Specification

Technical Specification - Renewal of Dry Well Sewage Pumping Stations

Table of Contents

Revision details

Version No.	Clause	Description of revision
2	Whole document	Format update, general update, references updated.
	3.1.2, 3.2, 3.2.1.1, 3.2.1.2, 3.2.1.3, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.1.6, 4.1.8, 4.1.9, 4.1.10, 4.1.11, 4.1.14, 4.2, 4.3.2, 4.3.3, 4.3.4, 4.3.5, 4.3.6, 4.3.7, 4.3.8, 4.4.1, 4.4.2, 4.4.3, 4.5, 4.6, 4.7, 5.2, 5.3, 6.1, 6.2, 6.3, 7.1, 7.2, 7.3, 7.4, 7.5, 8.1, 8.2, 8.3, 9., 11.2, 11.3, 11.5, 11.7, 11.8, 11.9.3, 11.9.4, 11.9.5, 11.10.2, 11.10.3, 11.11, 11.12, 12.2, 12.3.1	Amended.
	5.1, 6.1	Deleted. Subsequent clauses re-numbered.
	4.3.7, 4.3.9, 4.9, 7.7, 8.3, 11.1	New clauses. Subsequent clauses renumbered.
	10.	New clause ‘Structural assessment of existing structures’ added. Subsequent clauses renumbered.
1	First issue	Not applicable.

Introduction

This Specification is for the renewals of existing Sydney Water’s dry well sewage pumping stations. It must be read in conjunction with Sydney Water’s Technical Specifications Civil, Mechanical and Electrical.

Sydney Water makes no warranties, express or implied, that compliance with the contents of this Specification shall be sufficient to ensure safe systems or work or operation.

It is the user’s sole responsibility to ensure that the copy of the Specification is the current version as in use by Sydney Water.

Sydney Water accepts no liability whatsoever in relation to the use of this Specification by any party, and Sydney Water excludes any liability which arises in any manner by the use of this Specification.

For the purpose of this Specification “Sydney Water” is the nominated person or organisation that has written authority to act on Sydney Water’s behalf.

This document is uncontrolled once printed or downloaded.

Copyright

Acronyms

Acronym	Definition
A	Ampere
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ATS	Automatic Transfer Switch

Acronym	Definition
ATWL	Above Top Water Level
CAD	Computer Aided Drafting
CT	Current Transformer
DICACL	Ductile Iron Calcium Aluminate Cement Lined
DICL	Ductile Iron Cement Lined
DIFB	Ductile Iron Fusion Bonded
DN	Diameter Nominal
DTC	Deemed to Comply
GPO	General Power Outlet
IICATS	Integrated Instrumentation, Control and Telemetry System
I/O	Input/output
IP	Ingress Protection
kW	Kilowatt
LED	Light-emitting Diode
MPa	Megapascal
PE	Polyethylene
PLC	Programmable Logic Controller
PN	Pressure Nominal
RCD	Residual Current Device
RL	Reduced Level
RTU	Remote Terminal Unit
SPS	Sewage Pumping Station
TOC	Top of Concrete
uPVC	Unplasticized Polyvinyl Chloride
V	Volt
VSD	Variable Speed Drive
WSAA	Water Services Association of Australia

General Terms & Definitions

Term	Definition
Camlock	The generic term encompassing both Kamlok and Bauer brand name fittings.
Design life	Period for which equipment is to remain fit for use for its design purpose with normal maintenance.
Supplier	The person or organisation responsible for the fabrication or manufacture and supply of products, materials, equipment and components described herein.
WSAA Codes	Codes of Practice issued by Water Services Association of Australia
WSAA Code – Sydney Water Edition	WSAA Code with Sydney Water's modifications for use in Sydney Water's assets, where available.

1. General

1.1 Scope

This Specification covers the design, supply, installation, testing and commissioning requirements for the renewal of existing Sydney Water dry well type sewage pumping stations. It supplements the requirements of WSAA Codes and Sydney Water Technical Specifications - Civil, Mechanical and Electrical. If a dry well pumping station were to be converted into a submersible sewage pumping station, Sewage Pumping Station Code of Australia WSA 04 – Sydney Water Edition must apply.

The content of this document is based on:

- Specific requirements from Sydney Water stakeholders,
- Lessons learnt from previous sewage pumping station renewal projects, and
- All relevant Sydney Water specifications, WSAA codes and Australian Standards.

1.2 Proprietary items

Nomination of a proprietary item by Sydney Water does not imply preference or exclusivity for the item identified.

Alternatives that are equivalent to the nominated items can be submitted to Sydney Water for acceptance. The submission must include appropriate technical information, samples, calculations and the reasons for the proposed substitution, as appropriate.

2. Referenced documents

This Specification must be read in conjunction with current versions of the following:

- WSAA Sewage Pumping Station Code of Australia WSA 04, Sydney Water Edition
- WSAA Water Supply Code of Australia WSA 03, Sydney Water Edition
- WSAA Sewerage Code of Australia WSA 02, Sydney Water Edition
- WSAA Industry Standard for Submersible Pumps for Sewage Pumping Stations WSA 101
- Sydney Water's Supplement to WSA 101 WSAA Industry Standard for Submersible Pumps for Sewage Pumping Stations
- WSAA Manual for Selection and application of Protective coatings WSA 201
- Sydney Water's Supplement to WSA 201 Manual for Selection and Application of Protective Coatings
- Sydney Water Technical Specification - Civil
- Sydney Water Technical Specification – Mechanical
- Sydney Water Technical Specification – Electrical
- Sydney Water High Voltage Standards
- Sydney Water's Computer Aided Drafting (CAD) Standard and Specification
- Sydney Water Instrumentation and Control Standards TOG_TS01
- SPS Related Instrumentation and Control Standards – Sewage Pumping Stations Control Strategy and Design Functional Requirements
- Sydney Water Technical Specification – Permanent Emergency Gas Engine Driven Wastewater Pump
- Sydney Water Technical Specification – Permanent Diesel Pumps
- Sydney Water Technical Specification – Permanent Emergency Diesel Generator
- Sydney Water Design Specification for Sewage Pumping Stations Dry Well Ventilation
- Sydney Water Contract for Supply, Repair and Overhaul of Pumps and Mixers
- Sydney Water Specification – Commissioning, transitioning assets into operation
- Sydney Water Specification – Maintenance
- All relevant Australian Standards including all those referenced in the above Specifications and Codes

In addition to the above, the Sydney Water deemed to comply (DTC) drawings contain engineering solutions for various sewage pumping station related infrastructure and may be utilised in the design.

3. General requirements

3.1 Design

3.1.1 Design life

Refer WSAA Sewage Pumping Station Code of Australia WSA 04, Sydney Water Edition.

3.1.2 Flood levels

The designer must establish the current 1% AEP flood level for the site from the local council. The 1% AEP level must be shown on the drawings.

Refer WSAA Sewage Pumping Station Code of Australia WSA 04, Sydney Water Edition for requirements within flood prone areas.

3.2 General requirements

3.2.1 Valves

All valves must comply with Sydney Water Technical Specification - Mechanical.

3.2.1.1 Gate valves

All gate valves must be resilient seated complying to AS2638.2. They must be counter clockwise closing and fitted with non-rising spindles.

Buried gate valves must be supplied complete with extension spindle, extension spindle shroud and surface box. The surface box must be fitted with a concrete surround to enable asset labels to be affixed. All surface boxes must comply with WSAA Water Supply Code of Australia WSA 03, Sydney Water Edition.

3.2.1.2 Knife gate valves

Knife gate valves installed in dry wells must be bonneted. They may be either ductile iron bodied fusion bonded epoxy coated, or stainless steel bodied.

Knife gate valves installed in wet wells may be un-bonneted and must be Grade 316 stainless steel with stainless steel extension spindles, extension spindle brackets and spindle caps.

3.2.1.3 Non-return valves

All non-return valves must be long bodied swing check type complying with AS4794.

Wherever possible, non-return valves must be installed horizontally to minimise collection of debris against the valve seat and trim.

Non-return valve levers and counterweights must be positioned away from the main walking area. Sufficient side clearance must be provided to ensure the valve top cover and spindle can be removed whilst the valve is in situ.

In cases where non-return valve levers and counterweights are being retained on the non-return valves post commissioning, adequate guards must be provided in accordance with Sydney Water Technical Specification – Mechanical.

In cases where the levers and counterweights are being removed from the non-return valves, the lever and counterweights must be hung on metal hooks provided on the wall near the non-return valves. In the dry well, the best location is usually close to the either edge of the sump.

Non-return valves installed on discharges of all pumps must be supplied with proximity ‘no-flow’ switches for pump protection against no flow and, in case of variable speed pumps, for their speed ramp control during starting and stopping.

Non-return valves must have a BSPP (parallel thread) tapping point with plug provided on the highest point of the valve body or the valve inspection cover, where fitted. Non-return valves installed in valve chambers must be fitted with a grade 316 stainless steel two-part ball valve instead of the plug for air bleeding purposes. The tapping point sizes must comply with AS4794.

3.2.2 Supports

All pipework and valves must be adequately supported. All valves must be supported on concrete supports with 3mm thick neoprene sheet separating the valve body from concrete.

3.2.3 Dismantling joints

Dismantling joints must be thrust type. Non-thrust type dismantling joints, unrestrained couplings or grip type flanges and couplings or similar must not be used.

Where the dismantling joint and isolation valve are installed vertically, the required vertical position of the valve (for operation) must determine whether the dismantling joint should be installed upstream or downstream of the isolation valve. The loose ring of the dismantling joint must be installed nearest to the isolation valve.

When the dismantling joint is installed between the non-return valve and isolation valve, the loose ring of the dismantling joint must be installed nearest to the non-return valve.

3.2.4 Pressure testing

Refer to Sydney Water Specification – Commissioning, transitioning assets into operation and Sydney Water Specification – Maintenance.

3.2.5 Ventilation requirements

Refer to Sydney Water Design Specification for Sewage Pumping Stations Dry Well Ventilation for dry well and Sydney Water Edition of WSA 04 for wet well ventilation.

4. Dry well

4.1 Main pumps

4.1.1 General

The main pumps must be of a dry mounted submersible type. They may be vertically or horizontally installed, as required. The pumps must be selected in accordance with the requirements of:

- Sydney Water Contract for Supply, Repair and Overhaul of Pumps and Mixers
- WSAA Industry Standard for Submersible Pumps for Sewage Pumping stations WSA 101
- Sydney Water Supplement to WSA 101
- Sydney Water Technical Specification - Mechanical
- WSAA Sewage Pumping Station Code of Australia WSA-04 - Sydney Water Edition

4.1.2 Pump vendor scope of supply

Each pump must be supplied complete with the following items:

- Suction bend (vertical pumps only)
- Galvanised steel support stand (vertical pumps) or baseplate (horizontal pumps)
- Pump electrical and control cabling
- Protection relay (Xylem MiniCAS II or MAS801, depending on pump size)

4.1.3 Pumps with external wear plate adjustment

The wear plate on pumps from some manufacturers is adjusted externally. Over the life of the pump this may require the pump suction connection to be adjusted. To achieve this, vertically installed pumps must have a suction bend with slots or oversized bolt holes in the flange in vertical plane sized to accommodate the required adjustment. Horizontally installed pumps must have a load bearing dismantling joint with adjustable length installed on their suction pipeline.

4.1.4 Confirmation of pump selection

The designer must confirm existing system hydraulics by comparing actual test data for the pumping station with a calculated system curve. This will normally require reference to a combination of information such as:

- Technical data / Needs specification
- Pump test data report

The designer must evaluate new pump performance for all approved vendors, taking into account any changes to pipework and/or static head. The most suitable pump with respect to performance and efficiency must be selected by the designer and confirmed by Sydney Water.

Pump selection should also include consideration to site limitations such as space, weight, power, potential for excessive vibrations etc.

4.1.5 Life cycle costing

A 25 year life cycle costing analysis must be carried out to determine which pump supplier provides lowest life cycle cost. The life cycle costing analysis must include the following items as a minimum:

- Pump and motor efficiency and absorbed power at nominated duty point
- Pump purchase price including all vendor supplied items
- Pump installation and maintenance costs

4.1.6 Control levels and related information on drawings

The following information must be provided on the drawings:

- Suction safety level
- Pump duty cut in and cut out levels (all duties)
- Pump set point levels (for variable speed pumps)
- Emergency pump cut-in and cut-out levels
- Above top water level (ATWL)
- Station overflow level
- Pump suction and discharge pipework levels
- Pump stand reduced level or height above machinery floor
- All platforms reduced levels
- Reduced levels of dry well and valve chamber floors and wet well and valve chamber top of concrete (TOC)

4.1.7 Pump and motor information on drawings

The selected pump and motor details must be provided in the drawings in a Pump and Motor Table as per below:

Pump		Motor	
Make:		Make:	
Model:		Type:	
Flow:	L/s	Power:	kW
Head:	m	Speed:	rpm
Impeller diameter	mm	Voltage:	V
Impeller No.		Phase:	ph
		Rated Current:	A
Pump and motor total weight:	kg		

For variable speed pumps the flow, head and speed ranges must be stated.

4.1.8 Pump position for lifting and maintenance

Pumps must be aligned with the existing overhead lifting equipment where existing lifting equipment is being re-used.

Consideration must be given to ensuring access to the top of the motor to attach a crane hook to the motor lifting lug or bridle is available. A short section of a permanently attached suitably rated lifting chain may be considered where access is difficult.

The designated pump set down area is to be shown on the drawings. If provided on a nominated set down platform, it must be rectangular and marked with a 75mm wide yellow border with diagonal hatching.

The pump set down area must be sufficiently load rated. Load ratings must be written in prominent letters onto a suitable metallic label and affixed to a nearby permanent structure.

In stations without a superstructure over the dry well, the pump set down area in the dry well must align with the existing machinery openings at ground level to enable the pump to be lifted out of the dry well.

In pumping stations where there is insufficient room to provide adequate pump set down area, alternative arrangements must be discussed with and approved by Sydney Water.

Where new pumps are taller than the ones being replaced, the designer must consider removal and entry of pumps into the superstructure, e.g. a stub I- beam above the entry door. The I-beam must run across the superstructure ceiling and finish outside the superstructure such that the pump can be placed / lifted directly from a truck. For that purpose, the entry door must have sufficient headroom or provide a recess for the I-beam.

Where a pump is required to be lifted over another pump(s), or other plant to reach a set down point, the available lifting height from the overhead crane must be checked to ensure sufficient vertical lift is available for the required clearance. Clearance must be confirmed for both motor and impeller (in case if maintenance stand is used) and for the entire pump including its volute.

4.1.9 Pump cables

On larger pumps, consideration must be given to the pump cable supports. Cable supports and cable harnesses must be shown on the drawings. Furthermore, the orientation, number and size of the cabling entering the pump must be confirmed with the pump vendor. This is necessary to ensure the cable support attached to the pump head is orientated correctly to facilitate lifting.

4.1.10 Pump removal – motors 70kW or larger

The weight of the electrical cables for larger pumps during pump lifting can be significant. For pumps with motors rated 70kW or greater, access must be provided to the pump head to facilitate the disconnection of the power and sensor cables and their entry assemblies.

The cable entry assemblies must be secured to suitable parking bases. The parking bases must be mounted close to the pumps where their cables can reach with no need to disturb the cable supporting structures.

The parking base flange faces must be able to provide watertight seal using the “O” ring seals on the cable entry glands. The parking bases must be sized to suit the pump cables so that the cables can be neatly enclosed in the bases without damage to the cable insulation considering the required bending radius. The parking bases must cater for multiple cable entry glands.

After disconnecting the cables and prior to the pump removal, the pump head must be fitted with suitable cable entry cover plate(s).

Adequate pump head cover plate(s) and cable entry assembly parking base(s) must be provided for each pump installed in the pumping station.

4.1.11 Metallic pump stands (vertically installed pumps only)

Design drawings must clearly state the height of the stand from the base or show reduced levels (RL's) of the top of the stand and the base.

Pump stands must be kept as low as possible in order to minimise the overall height of the pump and motor and reduce the potential for excessive vibrations.

Vendor's drawings for the pump stands must be obtained to confirm stand dimensions and footprint is in accordance with the pumping station's general arrangement drawings.

Stands must be robust, fabricated from hot dipped galvanised mild steel. Galvanising must be carried out off site.

The design of the pump stand must eliminate areas for water to accumulate.

Stands must provide easy access to pump suction bend connections, wear adjustment screws (where applicable), pump mounting bolts, suction bend drain and suction bend inspection cover, where fitted.

The dry well floor area under the stand must be grouted in a dome shape such that water disperses outside the confines of the stand. Grout must be compatible with epoxy grout 'Conbextra EP65 Plus' used between the dry well floor and underside of the pump stand.

4.1.12 Pump stand - natural frequency

Refer to Sydney Water's Supplement to WSA 101.

4.1.13 Pump stand levelling and anchoring

Refer to Sydney Water Technical Specification– Mechanical.

4.1.14 Maintenance stands

When the pump motor and impeller are separated from the volute (volute remains in situ), the pump must not be set down directly onto floors/platforms in the vertical position as this can cause damage or be unsafe. For larger pumps, a maintenance stand will be required to set the pump down. The maintenance stand must be procured through the pump vendor. Where they need to be fabricated, the details must be provided in the detail design drawings.

The maintenance stand must be able to take the full load of the pump. It must have bolt holes in the top plate so that the pump can be secured in place with suitably rated bolts. The maintenance stand itself must be secured to a sound base such as concrete floor with bolts before placing pump on it.

Provided there is sufficient space, the maintenance stand must be kept at the dry well floor. Where an overhead crane is available, the maintenance stand can be placed in a lesser used floor area as long as it is within the operating envelope of the crane. Provision of a mobile or a permanent stand is site specific and must be confirmed with Sydney Water.

4.2 Sump pump

The sump pump must be of a submersible type and must incorporate a stainless steel body, impeller and motor casing. Wherever possible, a single phase, 230V pump must be specified. The pump must be fitted with an integrated float level switch control and starter. A hook must be provided on the wall adjacent to the pump to hang spare electrical cable.

To assist with the sump pump removal, the pump must be fitted with a PN16 flexible discharge hose with a camlock connection onto a rigid stainless steel pipe above the sump grate level.

A non-return valve, isolation valve and a DN15 drain/tapping point must be fitted into the stainless steel pipe spool downstream of the camlock connection. The tapping point must be fitted with a two-part stainless steel grade 316 ball valve with 90^{O} elbow and a drain pipe finishing approx. 500mm above the sump. If fitted with a swing arm and counterweight, the non-return valve must be provided with a counterweight guard. The stainless steel spool must connect to the existing sump pump riser pipework.

The pump must discharge back to the wet well above the overflow level. The designer must confirm the total head required when selecting the sump pump.

Stainless steel or marine grade aluminium open grating is to be provided over the existing sump opening. A cut out complete with kick plate must be provided within the grating to enable the pump to be withdrawn without removing the grating.

A sump pump data table, similar to the main pump table, must be provided on the drawings.

4.3 Dry well pipework

4.3.1 Existing suction pipework tie in point

Pump suction pipework penetrating through the wall from the wet well to the dry well must be confirmed as acceptable for re-use. In cases where this existing pipework is to be retained, the new dry well pipework and valves on the pump suction side must connect to the flanges on the existing suction pipework.

Due to this being a fixed tie in point, relative distances to other key interfaces within the dry well can be impacted, i.e. pump centreline, overhead lifting equipment, machinery hatches and discharge penetrations. Therefore, it is necessary to perform physical dimensional checks of the position of the suction pipework flange faces to confirm the exact tie in point for the new pipework and valves.

4.3.2 Suction and discharge pipework and fittings

All new stainless steel pipework must be Grade 316 Schedule 40S. Stainless steel pipes may be cut to correct dimensions and their flanges tack welded on the site to get correct alignment and then fully welded off site.

Ductile iron pipework and fittings may be used; however, the risk of dimensional tolerances should be assessed since site cutting and welding will not be possible.

Suction velocities must be kept to a maximum of 1.5m/s. The velocity in the discharge pipework should be sufficient to achieve efficient sediment transport through vertical bends and risers, usually in the range between 1.5m/s to 2.5m/s (a function of pipe size), but should not exceed 3m/s.

Where necessary, dismantling joints must be included in the pipework arrangement to allow for the dismantling of pumps and valves. Sufficient pipe supports must be provided so that all pipes remain supported if any of the valves is removed.

4.3.3 Suction and discharge instrument connections

Pump suction and discharge branches must have tapping points for pressure measurement during commissioning and pump testing. These tapping points must be fitted with DN15 block and bleed Grade 316 stainless steel ball valves. The valves must be of a two-part type and must be installed on both sides of each pump, i.e. downstream of the suction isolation valve and upstream of the pump discharge non-return valve, on top of the pipes. Where there are space limitations on suction pipework, the instrument connection point may be installed near to the upstream flange of the suction bend. A tapping point must also be provided in the valve chamber downstream of the isolating valve.

All pipe spools between valves must be fitted with DN15 Grade 316 stainless steel two-part bleed valves. Stainless steel tube with a down turn bend must be fitted to the discharge side of the bleed valves to ensure discharges are directed away from operators and towards the floor.

Threadolets must be used for stainless steel pipework / fittings. For new ductile iron pipework bosses must be cast at tapping point locations. Tapping bands complying with AS4793 may also be used on new ductile iron pipework where there are lead time constraints in procurement of ductile iron pipes with bosses.

4.3.4 Pump suction bend (vertically installed pumps only)

Suction bends must be included as part of the pump scope of supply. These must be fabricated from either Grade 316 stainless steel Schedule 40S or ductile iron fusion bonded. Refer to the Sydney Water Supplement to WSA 101 for further details.

Suction bends must be provided with adequate inspection port. For bends DN300 or greater the inspection port must be minimum dia. 150mm.

Each bend must be fitted with a DN50 drain valve. The valve must be a two-part Grade 316 stainless steel ball type. A male camlock hose connection must be fitted to the end of the DN50 drain valve.

A single hose of sufficient length to connect from the suction bend drain valve to the sump must be provided complete with a female camlock fitting and wall bracket to enable the hose to be stored within the dry well when not in use.

DN25 drain valves may be used if there is insufficient clearance to the dry well floor for installation of DN50 valves. This is subject to Sydney Water’s approval.

4.3.5 Pump suction reducer

Due to the limited space in the suction branch pipework, changes in diameter between the suction pipework and the pump suction flange may be achieved using a reducing bend (vertically installed pumps), or an eccentric reducer (horizontally installed pumps).

Where a reducer is used to taper the pump suction pipework, the soffit of the reducer must be horizontal (eccentric reducer with level soffit).

4.3.6 Discharge pipework drain point

A DN50 two-part Grade 316 stainless steel ball valve must be installed in each pump discharge branch to facilitate drainage of the pipework. Where there are space constraints, a DN25 valve may be used.

Where the pump discharge isolating valve is installed in the vertical riser pipe downstream of the duck foot bend, the drain valve must be located in the lowest point upstream of the duck foot bend. Where the isolating valve is installed in the horizontal pipe upstream of the duck foot bend, the drain valve must be

installed in the lowest point between the valve and the bend and, in addition, a DN15 drain ball valve must also be provided between the non-return and isolating valves.

4.3.7 Discharge pipework air bleed

An air bleed / test point must be provided immediately downstream of each pump and upstream of the pump discharge non-return valve and upstream of the non-return valve in the valve chamber.

Where there is likely that air may be entrained in sewage entering the wet well, an automatic air release valve must be installed. The air release valve exhaust must be piped back into the wet well above the maximum (overflow) level. Isolation valves must be installed both, upstream and downstream of the air valve. The upstream isolation valve must be resilient seated gate, and the downstream Grade 316 stainless steel two-part ball valve.

An air bleed point in the form of DN15 block and bleed two-part stainless steel ball valves must be installed where the pump risers are connected to the discharge manifold within the dry well.

4.3.8 Riser discharge bends

The ‘duck-foot’ riser discharge bends must be fabricated stainless steel or ductile iron. They must be supported from the base of the dry well on a concrete support and held in place by chemical anchors.

4.3.9 Pump air bleed

Where required, adequate air bleed to vent air from the pump motor jacket must be installed. The pump air vent port must be fitted with grade 316 stainless steel pipe with a two-part stainless steel ball valve. The pipe must be terminated at the dry well floor with a bend fitted with a male camlock connection. A hose with a mating female camlock connection of sufficient length such that each pump air vent can be drained into the dry well sump must be provided. The hose must be stored on a wall bracket approx. 1200mm above the dry well floor.

4.4 Dry well valves

4.4.1 Suction and discharge valves

A non-return valve must be installed downstream of each pump. As a minimum, isolation valves must be fitted upstream of each pump, downstream of each pump non-return valve, on each suction pipe from the wet well upstream of the suction manifold, where installed, and on the suction manifold.

Where there are space restrictions on suction pipework, bonneted knife edged gate valves may be considered, subject to approval by Sydney Water.

Electric actuators must be fitted to all dry well isolation valves DN450 and greater.

Handwheels must be provided on all isolation valves in the dry well.

Chain wheels must be avoided wherever possible. Where chain wheels are required for valve operation, they must comply with the requirements of Sydney Water Technical Specification– Mechanical. Hooks must be provided on the valve support to tie the chain up safely when not in use.

4.4.2 Isolation proof valves

DN15 stainless steel ball valves must be provided as test valves between branches on suction manifolds and between isolation valves on the by-pass pump connection pipework. These must be provided in pipe invert or, in case of by-pass pipework, 120mm above the concrete bund.

4.4.3 Wash down valves

One DN25 wash down tap must be provided in the dry well approx. 1000 – 1200mm above the floor complete with a minimum 15m length of hose (sufficient length to reach the sump) in the machinery well. The hose must be stored inside the dry well on a wall bracket about 1200mm above the floor level.

4.5 Dry well access

Safe access to all regularly maintainable items in the dry well must be provided.

A warning sign must be installed at the entry door to the superstructure to state: “No Entry Without Torch”.

All existing access facilities on site must be reviewed for structural integrity and compliance with AS1657. This must include, but is not limited to the following:

- All step and rung ladders
- Platforms
- Handrailing, knee railing and toe board
- Stairs
- Gates / barriers

All existing access facilities deemed as non-compliant to AS1657 or structurally unsound must be replaced or modified as required.

Consideration is to be given for access to both sides of the pumps for maintenance and removal activities. Crawling under or stepping over pipework is not considered acceptable.

Phosphorescent emergency exit signs must be provided.

Chains on top landings of access ladders, if provided, must be replaced with self-closing swing gates. A 5mm thick neoprene pad heat shrunk onto the strike plate of the swing gate must be installed on the strike plate of the swing gates.

A sign stating that minimum three points of contact must be maintained all the time must be provided at the top of each ladder.

Also, at the top of all ladders a sign must be provided stating that the ladder must be accessed facing the ladder.

All signs must comply with Sydney Water’s Customer Delivery Facility Safety Signage Specification.

4.6 Redundant pump plinths and valve supports

All redundant concrete plinths and supports must be demolished to the dry well floor level and the remaining surface must be made good in a workmanlike manner such that it finishes flush with the existing floor.

4.7 Dry Well Cleaning

Prior to commencing the dry well renewal works, the Delivery Contractor must pressure clean the walls and floor in the dry well to remove loose paint, dirt and redundant material. The water pressure must be sufficient to remove loose paint from the walls but not so high such that all paint is removed. The floor may need to be degreased prior to pressure washing where oil spills are evident.

The Delivery Contractor must not use the dry well sump pump during pressure washing, as it can get damaged by large solids or paint. A vacuum tanker or suitable temporary pump is to be used.

Painting / coating of the dry well walls is, generally, not required unless requested otherwise by Sydney Water.

4.8 Lifting facilities

Refer to Sydney Water Technical Specification– Mechanical.

4.8.1 Existing overhead cranes

The designer must confirm the weights of the new pumping units, electric cubicles and other equipment and check these against the certified rating of the existing lifting equipment. If the rated capacity of the existing lifting equipment is not at least 20% greater than the heaviest item that needs to be lifted, including the weight of the combined pump, motor and electrical cable, the designer must:

- Establish whether the crane load rating can be increased to the required capacity and, if it can, the crane must be tested and re-certified as part of the project. All calculations must be performed by a qualified structural engineer, or
- Consider replacing the complete crane / lifting facilities.

4.8.2 Electrically operated hoists

Refer to Sydney Water Technical Specification– Mechanical for criteria on when electrically operated hoists have to be provided.

4.8.3 Pendants for hoists

Pendants for hoists must not be battery operated due to the risk of batteries losing charge and preventing operation of hoists.

4.9 Flood gates and bund walls

Dry wells of pumping stations located below 1% AEP flood level or in areas subject to overland stormwater flows must be protected from flooding. This may include flood gates at the entry doors to the station superstructure and/or embankments or bund walls around the pumping station perimeter.

The flood gates must be on-seating and leak proof. The top of the flood gate must be min. 100mm above the 1%AEP level. The flood gates must be of lightweight, aluminium design. They must be hinged and preferably be able to open 180^{O}. They must be monitored and be able to be latched in open position.

Where embankments or bund walls are provided, the encircled area must be drained to a sump that drains into the inlet maintenance hole via a P-trap and non-return flap in the maintenance hole. Access stairs must be provided to cross over the embankment or bund wall.

All dry well wall penetrations must be sealed.

5. Wet well

5.1 Existing access steelwork

Existing ladders, step irons and platforms must be removed from the wet well to discourage unauthorised access. Following removal, all concrete surfaces must be made good, details and notes to which must be included in the drawings.

5.2 Wet well isolation

Inlet penstocks or valves to the wet well must be inspected and tested, or replaced if necessary, to ensure they can efficiently and safely isolate flows up to the maximum possible differential head both, in normal and abnormal (eg. during maintenance) operation. This is necessary for ensuring wet well and dry well works can be carried out safely.

Electric actuators must be fitted to the wet well inlet pipe and dividing wall valves/penstocks DN450 and greater. Actuators must be operable both locally and by IICATS.

When new penstocks are installed, their spindle cap must meet the requirements of AS2638.1. This is to ensure Sydney Water can use standard valve keys to operate penstocks and will not require special tools from the penstock supplier.

5.3 Hatches

Wet well hatches and safety grilles must be inspected for overall condition and compliance. New valve spindle openings must be provided in existing hatches if the position of valve or penstock spindles is changed. Existing openings must be closed with chequer plate.

Where new hatches and/or grilles are required, these must be in accordance with WSAA Sewage Pumping Station Code of Australia WSA 04, Sydney Water Edition, and Sydney Water’s Deemed-to-Comply drawings.

Where wet well access hatch size needs to be increased, the access opening must remain central to the dividing wall if provided in the wet well.

All new safety grilles must have a 125mm clear spacings starting from their perimeter. The level instruments must be accessed with the grille in place.

All new hatches and grilles must lay flat when fully opened. Where this is not possible, facility must be provided to enable the hatch and grille to be secured in open position to the adjacent structure to prevent inadvertent closure.

6. Inlet maintenance hole

6.1 Existing access steelwork

Existing ladders and step irons must be inspected for structural soundness and compliance with AS1657 and either retained if made from grade 316 stainless steel or replaced with a new stainless steel ladder. Following the removal of old equipment all concrete surfaces must be made good.

6.2 Access hatches

Inlet maintenance hole access hatch and safety grille must be inspected for overall condition and compliance with Sydney Water's requirements. Where required and if possible, the top of the inlet maintenance hole must be enlarged to provide a 1000mm x1150mm access opening.

Where a new hatch and safety grille are required, they must be in accordance with WSAA Sewage Pumping Station Code of Australia WSA 04, Sydney Water Edition, and Sydney Water's Deemed-to-Comply drawings. Inlet maintenance hole safety grille must be provided with a 'grille in grille' design for emergency pump out and dredging activities.

The new grille must have a 125mm clear spacings starting from its perimeter. The instrument hooks must be positioned so that they allow unimpeded removal of the instruments through the 125mm x 125mm openings. This is to enable level instruments to be accessed with the grille in place.

The new hatch and grille must lay flat when fully opened. Where this is not possible, facility must be provided to enable the hatch and grille to be secured in open position to the adjacent structure to prevent inadvertent closure.

6.3 High level inlet pipe

Unless already provided, a high level inlet pipe must be installed between the inlet maintenance hole and the wet well. Refer to WSAA Sewage Pumping Station Code of Australia WSA 04, Sydney Water Edition for details.

7. Valve chamber

7.1 Pipework and fittings

Pipework selection must comply with Sydney Water's Technical Specification– Mechanical.

All new pipework and fittings must be either Schedule 40S Grade 316 stainless steel or ductile iron.

Existing isolation valves must be tested to confirm they are in operable condition. Where existing isolation valves are inoperable or leak, these must be replaced.

Where tapping points do not exist, new DN15 tapping points and two-part block and bleed ball valves must be installed downstream of the isolation valve for pressure testing. Tapping bands to AS4793 for PN16 pipework may be necessary if installing on existing pipework.

DN15 bleed valves must also be provided between isolating valves.

Where an existing pressure main load bearing dismantling joint exists within the valve chamber, this may be re-used provided that the O-ring and flange gaskets are replaced.

A review of thrust forces must be undertaken to establish whether additional restraint is necessary when making modifications to the existing scour pipework.

7.2 Below ground pipework

All exposed pipework and penetrations through structures must be metallic, ie either ductile iron or stainless steel.

All buried pressure pipework upstream of the valve chamber must be DICL or Grade 316 Schedule 40S stainless steel.

All new buried scour pipework and high level pipe between the inlet maintenance hole and the wet well must be DICACL or DIFB.

All gravity drain pipework, e.g. from the bypass bund and valve chamber must be uPVC to AS1273.

Thrust restraints must be provided for all unrestrained pipework joints.

In all cases where flanges are installed below ground, they must be protected by PE sleeving as per Sydney Water Edition of WSA 03.

Break-ins to the pressure main outside of the valve chamber must be minimised if possible. Instead, connections (such as new scours) must be made off the new pipework, preferably within the valve chamber.

7.3 Valve chamber valves

As a minimum, the valve chamber must accommodate pressure main non-return and isolation gate valves. Where a new valve chamber is constructed, it may be sized to also accommodate scour and bypass pump connection isolation valves. Where the gate valve spindle is installed horizontally, a bevel gearbox must be provided complete with extension spindle, spindle support and opening in the cover for ease of operation without entering the valve chamber.

Operation of the pressure main isolation gate valve, scour valves and by-pass pump isolation valves installed within the valve chamber must be from surface level. Where required, the isolation valves must be fitted with an extension spindle and spindle brackets. All valve spindles must be raised to 50mm below the valve chamber cover. Final spindles lengths must be confirmed on site by the Delivery Contractor.

A double isolation is required on the scour line when the scour is located downstream of the pressure main isolation valve.

Due to space constraints, there may be insufficient room to install gate isolation valve(s) off the scour tee within the existing valve chamber. In this situation, the scour isolation valve(s) may be buried.

The use of lugged PN16 bonneted knife gates for scour isolation as an alternative to gate valves requires approval from Sydney Water.

Handwheels to gate valves must not be provided.

7.4 Valve chamber cover

Valve chamber covers are to be appropriately rated for vehicles when located in an access road and / or public road. If located in a non-trafficable location the covers must be open grid type for fenced sites or chequer plate for unfenced sites or near the shoreline. Galvanized mild steel or aluminium chequer plate may be used in unfenced public spaces. If near the shoreline the chequer plate must be marine grade aluminium or Grade 316 stainless steel.

Valve spindle access holes in open grid cover must be fitted with a galvanised reinforcement ring. ‘Tear drop’ covers must be provided over valve spindle access holes in all solid (chequer plate) covers.

Where existing covers are being re-used, the alignment of existing access holes must be checked against changed valve spindle locations. New access holes must be provided where required. Redundant holes must be covered with plates from matching material.

All valve chamber hatches must be locked in place using padlocks either directly (preferred) or indirectly. In some instances, it may be necessary to ensure that a certain hatch is always opened first or to reduce the overall number of padlocks. Use of holding down plates welded to hatch(es) to lock other hatch(es) indirectly is acceptable.

7.5 Penetrations

All new pipework penetrations through concrete walls must be fitted with puddle flanges in accordance with WSAA Sewage Pumping Station Code of Australia WSA 04, Sydney Water Edition.

7.6 Access into valve chamber

Existing access arrangements into the valve chamber must be reviewed along with any changes to the arrangement of the pipework and/or covers. A means of safe access and egress must be provided compliant with AS1657.

7.7 Flood sensor

Where specified (typically in larger sewage pumping stations), a float level switch must be installed in the valve chamber for valve chamber flooded alarm.

8. Emergency bypass arrangement

The design of the emergency bypass pump connection arrangement and associated bund and enclosure must comply with the WSAA Sewage Pumping Station Code of Australia WSA 04, Sydney Water Edition.

8.1 Emergency bypass arrangement drain valves

The bypass pump connection pipework must be fitted with DN15 drain ball valves. The valves must be located as follows.

- At the invert of the pipe spool between the Camlock hose connection and the non-return valve.
- In the vertical spool downstream of the bend prior to the bypass pipework going underground about 120mm above the bund floor. This drain is used for testing isolation and must be installed between both bypass isolation valves.

Tapping bands complying to AS4793 may be necessary if installing on existing ductile or cast iron pipework.

8.2 Emergency bypass connection in valve chamber

The emergency bypass pipe isolation valve must be installed as close as possible to the pressure main. This will prevent solids accumulation in the bypass branch. If buried outside the valve chamber, the valve must be supplied complete with extension spindle, spindle shroud and surface box.

8.3 Permanent bypass pump

Where nominated in the project scope, a permanent engine driven standby pump must be provided. The pump must be able to pump from the inlet maintenance hole bypassing the pumping station or, where impractical, from the wet well directly into the pressure main,.

Unless specified otherwise, the pump must be sized to meet the ultimate peak dry weather flow to the pumping station.

The pump must be self-primed by means of a vacuum pump or ejector or similar without any need for manual priming. The priming mechanism must be able to fully prime the pump in no more than 180 seconds.

A gas engine driven bypass pump is preferred to a diesel engine pump where adequate gas supply is available.

The pump must comply with the Sydney Water Technical Specification – Permanent Emergency Gas Engine Driven Wastewater Pump, or Permanent Diesel Pump Technical Specification, as appropriate.

9. Temporary bypass

This section relates to the temporary bypass requirements during the construction phase of the renewal works and is not to be confused with the requirements for the emergency bypass arrangement.

The preference is to use diesel or gas engine driven pumps over a generator and electrical pumps where feasible to do so.

The bypass pumping methodology must be agreed as early as possible in the project. Confirmation of the following must be sought:

- Required maximum flow rate during bypass operations
- Suction and discharge points for bypass pump
- Location of the bypass pump (some inlet maintenance holes are too small for bypass pumps)
- Suction static head available (when using diesel or gas engine pumps)
- Power supply
- Connections to IICATS
- Call out procedure/ hierarchy in event of a bypass pump failure

10. Structural assessment of existing structures

Structural assessment of the of the wet well, dry well, inlet maintenance hole and other structures must be undertaken to ensure that the residual service life is a minimum of 25 years. Where the assessed residual service life of the station is less than 25 years, refurbishment works must be carried out to ensure that the residual service life is extended to a minimum 50 years.

The structural assessment must take into consideration items that are necessary to predict the current residual life, including but not limited to the following:

10.1 Concrete deterioration

- The depth of concrete deterioration.
- Existing cracks and depths.
- The remaining sound concrete cover to reinforcement (if reinforced).
- Number of existing and proposed new penetrations through walls and their locations.
- The alkalinity level (pH) of the sound concrete cover to reinforcement (if reinforced). A pH reading of ≤10 at the surface of reinforcement must be deemed to have reached the service life as at this level the concrete no longer provides adequate level of alkalinity to prevent the corrosion of reinforcement.
- The existing daily weighted average of the hydrogen sulphide gas concentration (H2S) in the wet well and inlet maintenance hole.
- Future operational mode that can change the hydrogen sulphide gas concentration in the wet well and inlet maintenance hole.
- The predicted rate of ongoing deterioration of concrete including the reduction in the level of alkalinity.

10.2 Loading

10.2.1 Wet well and inlet maintenance hole

- Liquid pressure associated with normal operating mode.
- Liquid pressure associated with flooded condition when pumps are not operating.
- External earth pressure: upper bound value for design action and lower bound value for design resistance (refer to Sydney Water's Technical Specification -Civil for limits on these values).
- External ground water level corresponding to 1% AEP level or assumed at ground level, whichever is higher.
- Buoyancy forces associated with 1% AEP level or assumed at ground level, whichever is higher, assuming station is on bypass, i.e. empty
- Restrained shrinkage stresses in unreinforced concrete, particularly in horizontal directions.

10.2.2 Dry well and valve chamber

- Internal liquid pressure associated with water level at 1% AEP or ground level, whichever is higher, in the event of unexpected flooding for any reason.

- Thrust transfer from pressure mains penetrations through the walls. It must be assumed that anchorages provided outside the structures may not relieve thrust transfer to the walls. Any reduction in the full thrust transfer to the walls as the first line of anchorage must be demonstrated with good degree of confidence, unless special provisions are made to ensure that thrust forces are not transferred to the wall.
- Restrained shrinkage stresses in unreinforced concrete, particularly in horizontal directions as they will reduce the residual tensile capacity of uncracked concrete.
- Vibration associated with the operation of the mechanical equipment, such as pumps, non-return valves etc.

10.2.3 Earth pressure coefficients and load combinations

Earth pressure coefficients and load combinations must be in accordance with Sydney Water Technical Specification - Civil, depending on whether they are for design action or design resistance.

10.3 Structural analysis

A three-dimensional finite element analysis must be carried out for all unreinforced concrete walls.

10.4 Design parameters for material properties

10.4.1 Uncharacteristic strength of concrete

The strength of existing concrete must be assumed to be max. 25MPa, unless proven otherwise by testing of core samples. The concrete design properties given in the table below are applicable to concrete strength of 25MPa:

Design strengths of unreinforced concrete in tension and shear (ultimate strengths) corresponding to min. characteristic compressive strength of concrete of 25 MPa

Structural Action	**At Monolithic Construction[2]**			**At Vertical Construction and Cold[2] Joints**			**At Horizontal Construction and Cold[2] Joints**			**At Cracks**		
	External Walls	Dry / Wet Well Wall	Roofs	External Walls	Dry / Wet Well Wall	Roofs	External Walls	Dry / Wet Well Wall	Roofs	External Walls	Dry / Wet Well Wall	Roofs
Tension (MPa)	1.0	0.5	0.5	0.25	0.15	0.25	0.50	0.25	NA	0.0[1]	0.0[1]	0.0[1]
Shear (MPa)	0.25	0.15	0.15	0.10	0.05	0.05	0.15	0.1	NA	0.0[1]	0.0[1]	0.0[1]

Notes:

1. Cracks assumed to be full depth. Cores required to confirm if crack depths are assumed to be less than the full thickness of concrete.
2. Nominated values don't include any reduction due to restrained shrinkage stresses. The designer must assess the residual restrained shrinkage tensile stresses and adjust the design strengths accordingly.

10.4.2 Design for strength, durability and serviceability of reinforced concrete members

The strength of existing reinforced concrete members must be assessed in accordance with AS3600 where the asset was constructed in or after 1975.

Where the asset was constructed before 1975, ultimate strength design to AS3600 may be used but a reduced value for capacity reduction factors (φ) shall be adopted to reflect the age of construction.

In addition, serviceability and durability checks must be carried out to AS3735.

11. Electrical and control requirements

11.1 General

All critical electrical switchgear, including motor starters, power distribution boards, RTU panels, ventilation panels etc. must be moved to a location within the pump station building above ground level and min. 300mm above 1% AEP level.

11.2 Mains supply upgrade

Where the station refurbishment increases the site maximum power demand the designer must consider whether a mains supply upgrade is required. A mains supply upgrade must include:

- Assessment of maximum demand. Maximum demand calculations must exclude connected loads that cannot operate simultaneously (for example duty/ standby pumps).
- Prepare and submit an “Application for Connection” to the electricity distributor including payment of all necessary fees.
- Where the increase in maximum demand requires an upgrade of the electricity distributor’s network, prepare and submit a Level 3 Accredited Service Provider design for certification by the electricity distributor. This must include payment of all necessary fees.
- Provide a service protection device where it is not currently fitted or the existing device is underrated.
- Where an upgrade is required to an existing Form 1 Main Switchboard then it must be replaced with a Form 3b / Form 4 switchboard. Pump stations with an outdoor kiosk may be exempt from this requirement but must be verified with Sydney Water.
- If a new Main Switchboard is required, the designer must include the provision of a temporary generator connection with manual change-over switches. Switches must be accommodated in separate cubicles if the switches have protection functions. This facility must be provided even if the site has a permanent standby generator. Controllers for automatic transfer switches (ATS) to be in a separate compartment from the switches.
- Upgrade from direct metering to current transformer (CT) metering including a CT metering panel as required.
- Provide a new panel where the service protection device and/or CT metering cannot be accommodated within the existing switchboard.
- Provide adequate protection grading between the electricity distributor supply and all downstream protective elements.

11.3 Portable generator connection

All new main switchboards must be fitted with a portable generator connection regardless of whether a permanent generator exists on site. The same requirement must apply to sites where a permanent generator is to be provided as part of the project scope.

On sites where an existing portable generator connection does not exist, a portable generator connection panel must be provided adjacent to the generator set down area.

Power cabling between the generator breaker and connection panel must be provided.

A mechanical key interlock must be provided between the generator incomer and the normal supply incomer circuit breaker, to prevent the supplies from being inadvertently paralleled.

The generator panel, switching arrangement, and cabling must be as per the standard SPS electrical drawing templates.

11.4 Permanent generator

Where nominated in the project scope, a standby generator set must be provided. The generator must comply with the Sydney Water Technical Specification - Permanent Emergency Diesel Generator.

A gas engine driven generator is preferred where gas supply is available.

The generator must be sized to supply the calculated load based on its continuous prime rating. It must be capable of starting and running the required number of pumps to meet the ultimate peak dry weather flow to the pumping station, plus the station auxiliaries.

The scope must include an automatic transfer switch (ATS) on the main switchboard, power cabling and protection as required by the Service and Installation Rules of NSW and local power authority requirements.

11.5 Electrical switchboard modifications

The main switchboard is to be upgraded if any of the following applies:

- motor starter sizes or types are modified,
- pump motor current ratings are increased beyond the capacity of the existing starters and the switchboard,
- the equipment is deemed unserviceable,
- main power or auxiliary distribution boards are modified,
- additional loads are to be added,
- the main switchboard does not comply to the current service and installation rules, or
- there are no protective devices for the revenue metering units.

Pump feeder breakers must be sized to be larger than the associated motor rated current and of sufficient capacity to carry the starting current dependent on the starting method. The breakers are to be economically sized, however with sufficient capacity to prevent tripping on start-up. Protection must be selected to achieve discrimination minimising the impact of any potential fault.

Refer to Sydney Water standard SPS drawings power schematic E0105, Power Distribution Section GA E0300 and Power Distribution Section Equipment Schedule E0305 for typical main switchboard circuit arrangement and equipment details. Refer to Sydney Water Technical Specification - Electrical for switchboard and starter technical requirements.

Starters are to be upgraded based on the typical pump starter schematics, which are provided in the following standard Sydney Water standard SPS electrical drawing sets:

- S1 - Direct metered switchboard with pump motor soft starters with Mini CAS protection relays and one wet well;
- S2 - CT metered switchboard with pump motor soft starters with Mini CAS protection relays and one wet well;

- S5 - CT metered switchboard with pump motor soft starters with MAS801 protection relays and one wet well;
- S6 - CT metered switchboard with pump motor VSD starters with MAS801 protection relays and one wet well;
- S12 - CT metered switchboard with pump motor VSD starters with MAS801 protection relays and two wet wells.

Typical pump starter panel modifications, specific to dry well upgrades where conventional pump motor units are replaced with submersible units are:

- Provision of new Flygt Mini CAS or MAS801 relays and associated bases, replacing the existing relays (generally these are ATS Tritronics type relays),
- The upgrade of 2A, 24V DC power supplies to 5A units and associated changes to the control circuitry within the existing starter panels.
- Removal of the Unit Flooded switch and associated wiring for each pump. Bridging of the Pump Station Flooded switch terminals within the starter panels and removal of the indication lamps and associated labelling.

Additional supply breakers that are to be included, if nominated in the project scope, are cranes, motor actuated valves, sump pump and ventilation fans. Additional breakers must be included for power factor or active harmonic filters as determined necessary in the assessment of the site power quality to meet AS61000 and local power authority requirements.

The crane supply is generally a 3 phase breaker providing supply to the vendor supplied equipment box.

Motor actuated valves are generally 3 phase valve units complete with a local starter supplied by the pump station power distribution panel and controlled by the RTU. Schematics must be based upon the latest templates issued by Sydney Water.

The sump pump supply is generally from a single phase 10A RCD located in the pump station distribution board.

The ventilation fan starter and control panel are as per the standard drawings included in the Design Specification for Sewage Pumping Stations Dry Well Ventilation.

Temporary provision must be made to supply temporary bypass pump starters if required to continue maintaining well levels while the permanent equipment is undergoing refurbishment or replacement.

11.6 Actuated valve modifications

The common scope of work associated with actuated valves is as follows:

- Add or remove actuated valves (e.g. storm flow valves, wet well flush valves, isolation and penstock actuators, etc.) in line with the approved project scope.
- Provide power supply, monitoring and control to the actuator.
- RTU I/O assignment to be confirmed with Sydney Water Instrumentation and Control Services;
- Drawings to be provided in accordance with the latest Sydney Water SPS electrical templates.

11.7 Electrical cables

Upsizing of pumps may result in an increase in the existing consumer mains, pump starters and pump motor cabling. All new cables and existing cables affected by the project scope are required to be reassessed. They must be sized based on AS3008 taking into consideration the new loads and appropriate derating factor based on the number of cables on the shared route, cable support or enclosure, cable arrangement, insulation type etc.

New dry mounted submersible pumps come with potted submersible motor power, protection and monitoring cabling of a pre-ordered length that would replace the existing surface or conduit supported cabling. New cable route length must be assessed to confirm pump cable lengths required. Pump screened cables must be of sufficient free length to allow removal and laydown of pumps in the centre of the dry well for maintenance without disconnection.

The new pump cabling needs to be supported above the pump motor location and terminated in junction boxes or turrets. In some instances where the new submersible pump motors are large, nominally greater than 70kW, Sydney Water may elect to dispense with junction boxes or turrets and terminate directly into the starter panels. Disconnection, if required, must be at the motor termination box.

Cable supports in the form of stainless steel half circles, cable hooks and stockings need to be provided to ensure the full weight of the submersible pump cabling is not transferred to the terminals at the pump head, turret, junction box or starters. The cable supports are to be located to allow the cables to hang in a fashion that facilitates safe removal and does not obstruct dry well access.

Protection cabling will need to be modified to match the new submersible pump monitoring and protection equipment usually necessitating an increase in the number of cores in cabling from junction or turrets back to the pump motor starters. Additional terminals must be provided in turrets, junction boxes or starters where the existing units are able to accommodate these, if not, the equipment that is space constrained must be replaced with new units.

New IP68 instruments and latch stops must be supplied complete with cabling where terminations are potted. Cable run lengths are to be determined to ensure the correct cable length is supplied. To facilitate equipment replacement, removal and installation of the cabling, new individual and continuous conduits with long sweep bends must be provided.

All necessary cabling must be provided to complete the installation as required in the design. This may include, but is not necessary limited to, the following:

- Relocation of pump station switchgear.
- Temporary bypass pump starters.
- Separate light and power wiring into above flood level and below flood level circuits.
- New bypass connection flood lighting.
- New sump pump GPO.
- New motorised crane supply.
- New vent fans.
- New instruments.
- Any other pump station change that requires an electrical service.

The new and modified cabling details are to be updated in the site electrical cable schedule and block diagrams.

New cable penetrations are to be provided into the wet well, inlet maintenance hole, through kiosk bases or dry well entries as necessary to achieve the project objectives. The penetration details must be clearly and comprehensively covered in the site layout drawings. All existing or new penetrations must be fire stopped and properly sealed to be weatherproof, vermin proof and prevent the passing of sewer gases.

11.8 Pump power and instrument cable junction boxes and turrets

New junction boxes or turrets must be provided for the termination of new submersible pump and instrument cabling. These must be:

- Located above ground level and min. 300mm above the 1% AEP level
- Located to facilitate the segregation of other services and power and instrument cabling
- Located to minimise the installation of new or the relocation of existing pits and buried cable conduits

All existing junction boxes must also be moved to min. 300mm above the 1% AEP level.

New Sydney Water standard stainless steel turrets are to be utilised if there is sufficient space available on site. Care must be taken to maintain hatch and turret door opening clearances. Where space is limited, prohibiting the use of the standard stainless steel turrets, other options must be considered, such as Fulton FPB2TV green plastic turrets, or equivalent. Failing this, junction boxes may be mounted either off the exterior of the pump station walls or located on the mezzanine level, provided these locations are above the flood and overflow levels. The turrets or junction boxes must be provided with cable glands or conduit penetrations as required to accommodate the new cabling.

11.9 Lighting, power distribution and GPOs

11.9.1 General

Light and power distribution boards, lighting and general power outlets (GPO's) must be provided as specified in the project scope and the requirements stipulated within the Technical Specification –Electrical.

New internal and external lighting, switches and GPO's must be provided to replace any existing unserviceable or incorrect IP rated fittings.

New equipment must be provided to cater for any building plant layout or access changes.

11.9.2 Lighting

Lighting design is required where rearrangement of the dry well equipment has been required during the upgrade leading to obscuring of the lighting or casting of shadow on plant or access routes.

Renew existing lighting or provide new external lighting to facilitate the connection, running and dismantling of new bypass arrangements.

Ensure light fittings are easily accessible for the replacement. If they are not easily accessible, then the light fittings must be relocated to an accessible location. Lighting design must be performed to ensure required lighting levels are achieved.

The lights must be operated via a manual switch located inside the building, close to the personnel access door. A sign at the light switches must clearly identify the purpose.

Lighting installation and lux levels must be in accordance with the Sydney Water Technical Specification - Electrical.

Replaced or new luminaires located within the switchroom must be industrial type, LED type and must have an IP55 rating. Luminaires located outdoors or within the dry well must be non-corrosive rated IP56.

11.9.3 Distribution boards

Assessment must be carried out if the existing distribution board spare capacity is planned to be used. If there is insufficient capacity in the existing distribution board or the modification work to create additional spare capacity doesn't comply with SW Technical Specification - Electrical, Australian Standards or NSW Service and Installation Rules, then a new distribution board must be provided.

The GPO's and lighting power equipment must be segregated so that equipment above the flood and overflow level are powered from separate circuits to those below these levels. This change will ensure that if the dry well were to flood, the pump units and equipment above the high water level continue to operate but there would be no power supplied to general electrical fittings that are submerged. These separate circuits should be clearly labelled.

New RCD circuit breakers on the power distribution board must be provided where required. Lighting and GPO supplies must be re-arranged such that items above high water level are on a separate circuit to those below the high water level.

11.9.4 General power outlets

All GPO's in the dry well must be installed on separate power circuits. If not already completed, GPOs must be changed to IP56 rated equivalents. RCDs are to be provided on all GPO circuits. All GPO's must be installed min. 1.5m above the dry well floor level.

11.9.5 Sump pump GPO

The sump pump power supply must be via a wall mounted single phase industrial type weather proof (IP56), 230V AC 10A GPO located in the dry well near the sump.

Where a 230V sump pump is not available, a three-phase sump pump is specified with a 415 V 3 phase feeder must be provided in the low voltage distribution board supplying a new direct on line starter. The sump pump motor must be connected to the starter directly or to a termination panel. The starter or the termination panel must be located above the flood and overflow levels in a similar location to the main pump starters. Where 3 phase sump pumps are specified, additional IICATS I/O will need to be provided.

Level switches to control the pump on / off operation and to provide monitoring are to be connected back to the starter via a local IP67 junction box.

11.10 Modifications to instrumentation

11.10.1 General

All existing dry well instruments must be replaced with potted IP68 type instruments. The cables must be run in a separate continuous conduit for each instrument to facilitate instrument replacement. All bends to be long radius type.

11.10.2 Wet well level instruments

Sydney Water's preference for the monitoring of wet well levels is via a hydrostatic level transmitter located in the dry well. The transmitter is connected to a 50mm manifold that is installed through the wall separating

the dry well and the wet well. The manifold arrangement must be fabricated in accordance with the standard Sydney Water drawing.

The manifold and instrument must ideally be located below the centre line of the suction pipework and max. 300mm above the floor of the dry well.

11.10.3 Dry well level instruments

Replace all dry well float switches (machinery well flooded, sump level high unit flooded) where the potted cable has been terminated below the high water level.

Float switch cables must be terminated in an instrument junction box located above ground level and min. 300mm above the 1% AEP level.

Where conventional pumps have been installed in the dry well the existing "unit flooded" level switches and redundant circuit components must be disconnected and removed.

11.11 Latch stop stations

A risk assessment must be performed to determine whether local latch stops, local start/stop control or whether no local control is required. If local controls or latch stops are to be provided these must be IP68. Cabling is to be potted with lengths specified for site conditions and installed to facilitate replacement in separate conduits. All conduit bends to be long radius type.

11.12 Modifications to IICATS I/O and control functions

During the upgrade, the designer must identify any changes to the pumping station functional description, RTU and emergency PLC I/O.

New pumping units are generally of a dry well submersible type and as such are designed to operate when submerged. Therefore, the existing “pump stopped due to flooding” function needs to be removed for each pump. All, “Pump Stopped Due To Flooding”, relay contacts are to be replaced with the pump “Water in Oil” alarm contact in the RTU DI drawings.

One ball float must be maintained within the dry well to provide a “Machinery Well Flooded” alarm. This provides an IICATS alarm only and does not disable the pumping units.

The existing Omniflex RTU power supply must be replaced with Dyne Industries 5A custom analogue power supply based on the previously adopted Radameter unit. The voltage monitoring contacts are to be wired into the RTU DI monitoring circuit.

If not already implemented, dual power supply arrangement for the ATWL alarm circuit must be provided as shown on Sydney Water standard SPS electrical drawings.

All IICATS signals need to be checked with the I/O list provided by the Sydney Water Instrumentation and Control Services team. Drawings are to be updated in accordance with their requirements.

The standard RTU I/O assignment is specified in section 3.2 of the SPS Related Instrumentation & Control Standards, I & C_SPS_Part 1.

11.13 Electrical bypass

During the design of the upgrade works consideration is to be given as to what temporary arrangement is required to maintain operation of the pumping station during the works. If temporary electrical submersible pumps are to be utilised for bypassing operations these must be operated and controlled via temporary

bypass panels. Sydney Water have developed standard electrical bypass panels for two power ranges, 4.5 to 22kW and 22 to 75kW. Standard electrical drawings are available for these panels and all bypasses of within this power range must have these panels installed.

11.14 Removal of redundant equipment

All equipment made redundant during the project must be isolated, disconnected and removed from the site. The Delivery Contractor must, in consultation with Sydney Water, identify redundant equipment that must be retained by Sydney Water and determine a suitable location for its storage.

All decommissioned cables must be isolated, disconnected and removed from the existing pits, conduits and cable trays. The remaining cables must be rearranged in association with the new cable.

12. Site infrastructure

12.1 Survey labels

Survey labels showing reduced level of the roof in AHD are to be provided on all structures above instruments. Refer to WSAA Sewage Pumping Station Code of Australia WSA 04, Sydney Water Edition for details.

12.2 Anchor points

All anchor points must be located at 1.5m of the access openings and in line with the hatch hinges. The number and location of the anchor points must be confirmed with Sydney Water prior to commissioning.

All anchor points must comply with the requirements of WSAA Sewage Pumping Station Code of Australia WSA 04, Sydney Water Edition and Sydney Water Technical Specification - Mechanical.

12.3 Bollards

12.3.1 Permanent bollards

Permanent bollards must be provided to protect assets and/or structures on site from vehicles.

All permanent bollards to be concrete filled with concrete footings.

Two permanent bollards are required at each side of the vehicle entry doors to the station superstructure.

Vent shafts close to trafficable paths and in parks must be protected from vehicles using permanent bollards.

Where valve chamber, wet well, maintenance holes, emergency storage structures and other covers are not trafficable but there is a risk that traffic may drive over them, permanent bollards or alternative safety barriers must be provided.

12.3.2 Removable bollards

Removable bollards may be necessary to prevent unauthorised vehicle access to site entrances. The requirement for removable bollards is a site specific requirement and must only be provided if requested by Sydney Water.

Document control

Ownership

Role	Title
Group	Engineering and Technical Support
Owner	Manager, Engineering
Author	Milan Rubcic, Lead Engineer

Change history

Version	Prepared by	Date	Reviewed by	Approved by	Issue date
2	Milan Rubcic	7/05/2021	B. Maunder, C. Sebaratnam, L. Gupta, M. Pathirana, N. Keong, P. Zhou, R. Madhok, S. Sabanathan, W. Legg	Norbert Schaeper	7/05/2021
1	Ran Virdi	24/11/2017	B. Maunder, M. Pathirana, R. Madhok, M. Rubcic	Ken Wiggins	24/11/2017