lockable and designed to be safely opened by one person.

All access covers shall be gas and water tight and shall be of the size and class as specified on the drawings. Unless noted otherwise, all access covers shall have stainless steel or FRP safety grate underneath for fall protection.

DRC-W106.25 STEP IRONS AND LADDERS

Where specified, step irons shall comply with WSAA Product Specification WSA PS-314 and shall be either plastic encapsulated or stainless steel grade 316.

Where specified, fixed ladders shall comply with WSAA Product Specification WSA PS-315 and shall be either stainless steel grade 316 or fibre reinforced plastic.

DRC-W106.26 MAINTENANCE HOLES

All maintenance holes shall be cast in-situ unless specified as pre-cast being permitted on the drawings. Where pre-cast concrete maintenance holes are permitted they shall be compliant with WSAA Product Specification WSA PS-323 and shall be:

- Manufactured in accordance with AS 4198.
- Cement type SR with minimum cement content of 450 kg/m³.
- Concrete characteristic strength of 50 MPa.
- Aggregate durability exposure condition C as per AS 2758 clause 9.
- Provided with minimum cover to reinforcement of 40 mm internally and 25 mm externally, except at joint ends where a minimum cover of 20 mm shall be provided.
- Provided with two lifting inserts on each component, each having a safe-lift rating of at least 1 tonne.
- Either EPDM elastomeric joint sealed in accordance with AS 1646, AS 681 or butyl rubber joint sealed in accordance with ASTM C990M-09.

DRC-W106.27 CONCRETE

Concrete shall be compliant with WSAA Product Specification WSA PS-357 for normal class and shall comply with AS 1379. Where 'Special Class' concrete is specified, this shall be compliant with WSAA Product Specification WSA PS-358 and WSA 114.

Reinforcement shall be compliant with AS 4671.

DRC-W106.28 TRENCH FILL MATERIAL

Trench fill in trafficable areas shall be 20 mm crushed rock in accordance with Transport for NSW (TfNSW) standard specifications for DGS20.

Trench fill in non-trafficable areas may be select excavated or imported material and shall be free of vegetation, organic matter, debris, and rocks with a dimension not greater than 75 mm in any direction. Select material shall be capable of compaction, without excessive effort, to a mean value of density ratio (R_D) of not less than 95%.

DRC-W106.29 EMBEDMENT MATERIAL

Fine crushed rock embedment shall be compliant with WSAA Product Specification WSA PS-359.

Compaction sand embedment shall be Grade A and be compliant with WSAA Product Specification WSA PS-350.

DRC-W106.30 MAINTENANCE HOLES

All maintenance holes shall be cast in-situ, unless specified as pre-cast being permitted on the drawings. Where pre-cast concrete maintenance holes are permitted they shall be compliant with WSAA Product Specification WSA PS-323 and shall be:

- Manufactured in accordance with AS 4198.
- Cement type SR with minimum cement content of 450 kg/m³.
- Concrete characteristic strength of 50 MPa.
- Aggregate durability exposure condition C as per AS 2758 clause 9.
- Provided with minimum cover to reinforcement of 40 mm internally and 25 mm externally, except at joint ends where a minimum cover of 20 mm shall be provided.
- Provided with two lifting inserts on each component, each having a safe-lift rating of at least 1 tonne.
- Either EPDM elastomeric joint sealed in accordance with AS 1646, AS 681 or butyl rubber joint sealed in accordance with ASTM C990M-09.

DRC-W106.31 EPOXY COATING

Epoxy coating shall be of the type and installed at the locations specified on the drawings and or/Project Specification. Epoxy coating shall be installed in accordance with the manufacturers recommendations and requirements including preparation of concrete surfaces and application of all necessary primers/undercoats and coatings.

EARTHWORKS**DRC-W106.32 EXCAVATION**

All excavations for structures and pipes shall be to the lines, grades and forms shown on the drawings or directed by the Superintendent within the specified tolerances. Excavation shall be undertaken in accordance with Clause 28 of WSA04-2005.

For trenches, minimum trench width for pipes shall be in accordance with the Drawings and AS 2566. Where a trench is excavated across a paved surface, the trench width shall be kept to a minimum and bitumen and concrete surfaces saw cut in a neat straight line.

Spoil shall not be placed within 1000 mm from the zone of influence at the edge of any excavation. Excavated materials shall not be placed against the walls of any building or fence without the written permission of the owner of such building or fence. Topsoil from excavations shall be kept separate and utilised to make good the surface after backfilling.

The Contractor shall adequately support all excavations as the works proceed. When withdrawing supports, the Contractor shall exercise every precaution against slips or falls by means of intermediate shoring, planking or props. Backfilling shall be performed simultaneously with the withdrawal of supports.

Where the bottom of an excavation is soft or considered to provide an unacceptable foundation, the Contractor shall seek instruction from the Superintendent and then undertake foundation stabilisation in accordance with Clause 28.8 of WSA04-2005.

At the completion of each work day, excavations should be preferably filled. Any excavations left open shall be suitably secured and left safe for the public and others in the vicinity of the site. As a minimum open excavations shall be secured with security fencing or steel road plates.

The Contractor shall undertake erosion and sediment control at the site in accordance with Technical Schedule SW-101 General Construction.

DRC-W106.33 ROCK EXCAVATION

Unless noted otherwise, the Contract Sum is deemed to include excavation in any material including excavation in rock. Any delay due to the presence of rock shall be at the Contractor's expense and the Contractor shall not be entitled to any extension of time due to such delay.

Definition of Rock

Where rock excavation is stated to not be included in the Contract Sum, rock shall be defined as solid bedrock material than can only be efficiently excavated using a rock hammer attached to an excavator as determined by the Superintendent. Boulders and rippable material are not deemed to be considered rock and deemed to be included in the Contract Sum.

Measurement for payment of rock excavation, where provided for in the Contract, shall be measured based on the minimum trench width required. If the Contractor believes it has encountered rock, the Contractor shall notify the Superintendent within four hours. The Superintendent shall then inspect the material and determine whether the material is considered to be rock.

DRC-W106.34 BACKFILL

Backfilling shall be undertaken in accordance with WSA04-2005 Clause 33.

Backfill shall be placed and compacted in even layers on either side of structures to avoid differential loading. Backfill containing boulders, large rocks, logs, stumps, tree loppings, builders refuse, broken concrete and other like material is expressly forbidden.

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

Unless specified otherwise, backfill material/trench fill in trafficable areas shall be 20 mm crushed rock as per Clause DRC-W106.28. Fill material shall be placed and compacted in layers not exceeding 200 mm loose thickness, and shall be moisture conditioned as required to facilitate compaction to the required density. The minimum dry density ratio (AS 1289.5.4.1) as measured using the Modified Compaction test (AS1289.5.2.1) for trafficable areas shall be 95% except for the top 100 mm under existing roads which shall be 98%. In the event that the road owner has trench fill requirements which exceed the above, the road owner's requirement shall take precedence and apply.

Unless specified otherwise, backfill material/trench fill in non-trafficable areas may be select excavated or imported material complying with Clause DRC-W106.28. The Contractor shall establish the optimum loose layer thickness to achieve the required compaction, however this shall not exceed 300 mm. The minimum dry density ratio of non-trafficable trench fill shall be 90% except for the top 600 mm of the trench which shall be 95%. Where the works are located in areas with cohesionless soils (eg sand or silty sands) and using cohesionless trench fill then trench fill in non-trafficable areas shall achieve a Density Index (AS 1289.5.6.1 relative density of 60% or PSP/DCP penetration resistance of seven blows per 300 mm.

CONCRETE WORKS

DRC-W106.35 BEDDING FOR STRUCTURES AND PIPES

Bedding for structures and pipes shall be provided in accordance with Clause 29 of WSA04-2005 where required.

DRC-W106.36 WET-WELLS

Wet-wells shall be constructed in accordance with WSA 04-2005 clause 31.

The Contractor shall coat the internal surface of the wet-well with an approved epoxy, unless specified otherwise on the drawings.

DRC-W106.37 MAINTENANCE HOLES

Maintenance holes shall be constructed in accordance with WSA 04-2005 clause 31.

The Contractor shall coat the internal surface of the rising main discharge maintenance hole and any other maintenance holes specified on the drawings, with an approved epoxy.

DRC-W106.38 CONCRETE - GENERAL

Concrete works including delivery, formwork, reinforcement and placement shall be undertaken in accordance with Clause 20.10 of WSA04-2005.

DRC-W106.39 CONCRETE DELIVERY

The concrete for every part of the WUC shall be supplied as ready-mixed concrete supplied in accordance with AS 1379, except where modified by the Project Specification or drawings. Delivery of ready-mixed concrete in non-agitating trucks will not be permitted.

Each truck of ready-mixed concrete shall be accompanied by a docket bearing the following information:

- The specific part of the WUC for which the concrete was ordered and is intended.
- The quantity of concrete contained.
- The time of dispatch.
- The type of concrete supplied, including details of:
 - Type of cement
 - Slump
 - Maximum aggregate size
 - Concrete characteristic strength $f'c$
 - Admixtures used.

The Contractor shall retain these docket as a record of the ready-mixed concrete delivered, and this information shall be provided to the Superintendent on request.

Under no circumstances will hand mixed concrete be permitted.

Concrete shall not be placed when the site ambient temperature exceeds 30°C or is forecasted to exceed 30°C during the day the concrete is to be placed. Under no circumstances shall the concrete be supplied at a temperature less than 5°C.

DRC-W106.40 CONCRETE PLACEMENT

Placement of concrete in each section shall be in one continuous operation, or until an authorised construction joint is reached. Concrete shall not be dropped freely from a height exceeding 1200 mm except where obstructions prevent and in such cases pour to the approval of the Superintendent and in such a way as to prevent segregation and to ensure an unbroken stream of concrete.

Concrete shall be placed between construction joints as shown on the design drawings. Maximum pour lengths shall be 14 m for base and wall pours.

Preparation of concreting shall be such that all operations can be carried out without damaging or displacing reinforcement or formwork. Ensure surfaces against which concrete is to be placed are clean, moist (if absorbent), free from laitance and other coatings and free of weak or loose material. In hot weather, cool non-absorptive surfaces by watering and remove excess.

Concrete shall be placed in maximum 300 mm layers such that each succeeding layer is blended into the preceding one by the compaction process. No layer shall be tapered off, but shall be stopped against tight forms to produce square ends and shall be so moulded by inset formwork that the construction joint will finish approximately square to all exterior surfaces.

DRC-W106.41 CONCRETE COMPACTION

The Contractor shall use immersion and screed vibrators accompanied by hand methods as appropriate and form vibrators where use of immersed vibrators is impracticable. Concrete shall be fully compacted and entrapped air removed. Vibrators shall not be permitted to come into contact with partially hardened concrete, or reinforcement embedded in it. Vibrators shall not be used to move concrete along the forms. Insert at points maximum 500 mm apart. The Contractor shall provide the Superintendent with details of proposed methods of compaction.

The total compacting capacity in cubic metres of concrete per hour of all vibrators in effective operating condition and employed in concrete compaction works, shall be based on a rated capacity of 80% of the manufacturer's recommendation for each type of vibrator in operation, and the total compacting capacity so computed shall be not less than the maximum rate at which concrete is placed. Vibrators shall be capable of transmitting vibrations to the concrete at frequencies between 6,000 and 12,000 impulses per minute and shall visibly affect the concrete at a radius of 300 mm. Hold in reserve at least one vibrator in working order with one extra for each four vibrators in use. Avoid over-vibration. Do not allow vibrators to remain in any one position for more than 20 seconds.

DRC-W106.42 CONCRETE TESTING

The Contractor shall arrange for concrete sampling and testing, including transportation of cylinders. For concrete supply of over 1 m³, a minimum of two cylinders shall be taken. A Slump Test shall also be carried out at the time that the cylinders are taken.

Sampling and testing shall be in accordance with relevant Australian Standards, using NATA certified tests. The cost for all these works shall be borne by the Contractor.

DRC-W106.43 CONCRETE FINISHING

The Contractor shall ensure that tolerance requirements for formwork are in accordance with the specification.

All formwork shall be designed, constructed and stripped in accordance with AS 3610.

All formed surfaces, except where permanently concealed by backfill material, shall have a minimum surface finish of Class 2 in accordance with AS 3610.

All formed finishes that are permanently concealed by backfill material shall have a minimum surface finish of Class 3 in accordance with AS 3610.

All unformed surfaces shall comply with AS 3600. All unformed surfaces except roofs and footpaths shall have steel trowel or power float finish generally free of trowel marks. The finished concrete surfaces shall be true to the planes with tolerances not exceeding 6 mm in 3 m and abrupt edge/s not exceeding 2 mm anywhere on the surface. All other surfaces shall be wood float finished to the same tolerances as above. All edges and re-entrant corners shall be provided with 20 mm chamfers or fillets.

DRC-W106.44 CONCRETE CURING

Freshly cast concrete shall be protected from premature drying and excessively hot or cold temperatures. In windy conditions, windbreaks shall be erected to shield the concrete surfaces during and after placement. The concrete shall be maintained at a reasonable constant temperature with minimum moisture loss for the curing period. The curing method shall be as specified in the Project Specification or as otherwise approved by the Superintendent.

DRC-W106.45 COREHOLES, EMBEDDED SERVICES AND FIXINGS

The provision of coreholes and embedments shall be in accordance with the requirements of Section 14 of AS 3600, except as specified otherwise.

The Contractor shall verify location and sizes shown on concrete drawings and submit details of departures to the Superintendent. The Contractor shall provide sufficient notice to the Superintendent (not less than 24 hours) to enable inspection of the holes and fixings.

Holes for services and other purposes shall be blocked out and sleeves, bolts and other attachments required securely fixed in position before concrete is placed.

All inserts, anchor bolts and embedded fixings shall be grade 316 stainless steel unless otherwise indicated on the drawings. No embedded pipe or fixing shall be aluminium. Set holding down bolts accurately to the positions and levels shown on the drawings or required by the components to be installed and rigidly held in position by attachment to suitable templates while concrete is being poured. Reinforcement shall not be cut to provide space for embedded items or displace it without approval.

Where pipes are to pass through concrete, and in the opinion of the Superintendent, watertightness or load bearing capacity is not of prime importance the Contractor shall leave a hole in the wall large enough to allow the pipe fitting flange to pass through but not more than 50 mm larger than the flange. After the pipe fitting has been aligned correctly to match its connecting pipework the Contractor shall caulk the space around the pipe with dry pack mortar or S40 concrete and finish by stoning or otherwise to match the adjoining concrete.

Where pipes or other fittings are to pass through water retaining concrete, or in the opinion of the Superintendent, require to be securely fixed because of structural loading the Contractor shall fix the pipes or fittings through the formwork and cast them into the structure when placing the concrete. All paint and loose surface material shall be removed from such pipes and fittings over the surface to be embedded by wire brushing or other approved means. Unless otherwise specified or shown on the drawings tolerances shall be ± 10 mm.

Cutting or drilling holes in concrete and the attachment or insertion of fittings after the concrete has set unless required by the Specification or drawings shall only be carried out with the approval of the Superintendent.

Drilled anchor type fixings and fixings by explosive tools shall only be used if approved by the Superintendent.

DRC-W106.46 CONSTRUCTION JOINTS

Construction joints shall be to AS 3600, Clause 19.4.1 and provided at the locations as specified or as shown on the drawings.

Before fresh concrete is placed against hardened concrete at construction joints, the joint surface of the hardened concrete shall be thoroughly roughened by mechanical or wet cut means and cleaned so that all loose or soft material, all foreign matter, and all laitance are removed. Immediately ahead of concrete placement, the joint surfaces shall be dampened and shall not be allowed to dry out before placing the fresh concrete.

If the desired locations of construction joints are not specified or shown on the drawings, the Contractor shall submit to the Superintendent at least one week before commencing the placement of concrete in a section of the WUC the proposed locations of construction joints.

In general construction joints shall be perpendicular to the main reinforcement. Construction joints in cantilever slabs are not permitted. All construction joints in new concrete shall be formed either on horizontal or vertical planes unless otherwise shown on the drawings.

Before fresh concrete is placed at a construction joint, roughen and clean the hardened concrete surface of the joint, so that all loose or soft material, foreign matter and laitance is removed to expose clean coarse aggregate. Just prior to placement, dampen the hardened concrete surface, without leaving free water.

Unless otherwise specified, butt join the surfaces of adjoining pours. Surfaces/edges that remain visible, to AS 3610, physical quality requirements, Class 2.

In order to minimise shrinkage effects of the concrete, the drawings and this Technical Schedule require certain minimum periods to elapse between adjacent pours of concrete at joints. These periods shall not be varied without the approval of the Superintendent. Where time periods between pours are not indicated in the contract documents the Contractor shall submit their requirements in this regard to the Superintendent for examination and approval.

The time delay between concrete pours abutting vertical construction joints in walls shall not be less than three days. The time delay between concrete pours abutting horizontal construction joints in walls shall not be less than three days. The time delay between "pour strip" concrete and adjoining concrete shall not be less than 45 days.

PIPEWORK

DRC-W106.47 GRAVITY SEWERS

The construction of gravity sewers shall be undertaken in accordance with either of the following Technical Schedules as relevant to the WUC:

- SW-104 Construction of Gravity Reticulation Sewers; or
- SW-105 Construction of Gravity Trunk Sewers.

DRC-W106.48 SEWAGE RISING MAINS

The construction of sewage rising mains and pressure pipework shall be undertaken in accordance with Technical Schedule DCC-W107 Construction of Sewage Rising Mains.

DRC-W106.49 POTABLE WATER

The construction of potable water works for the Sewage Pump Station shall be undertaken in accordance with Technical Schedule SW-102 Construction of Water Reticulation and AS 3500 as applicable.

DRC-W106.50 MISCELLANEOUS PIPEWORK

Miscellaneous pipework such as vent pipework and conduits shall be constructed as detailed on the drawings and in accordance with the relevant Standards.

Unless specified otherwise on the drawings or relevant standards, the minimum depth of cover over pipes, measured vertically from the finished surface level to the top of any pipe, flange or socket shall be as follows:

- 450 mm in non-trafficable locations in residential areas (eg nature strips).
- 600 mm in non-trafficable locations in industrial areas (eg nature strips).
- 600 mm under sealed roadways and footpaths.
- 750 mm under major roadways or embankments.

METALWORK

DRC-W106.51 METALWORK GENERAL

Metalwork shall be undertaken in accordance with the relevant Australian Standards and Clause 25 of WSA04-2005.

The Contractor shall use metals so that they transmit the loads imposed and ensure the rigidity of the assembly without causing deflection or distortion of finished surfaces.

Incompatible metals shall be separated using concealed layers of suitable materials in appropriate thicknesses. Fasteners shall be used so that they transmit the loads and without causing galvanic corrosion.

For copper and copper alloys only copper or copper-alloy fixing devices shall be used. For aluminium and aluminium alloys only aluminium alloy or non-magnetic stainless steel fixing devices shall be used. For stainless steel only appropriate stainless steel materials shall be used.

The Contractor shall fabricate and pre-assemble items in the workshop wherever practicable.

Edges and surfaces shall be kept clean, neat and free from burrs and indentations. Sharp edges shall be removed without excessive radiusing. Joints shall be accurately fitted to a fine hairline. Bends shall be formed in tube without visibly deforming the cross section.

For colour finished work, colours of sheets, extrusions and heads of fasteners shall be matched.

Thermal movement shall be accommodated for in joints and fastenings.

SITE WORK

DRC-W106.52 ACCESS ROADS AND HARDSTAND AREAS

Access roads and hardstand areas shall be constructed in accordance with the drawings and Clause 26 of WSA04-2005 along with any other applicable Standards.

DRC-W106.53 RETAINING WALLS

Where retaining walls are required, these shall be constructed in accordance with the drawings and Clause 27 of WSA04-2005 for timber cantilever and concrete crib wall type retaining walls.

DRC-W106.54 FENCING

Where specified, site fencing shall be provided in accordance with the Drawings.

DRC-W106.55 RESTORATION

Pavements, lawns and other improved areas shall be cleaned and left in the same order as they were at the commencement of the works. Restoration shall be undertaken in accordance with WSA04-2005 Clause 35 which outlines the requirements for pavements, lawns, grassed areas and bushland.

All restored surfaces shall be maintained in the condition to which they are restored until the expiry of the Defects Liability Period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the Defects Liability Period.

Surplus material shall be removed and disposed of to areas arranged by the Contractor. Any tipping or disposal fees shall be paid by the Contractor, and are deemed to be included in the Contract Sum.

In locations where, in the opinion of the Superintendent, surplus material left in the vicinity of the WUC would not be objectionable, the surplus material may be disposed of by spreading neatly in the vicinity of the WUC to the satisfaction of the Superintendent in such a way as to minimise future erosion of the backfill and adjacent ground surfaces.

Any subsequent settlement of fill material after construction shall be made good by the Contractor, as required, by placing additional fill.

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

MECHANICAL INSTALLATION**DRC-W106.56 GENERAL**

Mechanical installation of pumps, valves and fittings shall be undertaken in accordance with the drawings, Project Specification and Clause 24 of WSA04-2005.

ELECTRICAL AND TELEMETRY WORKS

DRC-W106.57 SCOPE

The scope of the electrical and telemetry works shall be as detailed throughout the project documentation including Drawings and Specification. Unless specified otherwise, this shall include the furnishing of all labour, materials, equipment and services for the design, documentation, manufacture, supply, installation, programming, configuration, testing, commissioning and hand-over of the complete and operable electrical, control, instrumentation, PLC, telemetry and SCADA systems.

DRC-W106.58 ELECTRICAL GENERAL

The Contractor shall carry out the electrical works in accordance with the requirements of:

- Project Specification and Drawings (where applicable).
- Clause 21 of WSA04-2005.
- Wiring Rules AS/NZS 3000.
- Service Rules of the Supply Authority.
- All relevant Statutory Authorities.
- The Principal.

DRC-W106.59 TELEMETRY GENERAL

The Contractor shall carry out the telemetry works in accordance with the requirements of:

- Project Specification and Drawings (where applicable).
- Clause 22 of WSA04-2005.
- Wiring Rules AS/NZS 3000.
- Service Rules of the Supply Authority.
- All relevant Statutory Authorities.
- The Principal.

DRC-W106.60 SCADA SYSTEMS

The WUC shall be integrated into the Principal's existing SCADA systems by the Contractor to provide supervisory control and monitoring of the new works as specified, in accordance with the Principal's SCADA standards and to provide the overall plant performance functionality specified.

The SCADA systems shall be arranged for remote operation from the Principal's remote SCADA workstations.

The Contractor shall engage one of the Principal's approved SCADA Contractors to undertake the configuration and programming of the SCADA systems.

Upgrading of the Principal's SCADA package licence shall be undertaken separately by the Principal unless specified otherwise. The Contractor shall submit draft display layouts for approval prior to commencement of programming and configuration of the displays.

It shall be possible for operators to inhibit some of the specified alarms if required.

SCADA trending of all analogue inputs shall be provided.

All flow signals shall be totalised with monthly and yearly totals recorded on SCADA.

DRC-W106.61 CONTRACTOR'S DRAWINGS AND DATA

Drawings and Data

Drawings and data to be submitted by the Contractor, and its sub-contractors, shall include the following:

- Certified Design drawings and information.
- Manufacturing drawings.
- Emergency generator drawings and data (where applicable).
- Detailed 'As-Executed' drawings and documents.

All drawings shall be prepared generally in accordance with the recommendations of AS 1100 or AS 1102 as appropriate. Unless otherwise specified, symbols and abbreviations shown on drawings supplied by the Contractor shall be:

- As shown on the Contract Drawings supplied by the Principal.
- In accordance with the referenced standards.

All drawings submitted by the Contractor shall be prepared using AutoCAD release 2013 and electronic copies shall be provided in PDF and DWG format.

The format, content and layout of the drawings shall be similar and at least equivalent to those included in the Contract documents. The Contractor's drawing sheets shall be of a similar layout to the Principal's drawing sheets and shall use drawing numbers allocated by the Principal.

Within seven days of the Letter of Acceptance, the Contractor shall prepare and submit a schedule of drawings it intends to prepare for the whole of the WUC.

Acceptance by the Superintendent of any drawings or descriptive materials, shall not relieve the Contractor of his responsibility for any errors therein or his responsibility to complete the WUC in accordance with the Contract. Such acceptance shall be considered to mean only that the Superintendent has no objection to the Contractor using, upon his own full responsibility, the plan or method of work proposed, or furnishing the materials and equipment proposed.

Certified Design Drawings and Certified Design Information

The Contractor shall submit design drawings and information certified to an acceptable standard as being an accurate description of the plant or equipment supplied under the Contract.

The Contractor shall submit the following documentation prior to the Contractor commencing any related work associated with procurement, construction or manufacture:

- Detailed single line diagrams of all power supply systems.
- Circuit diagrams of each item of equipment and system supplied under the Contract. These shall include updating of the Contract Drawings with additional details including addition of model/part numbers, terminal numbers, wire numbers and the like.
- PLC drawings including input/output circuit diagrams and rack layout drawings.
- PLC interface circuit drawings.
- Instrumentation loop drawings.
- Alarm listings.
- Functional specification and data table layout of PLC systems.
- Detailed arrangement drawings of the cubicle/cabinets and panels showing general arrangement, major dimensions, masses, locations of terminal boxes, and all service connections.
- Shop drawings for the switchgear including material lists, general arrangements, front views, assembly drawings, foundation plans, circuit diagrams and wiring and connection diagrams. Overall dimensions, minimum clearances and door swings shall be shown for all equipment.
- Detailed listing, catalogue information and technical data for all electrical equipment, items and devices to be provided by the Contractor.
- Arrangement of floor and foundation openings and other foundation details required for panels and cubicles/cabinets.
- Detailed arrangement drawings of all other items of equipment supplied by the Contractor under the Contract.
- A Schedule of labels for equipment and devices.
- Proposed testing and commissioning procedure, and list of specified test equipment.

Manufacturing Drawings

During the Contract, the Contractor shall submit drawings of the various items of equipment to be supplied by the Contractor. These drawings shall include those used for manufacturer, such as all design and shop drawings.

The Contractor shall submit for approval, shop drawings of the switchgear, control cubicle/cabinets and panels showing:

- The general arrangement including detailed layout of all equipment and connections.
- Structural and enclosing elements including sheet metal and sealing details.
- Type and rating of equipment items.
- Terminal block layouts and identification.

Work As-Executed Drawings and PLC and SCADA Programs

The Contractor shall maintain an up-to-date 'Work As-Executed' record of the WUC during manufacture and installation and comply with section DRC-W106.70. Copies of the marked up drawings and programs shall be provided in the switchboard and control panel at each site at all times.

Details included on Work As-Executed Drawings shall include the addition of model/part numbers, terminal numbers, wire numbers and the like.

Work As-Executed Drawings PLC and SCADA programs shall be provided to Principal in the formats (including electronic format) previously specified and shall include all drawings and documentation prepared as part of this Contract.

The latest revision of the 'as installed PLC program' shall be provided as both a paper copy and a full listing (with descriptors) as an electronic copy. These shall include the complete program and documentation listings with address and rung comments and symbols.

ACCEPTANCE TESTING AND COMMISSIONING

DRC-W106.62 COMPACTION TESTING

Compaction testing shall be carried out in accordance with WSA04-2005 Clause 36.3 unless required otherwise by the road owner or modified otherwise by the Superintendent.

DRC-W106.63 PRESSURE PIPEWORK TESTING

All pressure pipelines greater than 20 m in length shall be hydrostatically pressure tested in accordance with Technical Schedule SW-102 Construction of Water Reticulation.

DRC-W106.64 GRAVITY SEWER AND MAINTENANCE HOLE TESTING

All gravity sewers and maintenance holes shall be air pressure and/or vacuum tested, deflection tested (flexible pipes) and CCTV inspected in accordance with Technical Schedule SW-105 Construction of Gravity Reticulation Sewers or SW-105 Construction of Gravity Trunk Sewers as applicable.

DRC-W106.65 WET-WELL AND EMERGENCY STORAGE TANK TESTING

The Contractor shall hydrostatically test the concrete SPS wet-well and emergency storage tank prior to application of coatings. Prior to testing of the concrete water retaining structure all stop gates required for that structure shall be installed. All pipework penetrations shall be in place and may be blanked off if the pipeline is not completed.

Tests shall be undertaken in accordance with AS 3735 and is not limited to the following components:

- Fill the structure to the level directed by the Superintendent, which shall be no less than the design top water level shown on the drawings;
- Check any valves/penstocks for leakage. If any leakage is noticeable, the Contractor may either undertake repair works to seal the penstock or temporarily seal the area with sandbags or the like to allow testing of the water retaining structure to continue and repair the leak following the test;
- Once the structure is full, allow the water to sit in the concrete for a period of seven days to allow for any water take-up;
- Fix a cylindrical bucket in the tank to be tested by suspending the bucket in the structure. Fill the bucket approximately 3/4 full and set the bucket such that the water level in the bucket is slightly higher than in the structure. Fix a ruler to the inside of the bucket and record the water level in the bucket at 24 hour intervals for seven days; and,
- At the end of the seven day test period, provide the results to the Superintendent for approval.

The Contractor shall rectify the WUC if the leakage is either visually evident or greater than the rate described in AS 3735.

DRC-W106.66 ELECTRICAL WORKS ACCEPTANCE TESTING

Electrical and control works shall be tested and commissioned in accordance with any Project Specification and WSA 04-2005 Section 36.9.

DRC-W106.67 ODOUR CONTROL SYSTEM TESTING

Following commissioning of the SPS, the odour control system shall be tested in accordance with WSA 04-2005 Section 37.3.

DRC-W106.68 CONNECTION TO EXISTING SEWERS

The Principal shall determine whether connections to existing live sewers may be undertaken by the Contractor or undertaken by the Principal. This determination will take into account the work involved in making the connection, impact on customers and impact on operation of the live water asset.

For connection works to be undertaken by the Principal, the Principal will not schedule the work until pre-payment of the full quoted cost has been made. Once payment has been made, the Principal will undertake the connection work. The Principal shall be given 10 clear working days' notice after payment of the quoted charge, of such connections being requested by the Contractor. The Principal may require longer notice in cases where the pipes are greater than DN150 in size.

Connection to existing sewers shall comply with WSA02-2014 Clause 34 unless otherwise agreed with the Water Agency.

DRC-W106.69 OPERATIONS AND MAINTENANCE MANUAL

The Contractor shall submit an Operation and Maintenance (O&M) manual and shall contain instructions for handling, installation, operation, and maintenance of the WUC.

The spine and front cover of each O&M manual shall be printed and contain the contract number, contract name and type of equipment. The O&M manual shall contain identification of the supplier's name and, as applicable, names, addresses and phone numbers of sub-suppliers, nearest material, equipment and parts suppliers and service organisations.

Not less than three weeks prior to final commissioning, the Contractor shall supply comprehensive instruction manuals suitable for the detailed training and guidance of personnel in the installation, operation and maintenance of the equipment supplied under this Contract.

Two bound copies of each manual shall be submitted for approval and three bound final copies shall be provided.

All manuals shall be in the English language and shall be specific to the equipment being provided. The Manuals shall include, but not be limited to:

- Literature, data sheets, etc required for operation and maintenance of the equipment;
- Data shall be functionally complete for all equipment and systems;
- Data shall include drawings, diagrams (including wiring diagrams), pictures or actual photographs, when they add to the understanding and clarity of the text, as necessary to describe the equipment provided;
- Precautions and warnings relative to personal safety and the protection of the equipment shall be included where applicable;
- A detailed manual for each item of equipment provided under the Contract;
- A detailed manual for each type of PLC module and instrument;
- Recordings of the settings and configuration of all electronic devices, such as soft starters and instruments;
- Commercial information (brochures, catalogues, etc) for many items of equipment shall be utilized under the following conditions:
 - Details of all calibrated equipment settings and test sheets; and
 - Operating and maintenance instructions.

DRC-W106.70 WORK AS-EXECUTED DETAILS

The Contractor shall prepare a set of Work As-Executed drawings that contain a similar level of detail to the design drawings. The drawings should be clearly marked "As-Executed" with the relevant date and revision number. The Work As-Executed drawings are required to show the all as-built information including coordinates (eastings and northings) of connection points, changes of direction or gradient, invert levels etc, even though the design drawings may not, in all instances, contain this information.

The location of all underground services, cables and conduits shall be accurately recorded on the approved for construction drawings during the course of the WUC.

Work As-Executed drawings shall be submitted by the Contractor to the Superintendent in both PDF and Autocad DWG format. Drawings shall be prepared to the Map Grid of Australia (MGA) coordinate system.

If, during the Defects Liability Period, the Contractor modifies any of the works, the modifications shall be included in amendments to the 'As-Executed' drawings and documentation.

DRC-W106.71 COMMISSIONING

Commissioning of the WUC shall be carried out in accordance with WSA04-2005 Clause 21, any project specification and any instruction from the Superintendent.

The Contractor shall test and/or inspect all materials, equipment, installation and workmanship included in the WUC to prove compliance with the specification requirements. Testing shall include pre-commissioning, field testing and performance testing of each part of the whole installation.

Tests and inspections shall comply with current relevant Australian Standards and WSA04-2005.

The Contractor shall prepare a Commissioning Plan and program and submit this to the Superintendent for approval at least four weeks prior to the commencement of commissioning.

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

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

Handover is when the system is accepted by the Water Agency as fit-for-purpose and subsequently put into operation by the Water Agency. It is also when all documentation is completed and supplied to the Water Agency by the contractor and when all system defects are closed out.

The Contractor shall prepare and use pre-commissioning and commissioning record sheets and/or checklists. At the completion of each phase, these shall be signed by both the Contractor and Superintendent or nominated representative who witnessed the test/s and then be submitted to the Superintendent.