DP-06 Standard for Local Network Wastewater Pumping Station Design and Construction

Ver. 0.4

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Revision log

Revision	Description	By	Date
0.4	First release - working draft	J de Villiers	29/06/2015

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Glossary: Terms and abbreviations

Term/Acronym	Explanation
ADWF	Annual dry weather flow
BEP	Best efficiency point, typically at about 85% of the pump shut-off head. This is the pump design point.
DN	Nominal metric diameter designation conforming to the International Standards Organization
ECS	Electrical and Control Systems. Internal department to Watercare.
GRP	Glass reinforced pipe
Head	Measure of liquid surface elevation
H_2S	Hydrogen Sulphide
H&S	Health and safety
KPa	Kilo-Pascal
LIM	Land Information Memorandum
l/s	Litres per second
MH	Manhole
NDC	Network discharge consent. Watercare's global discharge consent for overflows from its wastewater network in existing urban areas and some planned future urban areas
ppm	Parts per million
PS	Pumping Station
PN	Nominal internal pressure that a component can safely withstand
Rising main	Pressurised wastewater pipe through which wastewater is elevated to a point of discharge

1. Introduction

Design and construction of pumping stations needs to be completed by competent persons to the minimum requirements as set out in this standard. **The pumping station developer needs to consult with Watercare as early as possible to ensure compliance with the process stages outlined in section 5. Failure to follow this process will delay obtaining Watercare's approval.**

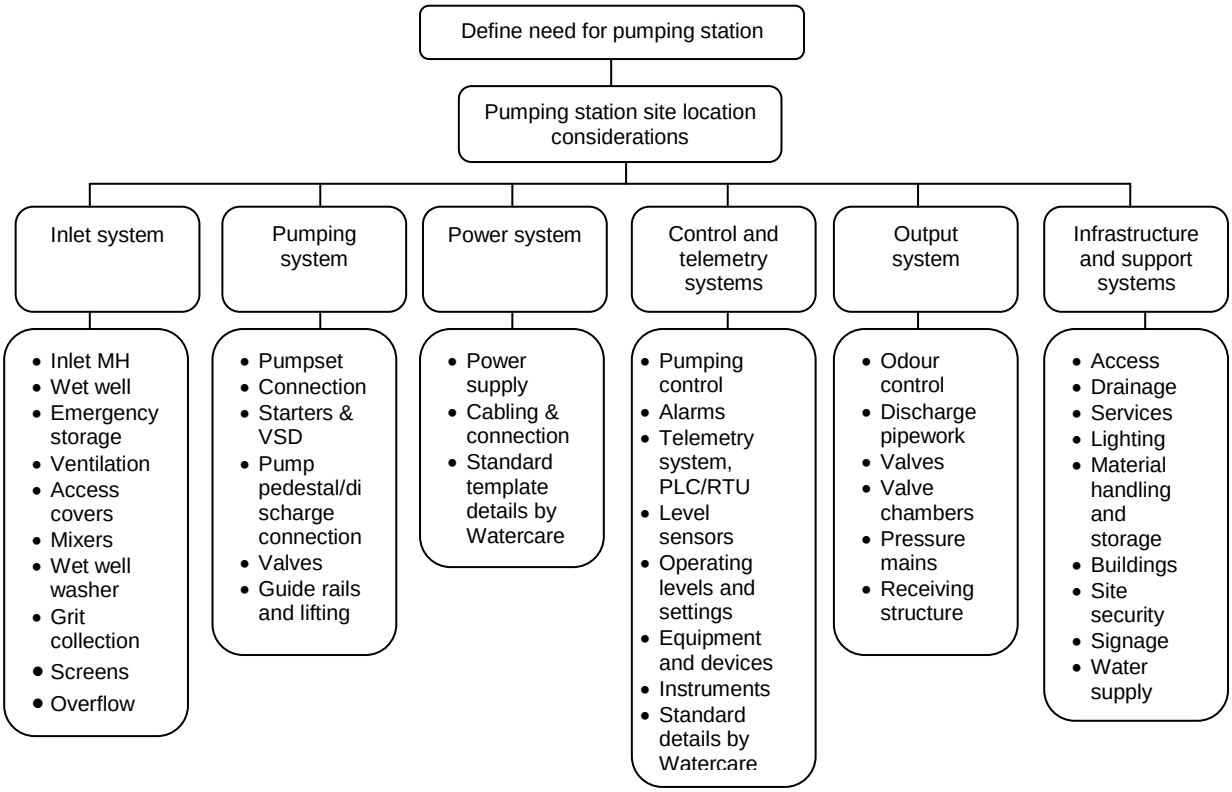
This standard covers the planning, design and construction of local network wet well pumping stations and pressure rising mains up to DN300 mm. The requirements for larger, dry well or Watercare Transmission wastewater pumping stations are covered by Watercare's Guidelines for Design of Wastewater Reticulation and Pumping Stations.

Privately owned pumping stations are excluded from this standard. The electrical standards are available separately and shall be read in conjunction with this standard. Watercare's telemetry requirements are location based and requires input from Watercare in the first instance to identify the applicable standards and/or site requirement for the proposed site location.

2. General Requirements

a) Pumping stations will only be considered and approved by Watercare when it can be demonstrated that a gravity solution is unpractical. Where pumping stations are developed by external developers, pumping stations shall be provided at the entire expense of the developer. If properly designed and constructed to Watercare's standard; Watercare will take over their future operation and maintenance after they have been commissioned and vested in Watercare. The developer shall be liable for any flushing during the first 12 month period where the design flows are not met during the development phase.
b) Pumping stations developed by Watercare or its consulting design engineers shall follow the same process of review and implementation.

For the purpose of this standard, 'developer' shall be interpreted as both an external party developing a pumping station to be vested to Watercare and any party contracted to Watercare to develop a local network pumping station. The design considerations for review by Watercare shall follow the following output format:



3. Pumping Planning Considerations

It is expected that alternative servicing options have been identified as part of the concept development and planning process and that the feasibility has been evaluated against technical, environmental and financial criteria over the entire design life of the system and that pumping has been confirmed as the least whole of life cost solution.

When planning and designing for a pumping station; consideration of pumping station placement, the number of pumping stations proposed in a development area and long term development forecast, including:

- Running costs, life-cycle and ongoing maintenance costs.
- Impact on existing pumping stations will require a full system integrated design.
- Upstream catchment growth and system delivery limitations.
- Septicity within the pump station and connected pipework, odour issues and corrosion of equipment, pipes and staged infrastructure.
- Environmental and health and safety risks.
- Dry-weather storage capacity either in the wet well or storage tanks (minimum 8 hrs).
- Consideration of future development / upgrades that will allow the existing infrastructure to accommodate overall increase in the capacity of the pumping station.
- Pumping station structures and connecting pipework shall have a typical asset life of 100 years. Valves, electrical equipment etc. are separately assessed and placed on Watercare's materials lists.

4. Pumping Station Site

Watercare requires that the pumping station has its own dedicated contaminate free lot, provided exclusively for the purpose of housing the station and all related structures and equipment. It will however be permissible for the access to be by right-of-way to be shared with other lots, in which case the station site must be of sufficient size to provide a parking space for service vehicles without obstructing the right-of-way. Watercare may also require the lot to be designated as a utility reserve or similar. The developer must notify adjacent lot owners, including lots being created, of the location of the pumping station with regards to counter sensitivity. These notices must be recorded on the existing or newly created adjacent property's LIM. It is important that the developer considers the telemetry serviceability of the pumping station site in the first instance; see **section 5 and 6.3** for more detail. The pumping station general site layout shall allow for:

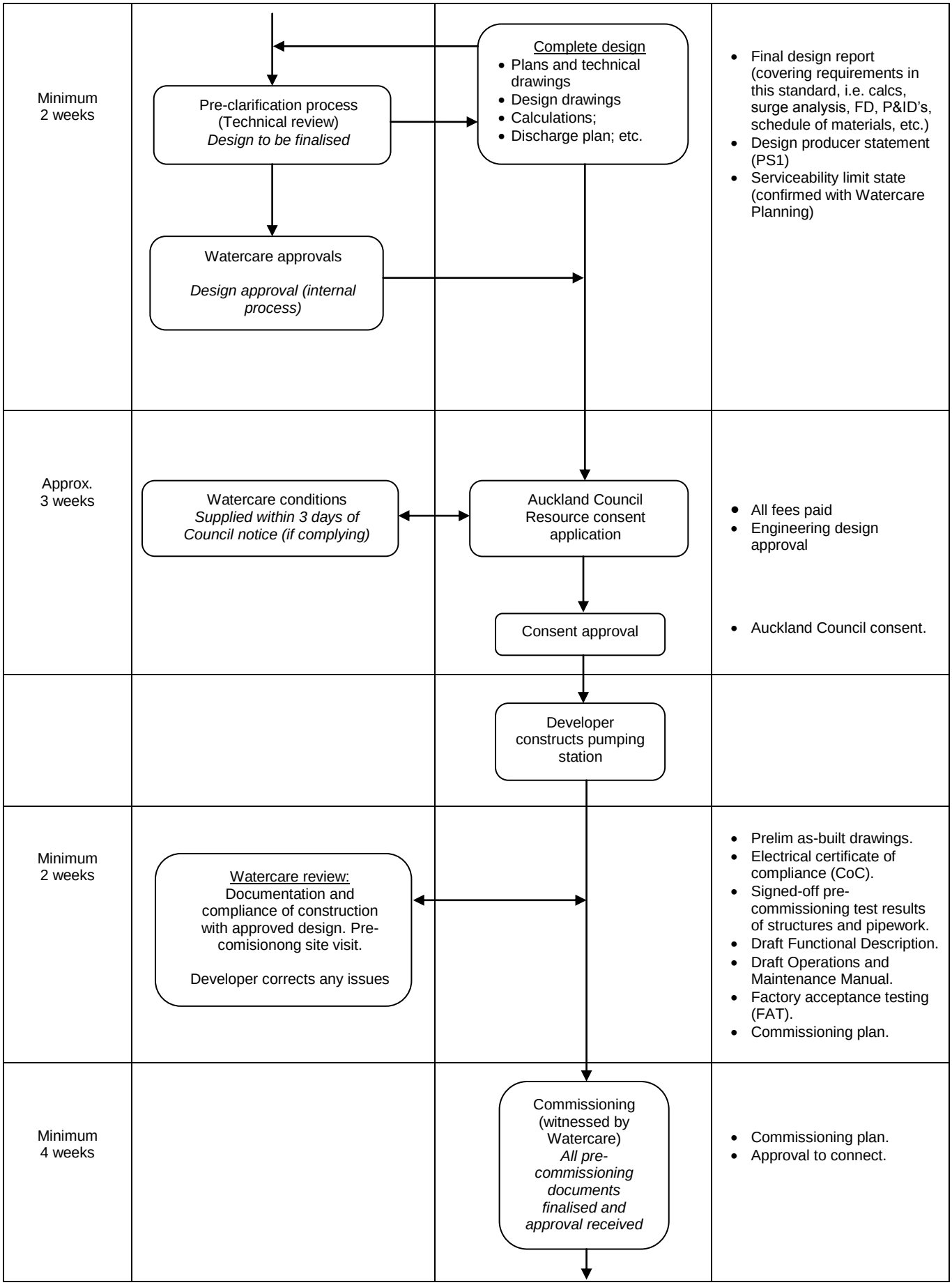
a) The site shall be level within the boundaries of the pumping station and free of any contamination.
b) 24hr all-weather vehicle access, adequate parking and where specified an adequate turning area within the pumping station boundary.
c) Adequate clearance around the wet well, inlet manhole, storage well and valve chambers to allow service vehicle access, lifting of equipment and parts and general serviceability of the pumping station.
d) Odour control system(s) shall be required at the pumping station and as required air valves on the rising main are to be considered as part of the overall design. Minimum 12m clearance from the adjacent properties to mitigate counter sensitivity.
e) Dedicated underground mains power supply.
f) A freestanding low height weatherproof control cabinet to house electrical equipment as per Watercare electrical and control standards.

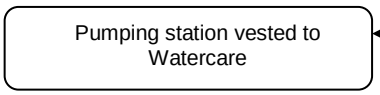
g) Building doors, switchboards, control cabinets and chamber cover-plates able to be provided with adequate clearances for maintenance access.
h) Electrical connection facilities for the provision of a temporary generator.
i) Dedicated electrical and control services trench.
j) Outlet valve chamber.
k) Magnetic flow meter chamber.
l) Drain-back bypass into the storage tank or wet well.
m) The storage tank shall be buried.
n) Where appropriate a minimum 1.8m high fence (to be agreed) with a lockable gate.
o) Landscaping and planting as required by consent conditions or as otherwise specified by Watercare during the design review.
p) Compliance with Watercare's Network Discharge Consent (NDC).

5. Design Process of Local Wastewater Pumping Stations

In order for Watercare to approve a pumping station a number of considerations are important that are best discussed and evaluated with Watercare before the developer begins the consenting process with Council. The following flow chart provides a guideline on the expected timeframes and requirements at each stage of the process:

Estimated timeframe	Process	Developer	Key documents
1 week	Determine PS requirement	Proposal • Size of catchment • Location • Demonstrate general requirements • Demonstrate planning considerations & NDC compliance	• Application forms. • Draft design. • NDC compliance. • Land transfer plan. • EDC form (engagement)
1 week	Watecare Developments / Planning / ECS / Operations *Review and set meeting date*		
1 week	Watercare ECS desk study on location servicibility *ECS provides cost estimate*		
	Watercare Draft approval / rejection of proposal & cost estimate (SCADA and telemery if any)	Amend proposal / proceed to next phase	


Minimum 2 weeks
Pre-clarification process (Technical review) Design to be finalised
Complete design
Plans and technical drawings
Design drawings
Calculations;
Discharge plan; etc.
Watercare approvals
Design approval (internal process)
Final design report (covering requirements in this standard, i.e. calcs, surge analysis, FD, P&ID's, schedule of materials, etc.)
Design producer statement (PS1)
Serviceability limit state (confirmed with Watercare Planning)
Approx. 3 weeks
Watercare conditions Supplied within 3 days of Council notice (if complying)
Auckland Council Resource consent application
All fees paid
Engineering design approval
Consent approval
Auckland Council consent.
Developer constructs pumping station
Minimum 2 weeks
Watercare review: Documentation and compliance of construction with approved design. Pre-comisionong site visit.
Developer corrects any issues
Prelim as-built drawings.
Electrical certificate of compliance (CoC).
Signed-off pre-commissioning test results of structures and pipework.
Draft Functional Description.
Draft Operations and Maintenance Manual.
Factory acceptance testing (FAT).
Commissioning plan.
Minimum 4 weeks
Commissioning (witnessed by Watercare) All pre-commissioning documents finalised and approval received
Commissioning plan.
Approval to connect.

			• Post-construction residual risks register. • Operations and Maintenance Manual. • Final Functional Description (FD) supplied separately to the O&M manual. • Electrical Certificate of Compliance. • Design drawing sets, as-built drawings and survey data. • Asset certificate. • Engineering producer statements.

6. Design

The design of pumping stations shall be carried out by engineers qualified and experienced in this field of expertise and per specific component or design field as required. Designs shall be signed-off (IPENZ PS1 or PS2) by a chartered professional engineer.

The design shall consider industry best practice for principles of Safety in Design (SiD). The goal of SiD is to integrate hazard identification and risk assessment early in the design process to eliminate and minimise the risks of injury during construction and the life of the pumping station.

The design shall be carried out in conjunction with the standard drawings in Appendix A. Appendix A provides the typical layout that is expected for a pumping station. It is expected that the core requirements shall remain unchanged with design outcomes establishing the pipe sizes, fall/grade changes, chamber sizes, wet well size and depth, storage tank dimensions, etc.

The general requirement for pumping station design shall include but not be limited to:

a) Determine system design flows in accordance with the Water and Wastewater CoP for Land Development and Subdivision, **chapter 5 section 5.3.5.1**.
b) All structural design with specific reference to the wet well and overflow tank shall be in accordance with Watercare standard DP-01 Design Principles for Seismic Design of Equipment, Equipment Supports and Tanks. The designation schedule attached to the standard shall be completed in consultation with Watercare to determine the appropriate serviceability limit state.
c) Determine the station lifting height requirements, flow losses through pipework and fittings to calculate the total head.
d) Develop system curve that considers:
    - Minimum flow velocity between 0.9m/s and 1.5m/s.
    - Maximum flow velocity shall be 2m/s. However future expansion should be considered that may require the maximum velocity to be increased over time. A lower maximum should be designed for in this circumstance.
    - Static and friction losses.
    - Total lifting head.

e) Select pumps where pump curve intersects with the system curve (Figure 1) allowing an overall inaccuracy factor of 10% for friction losses in the system curve. See **section 6.2** on pump selection.

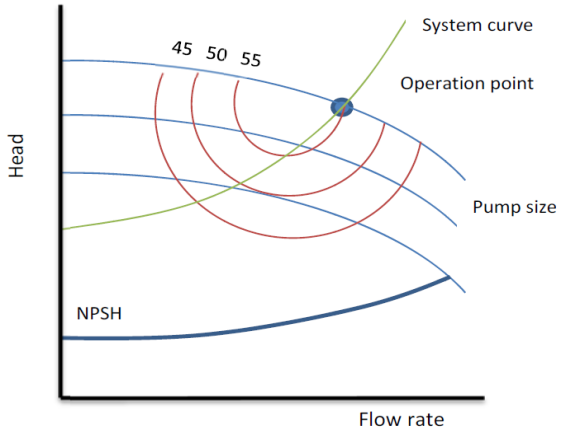


Figure 1: Pump selection by combining system curve and pump curve to determine the best efficiency point.

f) Storage in a tank or the wet well to provide 8 hours average dry weather flow capacity. Overflows shall not exceed the requirements of the NDC.

g) Pump stop/start not to exceed more than 6 cycles per hour. Pump duty standby to rotate on each successive pumping cycle.

h) Septicity and odour control.

i) Complete geotechnical investigation for the purpose of structural design, construction considerations and land contamination report. All data collected shall be uploaded to the Auckland Geotechnical Database in AGS4 format at: ***https://agd.projectorbit.com***

j) Structural design of infrastructure.

k) Pipework and general arrangements of equipment shall take into consideration best practice to minimise likelihood of corrosion and the need for ongoing maintenance.

l) The component layout design shall consider safe access and egress, operational ergonomics and minimisation of confined space entry under the expected operational situations as identified in the SiD.

m) Design of the rising main.

n) All drawings shall comply with Watercare drawing standards. Refer Watercare CAD Manual: "Standards and procedures for the upload and registration of AutoCAD drawings", document reference number 7363.

6.1 Pumping Station Inlet System

6.1.1 Pumping Station Inlet Structure

The inlet structure / manhole shall be situated wholly within the pumping station site. The design of the inlet structure shall have the following functions and requirements:

a) Collect all wastewater inflow into the pumping station.

b) Provide access or location for grit collection if required.

c) Be able to facilitate bypass pumping or serve as a temporary wet well for emergencies.
d) Isolation knife gate valve situated in the inlet structure. Depending on available space the gate valve may be situated within the wet well.
e) Fall through the manhole shall be as for any other gravity manhole (See CoP Wastewater, **chapter 5**, sections on manholes).

6.1.2 Grit Collection and Screens

In areas where grit collection or pre-treatment by screening is required the system shall be designed for incorporation into the inlet structure. Approval of these systems shall be evaluated, or may be instructed by Watercare. These structures are not desirable due to increased maintenance cost and increased H&S and Environmental risks.

6.1.3 Wet well

For the purposes of small capacity pumping stations only a single wet well shall be provided. The following general arrangements of the wet well shall be incorporated into the design:

a) Ground conditions and geotechnical requirements (e.g. screw pile foundation) to protect against seismic movement or ground settlement.
b) Prevention of septicity and "dead zones" where solids can accumulate.
c) Detention time of wastewater during normal operation shall be maximum 2 hours.
d) Benching shall be formed at a minimum 45º angle to guide flow towards the pump suction and achieve self-cleansing.
e) Allow adequate clearance from well sides and base to pump inlets in accordance with the pump manufacturer's installation recommendations.
f) Well washer connected to potable water supply with a flexi-hose connection and stainless steel lifting chain. The well washer shall be hinged to enable repositioning when doing maintenance.
g) Installation of mixers requires approval from Watercare.
h) Ventilation shall be installed for all pumping stations at a level of at least 150mm above the well overflow level and 150mm below the well lid and at least 1m above the pump duty point. The location and angle of the outlet of the duct will allow condensation to freely drop back into the well and be at the furthest point away from the inlet.
i) The vent shall be into a vent stack/shaft of suitable length to disperse air above the surrounding roof tops. Where natural venting can be predicted to be insufficient, a suitably sized activated carbon filter shall be installed at ground level. The ventilation system shall be designed to provide an appropriate ventilation velocity. The capacity design for carbon filter replacement shall be a minimum of 5 years.
j) The access hatch shall provide a full clear opening over the discharge pipe bend and up to the external dimensions of the installed pump set. Watercare standard design details shall be used for all lids. **See Appendix A**.
k) All access hatches shall be fitted with a hinged safety grille underneath the lockable access hatch to Watercare standard design.
l) A safety harness attachment lug shall be installed next to the access hatch.
m) Anti-buoyancy design to prevent wet well floatation.

The inlet pipework into the wet well shall have the following features:

- Isolation knife gate valve situated in the wet well inlet or inlet structure depending on available space (if not installed on the inlet structure).
- Pipe inlet arrangement to minimise turbulence that could create H_2S gas generation or poor pump performance and be situated as far as possible away from the pump inlets.
- Prevent discharge from the inlet pipe directly onto a pump and such that the inflow into the well from larger inflows does not cause eddies (e.g. deflector plate).
- Inlet fall height shall not exceed 1m above the bottom operating water level to prevent air entrapment.
- External flexible connection designed to off-set seismic event or ground settlement.

The size of the wet well shall be determined by the following criteria:

a) The wet well operating range shall be a maximum of 1m in height from the base of the pump inlet to prevent settling.
b) Minimum free-bore clearance of 1m from the installed pump guide-rails, cables etc. to facilitate maintenance.
c) The volume between pump start and pump stop shall be determined by pump capacity and shall be set to limit the frequency of pump starts (Refer to 6.6 (g)). The pump start level shall take into account the need to prime the pumps.
d) The centre to centre clearance between pumps shall be minimum 1.5 times the external pump diameter at its widest section.
e) The side clearance from the centre of the pumps to the well walls shall be minimum 0.8 times the external pump diameter at its widest section.

6.1.4 Emergency storage

Additional storage may be required where the minimum ADWF storage of 8 hours cannot be contained within the wet well. The emergency storage shall be maintained between the high level alarm level and the wet well overflow level.

The storage tank shall be fitted with one or more washers as appropriate for the size of the storage tank.

The storage to wet well interconnected arrangement shall be such as to allow the storage to be used in an emergency for pump or wet well failure and maintenance scenarios.

The design shall incorporate an anti-buoyancy design to prevent the storage tank from floating when not in service.

6.1.5 Wet well overflow

The wet well overflow shall be determined by the location of the pumping station and the environmental impact assessment and consequently consented conditions. The overflow shall be into an overflow structure with connecting outfall that must be accessible by sucker truck.

The outlet from the overflow manhole shall be fitted with a stainless steel baffle plate to prevent scum discharge to the environment. Drainage fall shall be away from the overflow manhole to allow draining

back to both the wet well and to the outlet that shall be fitted with a non-return flap valve. The outlet shall be constructed with a wing wall and fitted with a stainless steel grid.
The specific design shall take into consideration energy dissipation and erosion control in the receiving environment.

6.1.6 Material selection

All materials shall comply with Watercare material supply standards and conditions of accepted materials. The following special considerations shall be taken into account:

6.1.6.1 Inlet structure

The structure shall comply with the material requirements for manholes, Watercare standard BD-02.

6.1.6.2 Wet wells

Wet wells shall be constructed from either concrete with resistance to corrosive attack i.e. calcium aluminate, polymer concrete or be protected with a suitably specified painting system as per Watercare standard CG-10. Alternatively GRP is an acceptable option.

6.1.6.3 Inlet pipework

Inlet pipework may be selected to the appropriate design class from the materials list provided in Appendix A in the Code of Practice for Land Development and Subdivision. The selected material shall comply with the applicable Watercare material standard.

6.1.6.4 Storage tanks

Storage tanks shall be constructed from either concrete with resistance to corrosive attack i.e. calcium aluminate or be protected with a suitably specified painting system as per Watercare standard CG-10 or GRP.

6.1.6.5 Ventilation stack

All components, fixings, supports, etc. shall be fabricated from corrosion resistant materials. Preferred materials include stainless steel 316, PVC and GRP. Galvanised steel is not acceptable. The ventilation stack shall be fitted with a cowl covering to disperse the ventilated air and prevent wind from affecting the ventilation velocity.

6.2 Pumping System

6.2.1 Hydraulic design

The hydraulic design shall be determined by the following parameters:

a) Invert level of the incoming wastewater.
b) Pumping station capacity (initial and ultimate capacity).
c) Internal diameter, length, route and materials of the rising main, including surge and fatigue analysis.
d) Levels and profile of the rising main.
e) Level of the rising main discharge point.
f) High points - to account for possible characteristics controlled by intermediate highpoints along the rising main.
g) Detention times for wet well and rising main(s).
h) Shear velocity to prevent slime build-up in rising mains that will over time increase flow resistance.

The system design shall be based on the total pumping head with design flows anticipated at ultimate wet weather inflows and used to develop the system curve. In deriving the system curve the static head shall be based on pump duty start level at 150mm below the invert level of the incoming wastewater.

6.2.2 Pump selection

a) Pump selection shall be within ±5% of the pump best efficiency point (BEP).
b) The pump efficiency is influenced by the type of impeller selected for the specific pumping application. The minimum overall pump efficiency shall not be less than 50%. Lower efficiency may be considered in the following exceptional circumstances:
    - Where pumping stations are very small, or
    - The pump curve is very flat thereby consuming less power at intermediate flows, or
    - The anticipation of excessive impeller clogging and the associated maintenance outweighs the energy saving costs of selecting a more efficient impeller type.
c) Pump head curves with very flat head flow characteristics can make the pump difficult to control. Small changes in system resistance can create large changes in flowrate or cause 'hunting'. The use of variable speed drives (VSD) in these scenarios shall require prior approval from Watercare.
d) Consideration to pump wear over the pump maintenance cycle to achieve flow design criteria.
e) 100% standby capacity i.e. one duty pump and one standby pump. The pumps shall be of exact size, model and make and be approved by Watercare.
f) Net positive suction head (NPSH) analysis is not required for wet well pump design, but shall be a minimum of 1m over the wet well operating range.
g) Refer to Watercare electrical standards for VSD and starter requirements.

6.2.3 Pump physical requirements:

The minimum requirements of pumps shall comply with WSA101-2008 unless where exceeded or amended by this standard. The amendments are listed in the following table.

Clause	Amendment
2.1	Paragraph 1, delete: "See Appendix B for alternative materials"
	Replace Note with "Material equivalence will be considered by Watercare standards governance group or as may be nominated by the Standards Engineer"
2.4	Paragraph 4, delete: "hot-dip galvanized to AS/NZS 4680"
	Delete "Note: Other protective… may be acceptable"
Table 2.1	Delivery hose minimum grade "Class C rated to 10 bar" replace with "16 bar"
3.7.1	Notes, replace "a ruling committee of asset owners and operators selected by the Water Services Association of Australia (WSAA)" with "Watercare Services Ltd"
3.7.2	Note, replace "a ruling committee of asset owners and operators selected by the Water Services Association of Australia (WSAA)" with "Watercare Services Ltd"
3.7.3	Delete clause (b)

3.7.7.1	Delete clause 3.7.7.1 Insert: ”Electrical Motors shall comply with the requirements as specified by Watercare standard EC-06 Electrical Motors”
3.7.7.6	Last paragraph “of 15 m” , replace with “up to the maximum depth of the manhole wet well plus 5 m”
3.8.1	Delete “Note:…”
3.9.1	Delete clause 3.9.1
3.9.5	Replace “Flange gaskets… WSA 109.” with “Flange gaskets shall comply with Watercare standard MS-10 Supply of bolts, nuts, washers and gaskets. O-rings shall comply with AS1646:2007.”

6.2.1 Outlet pipework in the wet well

Outlet pipework from the pumps to the the first flange inside the the outlet valve chamber shall additional to the internal corrosion protection have external corrosion protection to withstand H_2S levels of up to 50 ppm with a high abrasion resistance rating in excess of 25 years. Suitable material may include stainless steel, ductile iron with suitable polymer coating or polyethylene sleeved or polyethylene pipe.

6.2.2 Valves

Valve installations shall be constructed with adequate support that will allow freestanding should any other component be removed. Dismantling joints shall be provided to allow removal of components. Isolation and non-return valves shall be the same diameter as the pipework being installed on.

The isolation valves with non-return valves shall be housed in a chamber adjacent to the wet well. In the case of the valve chamber being integrated with the wet well (preferred), the chamber shall be isolated from the wet well to prevent H_2S gas collecting in the valve chamber. The valve chamber shall be self-draining to the wet well through a check valve and trap arrangement.

6.2.2.1 Non-return valves

Non-return valves shall be swing check type with a rubberised steel disc and as accepted by Watercare.

6.2.2.2 Isolation valves

Valves shall comply with Watercare standard MS-15. Isolation valves shall be installed on each pump discharge line downstream of the non-return valves.

6.2.2.3 Air release valves

Air release valves shall be double acting and as accepted by Watercare. The air valves shall be located in an accessible chamber that is vented and fitted with either an activated carbon filter or vent stack (H_2S < 1ppm).

6.2.2.4 Knife gate valves

Knife gate valves may require to be installed on the inlet structure or the wet well. Knife gate valves shall be approved on a case by case basis and specific for the application head and flow rate.

6.2.3 Guide rails and lifting

Guide rails shall be stainless steel grade 316 to suit the standard dimensions for the pump pedestal. A double guide rail shall be supplied for each pump to allow free sliding and correct seating for the specific pump model.

All mounting brackets and fixtures shall be stainless steel grade 316. Spacing of mounting brackets shall be such as to avoid deflection. Minimum top and bottom fixing is required.

Lifting chains shall be stainless steel grade 316 and installed for each pump and the well washer.

6.3 Electrical, Control and Telemetry

Electrical, control and telemetry design and installation shall comply with the Watercare Electrical and Control series standards and drawing set 2010141 for wastewater pumping stations.

6.3.1 Electrical

The developer shall provide all equipment and wiring to complete the electrical connection. Additional to the electrical standards the following requirements for establishing electrical power on site shall be considered:

- Is the site owned by Watercare? Sites owned by Watercare can be coordinated for connection through Watercare Electrical and control department.
- Is there mains electricity available at the site location? If not a new installation point (ICP) is required to be made available by the developer.
- If mains electricity is available ensure that it is of sufficient capacity. Possible future expansion shall also be considered.
- Information required for the ICP include: supply phase; maximum demand load in Amps; physical address of connection; name and contact of the electrical contractor undertaking the works.

6.3.2 Control and Telemetry

The developer shall provide and install all telemetry equipment, data radio, aerial, mounting equipment, power supplies, relays and cabling including the field or control devices shown on the drawings. Watercare will provide a cost estimate for connecting to Watercare's network.

Watercare ECS department will complete a connection suitability study at the cost of the developer, per suggested location, to establish the telemetry requirements for the proposed pumping station site. The developer shall supply the GPS co-ordinates to WG84 at the centre of the proposed site. A desk study will determine if there is an available connection for the location.

If a connection is possible, the desktop study is followed by a site check to establish the signal to noise level to ensure a good quality signal is available.

Should there be no communications available or the signal strength is less than -82dB a specific design will be required. The cost of additional supporting infrastructure and design (if any) is a responsibility of the developer. An alternative location may be suggested to relocate the proposed pumping station to meet the telemetry requirements. These options will be communicated to the developer for consideration.

The telemetry and radio system shall be purchased from a Watercare standardised supplier, refer to EC-01. The installation shall be carried out by a Watercare approved contractor (contact details provided by the ECS department).

The developer shall obtain a facility code from Watercare that is used to provide the tag information used to configure the control system. The information required to obtain the facility code is:

- GIS location of the site.
- The physical address associated with the site.
- Lot number or Land Registry identification.

The SCADA software shall be developed and implemented by Watercare at the cost of the developer to allow connectivity to our systems.

Watercare has five different control systems. A guideline of the control system per Auckland area is given in the table below:

Auckland Area Major Facilities	Control System
Water Treatment DCS Metropolitan (Bulk)	Emerson DCS
Water Transmission SCADA Metropolitan (Bulk)	In touch SCADA
Wastewater Transmission SCADA Metropolitan (Bulk)	In touch SCADA
Wastewater Treatment DCS Metropolitan (Bulk)	Emerson DCS
Wastewater Transmission SCADA Metropolitan (Bulk)	In touch SCADA
Water Networks SCADA Metropolitan	IFIX LNT SCADA
Wastewater Treatment (NSCC Rosedale)	Citect SCADA
Wastewater Networks SCADA Metropolitan	IFIX LNT SCADA
Water Treatment Local/ Rural	Emerson DCS
Water Transmission SCADA Metropolitan (Bulk)	In touch SCADA
Wastewater Transmission SCADA Metropolitan (Bulk)	In touch SCADA
Wastewater Treatment DCS Metropolitan (Bulk)	Emerson DCS
Wastewater Transmission SCADA Metropolitan (Bulk)	In touch SCADA
Water Networks SCADA Metropolitan	IFIX LNT SCADA
Wastewater Treatment (North Shore City Council)	Citect SCADA
Waitakere (Ex Eco Water)	IFIX LNT SCADA
Rodney	IFIX LNT SCADA
Rodney Treatment Plants Water & Wastewater	Citect SCADA
Metropolitan (Ex Manukau)	IFIX LNT SCADA
Franklin	IFIX LNT SCADA
FranklinPlant Control	Abbey Systems Powerlink
Manukau	
Beachlands Wastewater Treatment	Citect SCADA
Kawakawa Bay Wastewater Treatment	Citect SCADA

In order for Watercare to complete the SCADA the following will be developed and supplied by the developer:

- Produce a Level 1 Functional Description (FD), to be reviewed and signed off by Watercare Operations before software programming commences.
- Liaise with ECS Point of Contact in the production of the Electrical/ Control system design.
- Process and instrumentation diagrams (P&IDs).
- Bill of materials.
- Confirmed Input and Output lists (I/O).

See **section 9** of this standard on readying for commissioning and handover.

6.4 Pumping Station outlet system

6.4.1 Discharge pipework (rising main)

6.4.1.1 Pipe Material

The minimum size of the rising main shall be 100mm. Smaller pipe sizes shall only be considered where future extension of the catchment is not foreseeable. Pipe material shall be supplied as complying with the applicable Watercare material standard.

The minimum pipe pressure rating shall be PN12 and any other component valve or fitting shall have a minimum pressure rating of PN16. Air release/vacuum valves with a pressure rating of PN10 may be considered on a case by case basis and is dependent on the discharge pipe hydraulics at locations such as close to the discharge structure.

The maximum pressure design shall consider pipe and fittings to be pressure de-rated based on the material maximum cyclic pressure range (MCPR).

The maximum operating pressure shall be less than the MCPR and the design pressure shall be less than the maximum operating pressure.

6.4.1.2 Hydraulic design

The rising main pipe shall be designed to:

- The minimum and maximum allowable flow velocities.
- Consideration to dry weather and wet weather flows (existing systems only where wet weather infiltration is current).
- Length of the main and allowable detention time.
- Maximum allowed number of pump starts.
- The working head.
- Withstand surge pressures not less than 200kPa.
- Withstand a transient pressure of at least 80kPa below atmospheric pressure.
- Length of the main and allowable detention time.

The maximum flow velocity shall be 2m/s. The minimum flow velocity shall be between 0.9m/s and 1.5m/s. The minimum flow velocity shall be calculated at the expected start of the service life. The design shall be carried out on the basis of full bore flow.

Head loss shall be calculated using the Darcy-Weisbach equation with frictional coefficients determined using the Colebrook-White equation. See the Watercare Code of Practice for Land Development and Subdivision, chapter 5, for a guideline to the roughness values of various pipe materials. Coefficients shall be considered for worn or aged pipe material.

Head losses through fittings shall be determined using head loss coefficient values referenced by the Hydraulic Institute Standard. Where a component is not listed by the Hydraulic Institute Standard the component manufacturer's value shall be used with a 10% in-accuracy factor.

Pressure surges shall be demonstrated to be within the amplitude of the acceptable limits throughout the system. The surge analysis shall take into account the material fatigue of the selected pipe material and the derived maximum allowable operating pressure. The design shall identify solutions for Watercare's approval to mitigate the surge effects. Possible solutions may include options such as surge control devices, pipe diameter, pipe material and pumping control.

6.4.1.3 Rising main layout

The main shall wherever possible rise continuously from the pumping station and terminate at its upper end into the receiving structure. Rising and falling mains (complex rising mains) shall be considered on exceptional circumstances. Where constructed in the road corridor the minimum cover shall be 900mm to the top of the rising main or as otherwise specified by the road corridor manager. The minimum rising or falling grade shall be 0.5%.

Where a continuous rising main is not achievable the following shall be provided for:

a) Peaks and low points shall be minimised.

b) Peaks shall be constructed with a double acting air release valve structure. The air release chamber shall be fitted with a ventilation stack to release air above the level of the surrounding roof tops or on approval into a surface mounted activated carbon filter designed for the expected air flow.

c) Low points shall be prominent and fitted with a scour arrangement that allows for health and environmentally safe discharge location accessible for a sucker truck

d) Scour valve and air release valve chambers and access shall be located in the back berm of the road corridor (the first 1m width of the road berm is defined as the front berm).

Rising mains shall not be situated in private properties. Clearance from buildings, structures and other infrastructure shall be observed as specified in the Watercare Code of Practice for Land Development and Subdivision, **Chapter 5 section 5.3.7**. No structures shall be constructed over rising mains or planting of any native species tree or shrubs with a maturity height over 1m tall.

6.4.1.4 Combined rising mains

Watercare will not accept the connection of a new rising main into an existing pumping rising main. Under exceptional circumstances parallel pumping will only be considered where the design basis is for a complete new parallel system or where the existing systems are re-designed and replaced. The replacement and upgrade of any existing infrastructure to enable a parallel connection into an existing system shall be at the cost of the developer.

The operating points for parallel pumping stations shall be considered for the full system to set individual pumping points based on the pumping head for each pumping station on the common rising main. The combined output shall be graphically determined using the individual geodetic heads; head loss components for each pumping station to the discharge point and then combined onto a single graph.

Where the common rising main is a complex rising main the graphical determination shall be supported with modelling software. Watercare prefers that the modelling information is provided in *InfoWorks*.

6.4.2 Receiving structure (Discharge MH)

The rising main shall discharge into a purpose manhole structure that will dissipate the energy of the rising main for transition into the gravity system. The rising main shall discharge into the MH on a rising gradient. The rise into the receiving structure shall be minimum 3m long. No other connections shall be made into the discharge MH.

The fall through the chamber between the top of the rising main pipe entry and the outlet pipe shall be minimum 150mm. The rising main and MH outlet shall not be more than 30^{o} out of alignment.

6.4.2.1 Odour control

Depending on the length, flow rate and energy dissipation, odour control and air relief may be required at the receiving structure.

Control shall be achieved by an appropriate filter or stack to disperse exhaust ventilation air over the roof tops of the surrounding buildings. Where it is predicted that a vent stack will be insufficient, a suitably

sized activated carbon filter installed on ground level or an odour bed (standard WW-08) shall be constructed.

6.5 Infrastructure and support systems

6.5.1 Water supply

A water supply through a metered connection with reduced pressure zone backflow preventer (RPZ) shall be installed to allow for wash-down and connection of the wet well and storage tank washer systems. The supply shall be fitted with a hose and reel long enough to reach the furthest internal end of any of the pumping station structures. The water service connection shall be minimum DN32 terminating in a stainless steel lockable cabinet adjacent to the wet well. See G12/AS1 of the Building Code, for the methods and devices required to comply with Watercare's requirements.

6.5.2 Lighting

Where considered an operational requirement or for safety reasons, site lighting may be specified. The lighting may be mounted to the ventilation stack, radio pole or a specific light post.

The position must be such as to provide adequate lighting over the wet well at a level that will not have obstructive and obtrusive effects. The lighting shall be adequately controlled to prevent annoyance to the neighbouring properties. The light switch shall be situated inside the control cabinet.

6.5.3 Drainage

The site shall have adequate drainage and fall to prevent standing or ponding water and prevent inflow into the station and cabinets. Overland drainage shall not affect neighbouring properties and may require a storm water system to be installed for discharge to a suitable location.

6.5.4 Noise control and vibration

Noise generated by the pumping station shall not exceed the Council permitted levels. The design shall include measures to reduce noise appropriately. Where the maximum noise level has not been specified under the resource consent the maximum shall level be 45 dB $L_{Aeq(15min)}$ measured at the pumping station boundaries.

Strong and long term vibrations can cause soil settlement in certain soil types as well as long term structural problems. Apart from the effects on physical structures vibration may also cause discomfort to adjacent property occupiers. The vibration velocity level shall not exceed 1mm/s measured at the pumping station wet well.

6.5.5 Materials handling

A rotating lifting arm or davit pole shall be specifically designed and fitted over the wet for lifting material in and out of the wet well. In some locations it may be required to install a removable davit arm. In this case a lifting pole socket shall be provided. The lifting pole shall be of sufficient minimum load rating to be used as a retrieval device for personnel entry. The maximum lift rating shall be imprinted on the davit arm. Adequate access shall be provided for mobile lifting plant around the pumping station installation.

6.5.6 Security

The site fencing shall have a lockable gate. All cabinets and access manholes shall be lockable. Cabinets and the wet well shall be fitted with an alarm that will signal unauthorised access through the SCADA system. Access lids shall be supplied with 'universal' padlocks and locking bolts. These shall be replaced by Watercare at commissioning of the pumping station.

6.5.7 Signage

Signage shall be provided that identifies the pumping station as the property of Watercare (requirements to be specified by Watercare communications unit) as well as the informative operational, health and safety signage that shall be installed at the pumping station perimeter.

6.5.8 Site access road

The site access road shall comply with Watercare standard CG-01 Site Roading and Development. Where required (typically at the end of a right-of-way) an adequate vehicle turning area shall be provided within the site. The access road shall have a load bearing sealed width of minimum 3.5m.

7. Design review

Once the design has been completed the designer shall undertake a review to ensure compliance with this standard. The design shall be signed-off (IPENZ PS1 or PS2) by a chartered professional engineer. Compliance checks shall cover the following minimum criteria before submittal for evaluation by Watercare:

- Health and safety considerations identified during the design that includes for construction, normal operation, maintenance and emergency operation.
- Community and environmental impact assessment.
- System components, layout and configuration meet this standard and are in accordance with the typical pumping station standard details in Appendix A.
- Pump selection.
- Plans indicating layout covering pipe size, grade, material types, transfer points and long sections.
- Details of air release/vacuum and scouring points.
- Route selection meets concept/planning design.
- Easements as appropriate.
- Geotechnical data and considerations taken into account during design.
- Provisions made for future extension as appropriate.
- Life cycle cost.
- Compliance with referenced standards.

8. Construction

The developer undertakes and finances the complete works in accordance with the approved design drawings. Construction monitoring shall be at CM4 level and a producer statement PS4 by a chartered professional engineer shall be provided (IPENZ).

Connection of the inlet and rising main outlet shall be on confirmation from Watercare Operations once all work has been constructed.

Each section, the inlet with emergency storage, the wet well with pumps and the outlet system shall be constructed but not connected until individually tested.

Construction practices for components shall comply with the following Watercare standards as applicable:

1. AI-02 Equipment labelling
2. BD-02 Manholes and miscellaneous chambers
3. CG-01 Site Roading and Development
4. CG-02 Pipeline construction
5. CG-03 Excavation and backfilling
6. CG-04 Pipe laying in embankment
7. CG-06 Installation of Polyethylene pipe

8. CG-07 Standard for Horizontal Directional Drilling
9. CG-12 Concrete construction
10. CG-13 Concrete construction for small structures
11. CG-15 Plumbing
12. CG-16 Altex Coating Standards
13. WW-01 Laying concrete and ceramic pipes
14. WW-02 Laying of CLS wastewater pipes
15. ME-07 Installation of full bore magnetic flowmeters (substitute BSEN 1092 for AS/NZS 4087 flanges)

As-built drawings shall comply with standard AI-01 “As Built and GIS data for Pipelines and Structures”. As a minimum redline mark-ups will be accepted for commissioning in anticipation of the final CAD versions being provided at handover.

8.1 Pumping station assets

Apart from capturing the linear assets on the pipelines, the following table lists the level of assets to be captured for the pumping station specifically:

Functional Location	Asset Name	Description
Pumps	Pump 1	Each pump (including motor if submersible pump) including guide rails, cabling, plug and socket
	Pump 2	Each pump (including motor if submersible pump) including guide rails, cabling, plug and socket
	Macerator	Pump station macerator (if separate from pump)
Buildings and Structures	Wet well	Main wet well structure including associated equipment such as lids, hatches, access ladders and platforms
	Wastewater Storage Tank	On-site wastewater storage tank including all associated equipment
	Safety Grille	Wet well and Storage tank safety grilles
	Wash-down System	Automated wash-down system for wet well or storage tank
	Drywell	Main underground (drywell) structure including associated equipment such as lids, hatches, ladders platforms and sump pumps
	Building	Main structure above ground including all building components, plumbing, lighting, ladders, platforms, wash-down hose
	Inlet Chamber	Inlet chamber (if separate from wet well) including associated equipment such as lids, hatches, ladders platforms
	Outlet Chamber	Outlet chambers for non-return valves and pump

		station/rising main isolation valve
	Flow Meter Chamber	The main flow meter chamber structure
	Overflow	The overflow structure including chambers, pipework and fittings
	Field Cabinet	Field cabinet containing electrical, control and communications equipment (Montrose box)
	Access Way/Hard Stand	All access ways, roads, footpaths and hard standing areas
	Fences	Fences gates and bollards
	Retaining walls	Seawalls or retaining walls
	Pole	All poles (excluding poles owned by other utilities i.e. Vector's power poles)
Valves	Inlet Valve/Penstock	Outside (if installed)
	Non Return Valve Pump 1	Including actuator if installed
	Non Return Valve Pump 2	Including actuator if installed
	Rising Main Isolation Valve	Pumping station/rising main isolation valve including actuator if installed
	Water Back Flow Prevention Device	Internal water backflow prevention device (excludes existing site's water meter and backflow prevention device)
Pipework	Pipework	Wastewater pipework, pump manifold pipes including fittings and equipment isolation valves
Electrical	Switchboard	Main electrical switchboard including motor cells, power factor correction, generator connection
	Generator	Generator and associated equipment and proprietary controller
	Motor 1	Motor for each pump (if separate from pump) including cabling
	Motor 2	Motor for each pump (if separate from pump) including cabling
	DOL Motor Starter 1	Pump's Direct on line (DOL) starter (if installed)
	DOL Motor Starter 2	Pump's DOL starter (if installed)
	Soft Starter Pump 1	Pump's soft starter (if installed)
	Soft Starter Pump 2	Pump's soft starter (if installed)
	VSD Pump 1	Pump's variable speed drive (if installed)
	VSD Pump 2	Pump's variable speed drive (if installed)
Controls	Control System	Control system (PLC, RTU, DCS) including cabling
	Communications	Communications equipment includes radio, aerial, mast and cabling

	Flowmeter	Pumping station flowmeter
	Level Control	Includes all level switches and instrumentation i.e. ultrasonic, probe and float switches
	Power Backup	Uninterrupted Power Supply (UPS), batteries and charger (typically 24V)
Odour Control	Fan	Extraction fan or fan associated with the odour control unit
	Ducting	Ducting associated with odour control unit
	Filter or Biofilter	Odour control structure/equipment including filter media
	Vent Stack	Odour vent stack
	Ozone Generator	Ozone odour control system
Lifting Equipment	Lifting Equipment	Includes all lifting equipment i.e. monorail, lifting davit
	Fall Restraint	Fall restraint connection
Fire & Security	Fire Protection	All fire protection equipment including smoke detection, fire extinguishers, fire hose reel
	Security System	All security system components

9. Testing and Handover

9.1 Commissioning

The inlet, outlet systems and wet well shall be tested in accordance with the Watercare Code of Practice for Land Development and Subdivision, Appendix C Field Testing of Pipelines and Manholes. All pre-testing shall be completed before commencing with commissioning.

Once the individual sections have been tested the final connections are made ready for commissioning of the pumps. A suitably qualified Watercare representative for the respective engineering disciplines shall witness and approve the commissioning.

Commissioning work shall not progress unless the following documentation has been provided and has been approved to proceed:

- Preliminary as-built drawings.
- Electrical certificate of compliance (CoC).
- Signed-off pre-commissioning test results of structures and pipework.
- Draft Functional Description.
- Process and instrumentation diagrams (P&ID).
- Draft Operations and Maintenance (O&M) Manual.
- Factory acceptance testing (FAT) completed, see Appendix B.
- Redline mark-up drawings.
- Commissioning plan.

The developer's commissioning plan shall include:

- HAZOP study.
- Testing of all control system inputs and outputs (I/O's), see Appendix C.

- Wet well level sensors and height adjustment.
- Alarm status.
- Pump control units.
- Data logging and analysis.
- Remote control and data transmission (RTU and PLC checks).
- Pump flow rates and rising main performance.
- Noise and vibration levels during operation.
- Odour control testing (following operational time).

Following commissioning of the pumping station the odour control systems shall be tested. A minimum of 4 weeks of operation shall have passed from the date of commissioning before testing H_2S levels at all venting locations. Any faults shall be corrected and retested after a further 4 weeks of bio-acclimatisation. H_2S concentration shall be measured to be less than 1 ppm at the perimeter of the pumping station.

Where biofilters have been installed the relative humidity shall be between 50-90% and maintaining an operating temperature in the range of 15 – 45 ºC. Also see Watercare standard WW-08 for additional commissioning requirements on biofilters.

Any non-conformance with this standard shall be corrected and re-tested.

9.2 Rejection of materials or products

All materials supplied shall be accepted or standardised equipment as applicable. Where products are required to be sourced that is not listed on any of these materials lists, prior approval by Watercare is required.

Materials supplied shall comply with the nominated standards and the minimum certification criteria provided as part of the handover process. Where substitutions of any materials or products are deemed necessary during the construction of the pumping station, approval in writing from both Watercare and the pumping station designer is required.

Materials not accepted by Watercare shall be replaced at the cost of the developer before Watercare takes over the pumping station or any of its operational components.

9.3 Handover documents

Watercare shall take over the pumping station when all of the below documentation are finalised and supplied:

i. Post-construction residual risks register.

ii. Operations and Maintenance Manual, see Appendix E.

iii. Final Functional Description (FD) supplied separately to the O&M manual, see Appendix D.

iv. Electrical Certificate of Compliance.

v. Design drawing sets, as-built drawings and survey data.

vi. Asset certificate (as per **section 8.1**), including other linear assets.

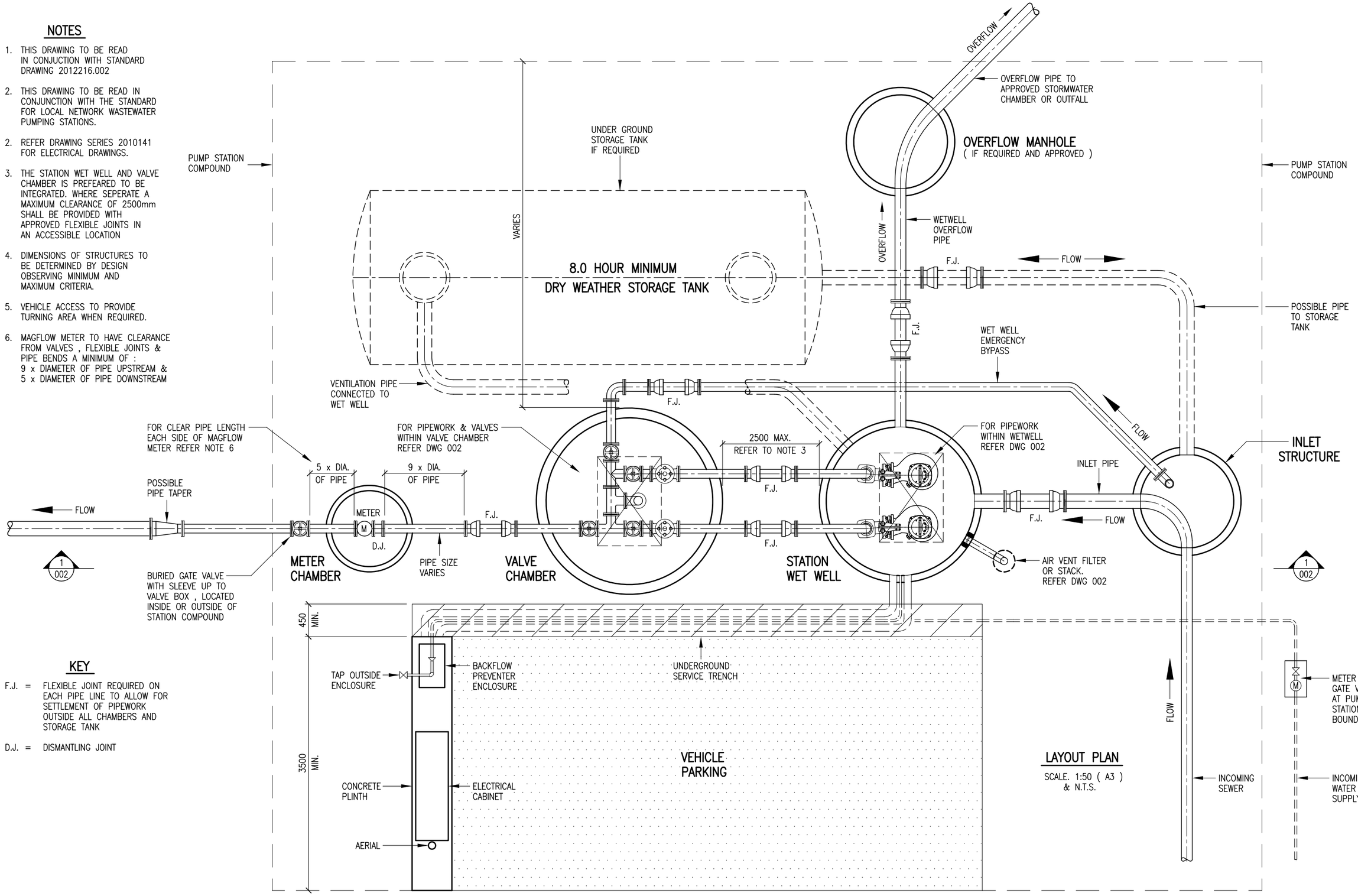
vii. Engineering producer statements.

All component, products and material warranties and guarantees shall be transferred to Watercare when vested. Power and water is transferred to Watercare once the pumping station is fully compliant.

10. Appendix A: Local Network Pumping Station Standard Design Drawings

NOTES

1. THIS DRAWING TO BE READ IN CONJUCTION WITH STANDARD DRAWING 2012216.002
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH THE STANDARD FOR LOCAL NETWORK WASTEWATER PUMPING STATIONS.
2. REFER DRAWING SERIES 2010141 FOR ELECTRICAL DRAWINGS.
3. THE STATION WET WELL AND VALVE CHAMBER IS PREFEARED TO BE INTEGRATED. WHERE SEPERATE A MAXIMUM CLEARANCE OF 2500mm SHALL BE PROVIDED WITH APPROVED FLEXIBLE JOINTS IN AN ACCESSIBLE LOCATION
4. DIMENSIONS OF STRUCTURES TO BE DETERMINED BY DESIGN OBSERVING MINIMUM AND MAXIMUM CRITERIA.
5. VEHICLE ACCESS TO PROVIDE TURNING AREA WHEN REQUIRED.
6. MAGFLOW METER TO HAVE CLEARANCE FROM VALVES , FLEXIBLE JOINTS & PIPE BENDS A MINIMUM OF : 9 x DIAMETER OF PIPE UPSTREAM & 5 x DIAMETER OF PIPE DOWNSTREAM



KEY

F.J. = FLEXIBLE JOINT REQUIRED ON EACH PIPE LINE TO ALLOW FOR SETTLEMENT OF PIPEWORK OUTSIDE ALL CHAMBERS AND STORAGE TANK

D.J. = DISMANTLING JOINT

LAYOUT PLAN

SCALE. 1:50 (A3) & N.T.S.

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ISSUE	DATE	AMENDMENT	BY	APPD.
–	06:15	CONSTRUCTION ISSUE	L.C.	J.D.

DESIGNED	J.D.	06–15	SIGNATORY 1
DES. CHECKED	S.D.	06–15	OPERATIONS
DRAWN	L.C.	06–15	
DWG. CHECKED	I.M.	06–15	SIGNATORY 2
PROJECT LEADER	J.D.	06–15	
INFRAST'R APP'D	A.S.	06–15	INFRASTRUCTURE

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WASTEWATER RETICULATION STANDARD
PUMPING STATION AND VALVE CHAMBER
TYPICAL LAYOUT PLAN

DRAFT

CAD FILE 2012216.001	DATE 26–06–15
ORIGINAL SCALE A1 AS SHOWN	CONTRACT No. –
REF. No. –	ISSUE –
DWG. No. 2012216 .001	–

PUMP STATION COMPOUND

STANDARD MANHOLE COVER AND FRAME

STANDARD SEALED HATCH REFER DWGS 2001979.XXX & XXX FOR SAFETY GRILLE

HATCH AS FOR VALVE CHAMBER

AIR VENT WITH FILTER OR STACK REFER NOTE 5

STANDARD MANHOLE COVER AND FRAME

900mm MIN.

RISING MAIN

P.T.

METER

F.J.

600 MIN.

F.T.J.

D.J.

VENTILATION PIPE FROM STORAGE TANK

150 MIN.

AIR VENT PIPE

STAINLESS STEEL CLAMP

OVERFLOW PIPE. REFER PLAN ON DWG 001 FOR POSSIBLE OPTIONS

INLET STRUCTURE WITHIN STATION COMPOUND REFER DWG 006

BURIED GATE VALVE WITH VALVE BOX ABOVE

400

G.V.

G.V.

N.R.V.

N.R.V.

150 MIN.

ANTI–FLOAT AS REQUIRED

METER CHAMBER

VALVE CHAMBER

COMPACTED MATERIAL

VALVE CHAMBER DRAIN PIPE

PUMPING STATION WET WELL

INLET STRUCTURE

WET WELL WASHER

FALL TO WET WELL

STAINLESS STEEL DEFLECTION PIPE OR STILLING DROPPER

F.J.

INLET PIPE

COMPACTED GAP40

TWO PUMPS SIZE VARIES

SECTION 1 – 1 – 001

SCALE. 1:50 (A3) & N.T.S.

MASS CONCRETE SURROUND

COMPACTED GAP40

NOTES

1. THIS DRAWING TO BE READ IN CONJUCTION WITH STANDARD DRAWING 2012216.001
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH THE STANDARD FOR LOCAL NETWORK WASTEWATER PUMPING STATIONS.
3. DIMENSIONS OF STRUCTURES TO BE DETERMINED BY DESIGN OBSERVING MINIMUM AND MAXIMUM CRITERIA.
4. REFER DRAWING SERIES 2010141 FOR ELECTRICAL DRAWINGS.
5. FOR AIR VENT OPTIONS REFER TO DWG 2012216.009
6. MAGFLOW METER TO HAVE CLEARANCE FROM VALVES , FLEXIBLE JOINTS & PIPE BENDS A MINIMUM OF : 9 x DIAMETER OF PIPE UPSTREAM & 5 x DIAMETER OF PIPE DOWNSTREAM

KEY

F.J. = FLEXIBLE JOINT
G.V. = STEEL GATE VALVE
P.1. = PUMP No1
P.2. = PUMP No2 (STANDBY)
P.T. = PUMP TAPER
D.J. = DISMANTLING JOINT
N.R.V. = NON RETURN VALVE
F.T.J. = FLANGED TEE JOINT
P.D.C. = PUMPOUT CONNECTION POINT

FOR PIPEWORK OUTSIDE WET WELL AND SATELLITE MANHOLE REFER TO LAYOUT PLAN ON DWG 001

VENTILATION PIPE CONNECTED TO WET WELL FROM STORAGE TANK

FOR CLEAR PIPE LENGTH EACH SIDE OF MAGFLOW METER REFER NOTE 6

REFER ' KEY ' ABOVE FOR VALVES TYPES AND FITTINGS WITHIN VALVE CHAMBER

5 x DIA. OF PIPE

9 x DIA. OF PIPE

POSSIBLE PIPE TAPER

FLOW

METER

F.J.

D.J.

P.D.C.

P.2.

P.1.

G.V.

G.V.

N.R.V.

D.J.

F.J.

F.J.

F.J.

F.J.

FLOW

FLOW

FLOW

PUMP STATION COMPOUND

INLET PIPE

PIPE SIZE VARIES

METER CHAMBER

VALVE CHAMBER

STATION WET WELL

INLET STRUCTURE

BURIED GATE VALVE WITH SLEEVE UP TO VALVE BOX , LOCATED INSIDE OR OUTSIDE OF STATION COMPOUND

AIR RELEASE WITH FILTER OR STACK

PLAN 2 – 1

SCALE. 1:50 (A3) & N.T.S.

TAP OUTSIDE ENCLOSURE

BACKFLOW PREVENTER ENCLOSURE

VEHICLE PARKING

UNDERGROUND SERVICE TRENCH

FLOW

INCOMING SEWER

METER AND GATE VALVE

INCOMING WATER SUPPLY

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WASTEWATER RETICULATION STANDARD
PUMPING STATION AND VALVE CHAMBER
PLAN AND LONGITUDINAL SECTION

DRAFT

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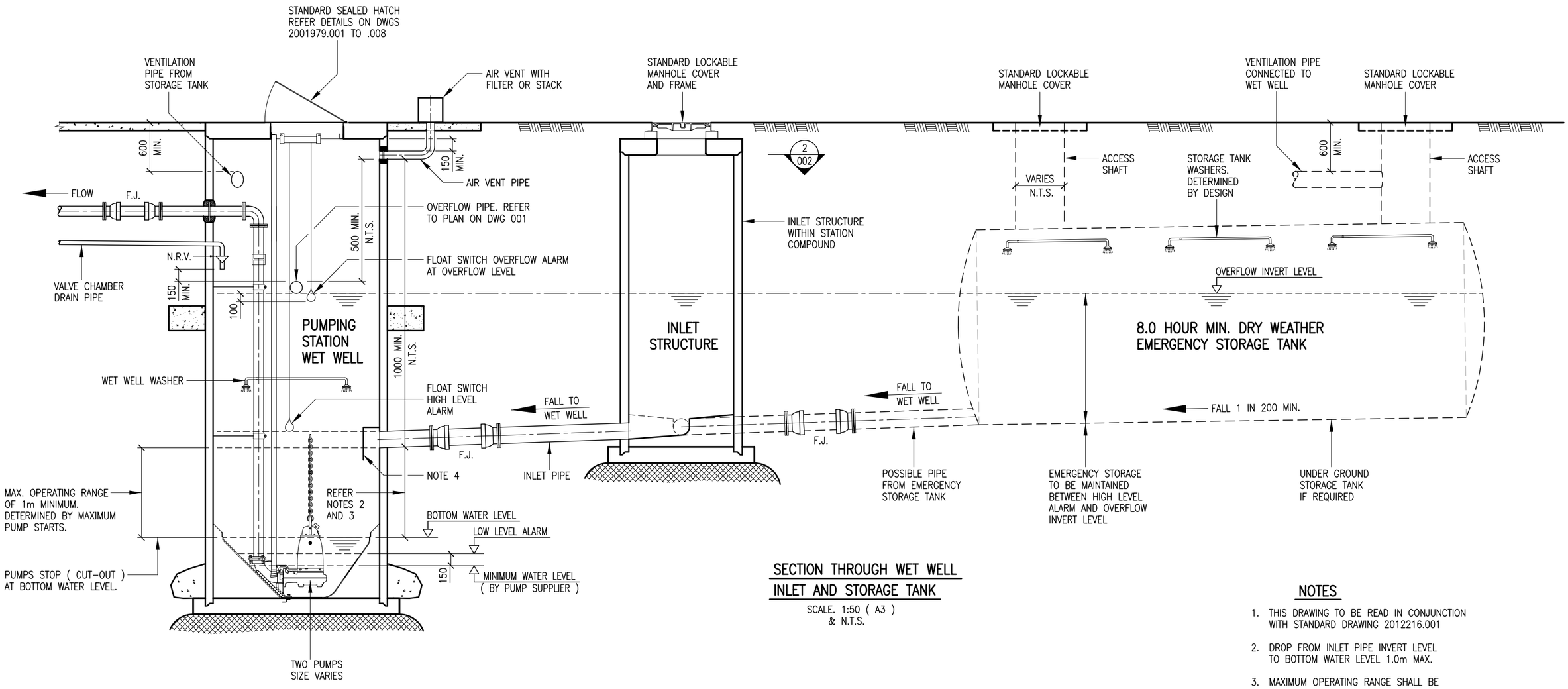
KEY

F.J. = FLEXIBLE JOINT
N.R.V. = NON RETURN VALVE
N.T.S. = NOT TO SCALE



SECTION THROUGH WET WELL INLET AND STORAGE TANK

SCALE. 1:50 (A3)
& N.T.S.

NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH STANDARD DRAWING 2012216.001
2. DROP FROM INLET PIPE INVERT LEVEL TO BOTTOM WATER LEVEL 1.0m MAX.
3. MAXIMUM OPERATING RANGE SHALL BE BELOW INLET PIPE INVERT LEVEL.
4. STAINLESS STEEL DEFLECTION PIPE OR STILLING DROPPER
5. DIMENSIONS OF STRUCTURES TO BE DETERMINED BY DESIGN OBSERVING MINIMUM AND MAXIMUM CRITERIA.

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DESIGNED	J.D.	06–15	SIGNATORY 1
DES. CHECKED	S.D.	06–15	OPERATIONS
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WASTEWATER RETICULATION STANDARD
PUMPING STATION INLET AND STORAGE
WET WELL LEVELS

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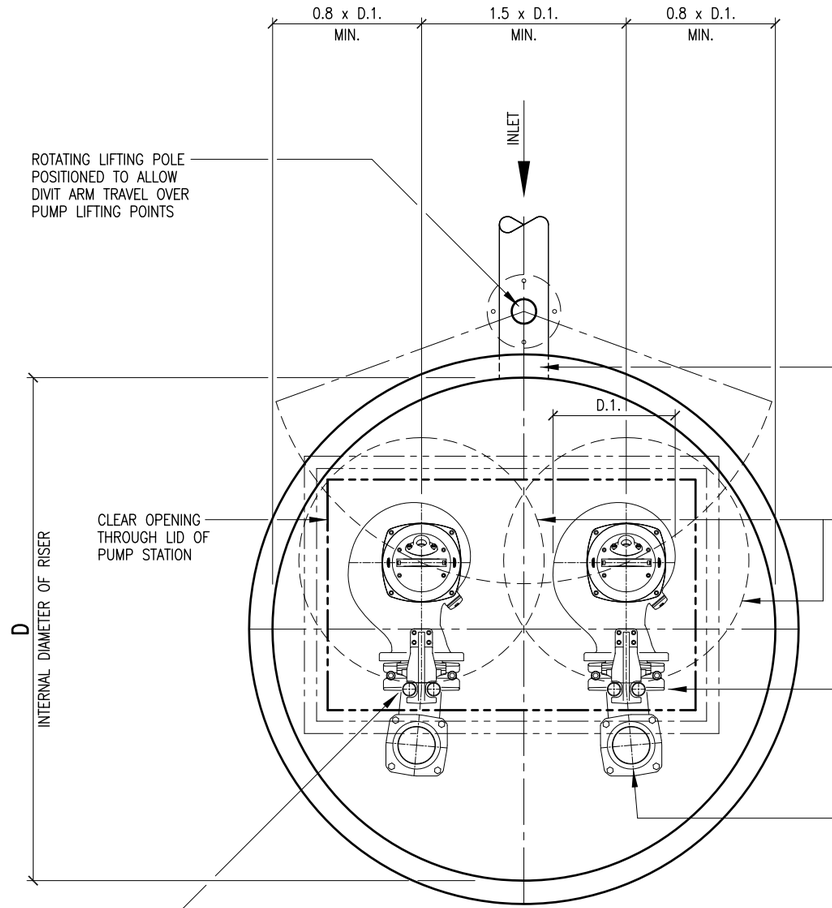
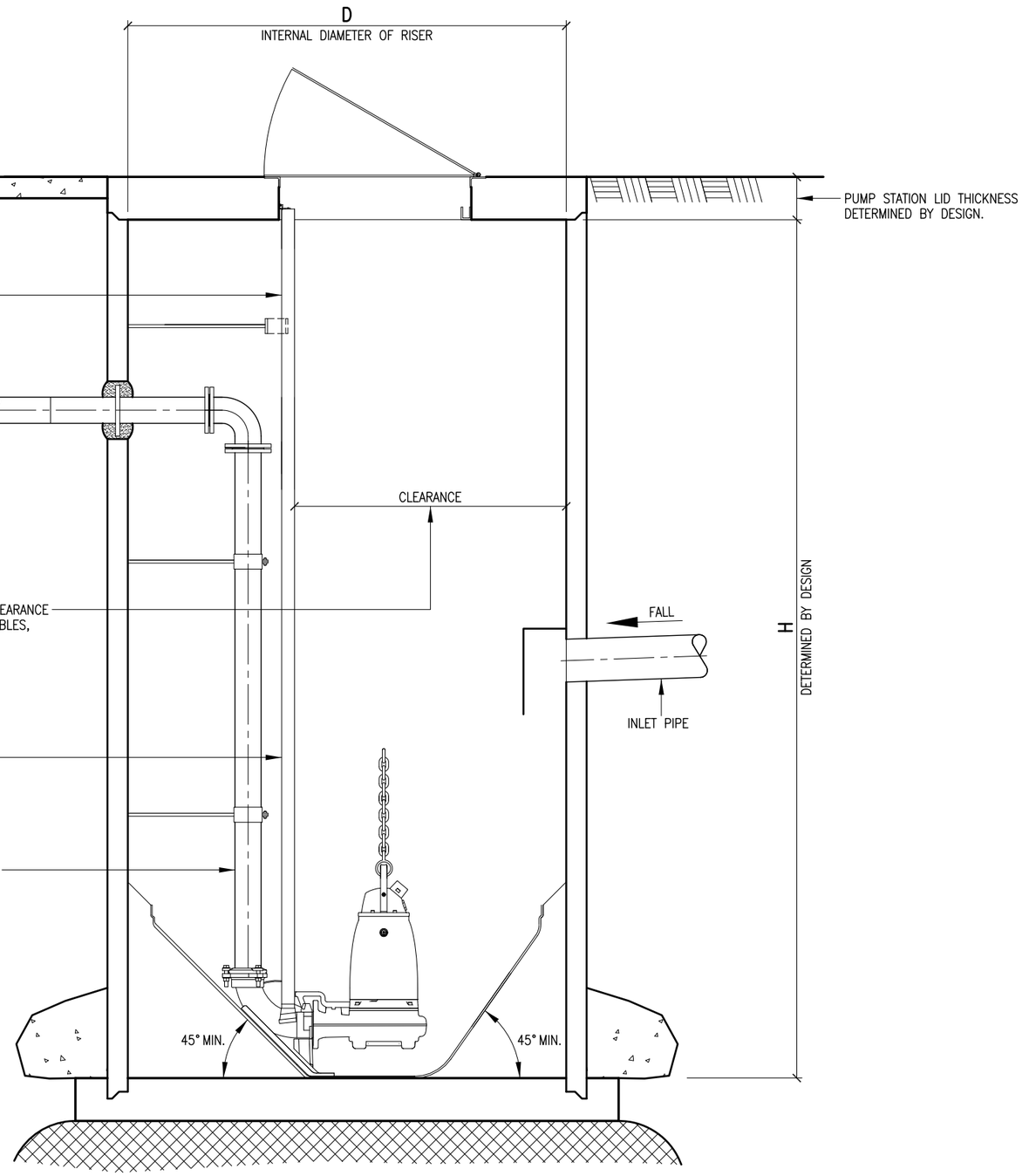


PLAN AT WET WELL

SCALE. 1:25 (A3)
& N.T.S.



SECTION THROUGH WET WELL

SCALE. 1:25 (A3)
& N.T.S.

KEY

D	=	INTERNAL DIA. OF MANHOLE RISER
H	=	HEIGHT FROM UNDERSIDE OF LID TO BOTTOM OF WET WELL
D.1.	=	OVERALL MAX. DIAMETER OF PUMP
N.T.S.	=	NOT TO SCALE
MIN.	=	MINIMUM

NOTES

1. H & D TO BE DETERMINED BY DESIGN
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWING 2012216.003 AND 005
3. PIPE CLEARANCES STATED ARE THE MINIMUM OR AS OTHERWISE SPECIFIED BY THE PUMP SUPPLIER, WHICH EVER IS GREATER.

L:\---\EGCADFI\2015\STANDARD WASTEWATER DRAWINGS\2012216.004 .DWG

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–	06:15	CONSTRUCTION ISSUE	L.C.	J.D.

DESIGNED	J.D.	06–15
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PROJECT LEADER	J.D.	06–15
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	BY	DATE

SIGNATORY 1
OPERATIONS
SIGNATORY 2
INFRASTRUCTURE

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WASTEWATER RETICULATION STANDARD
PUMPING STATION WET WELL
WET WELL CLEARANCES AND DIMENSIONS

DRAFT

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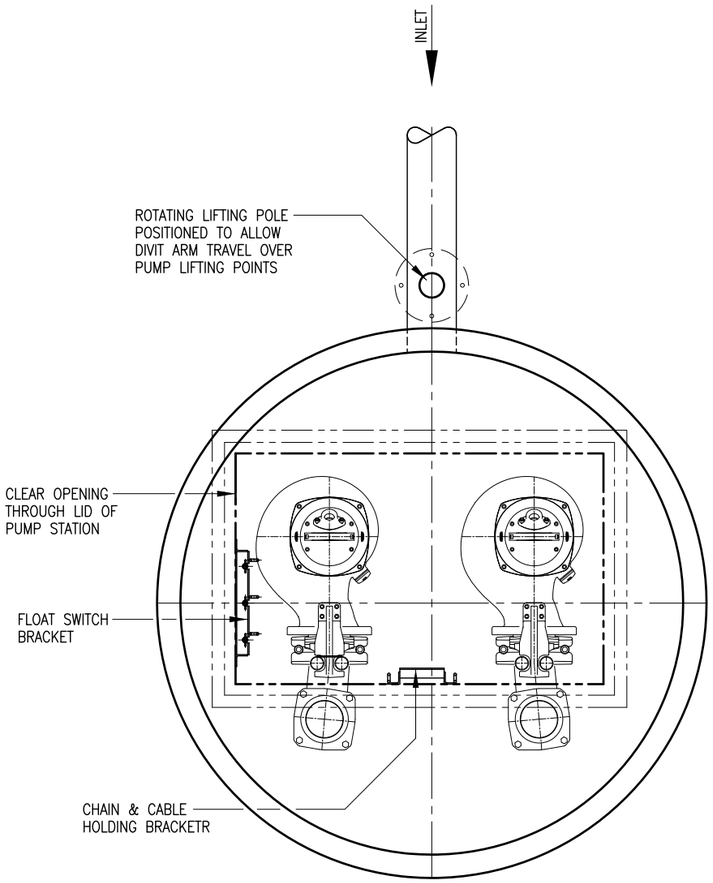
ORIGINAL SCALE A1 AS SHOWN	CONTRACT No. –
REF. No. –	ISSUE –
DWG. No. 2012216 .004	–

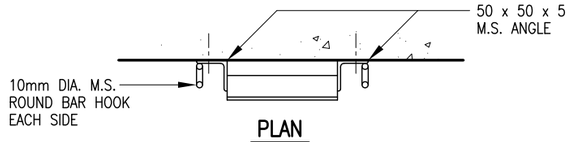


PLAN AT WET WELL

SCALE. 1:25 (A3)
& N.T.S.

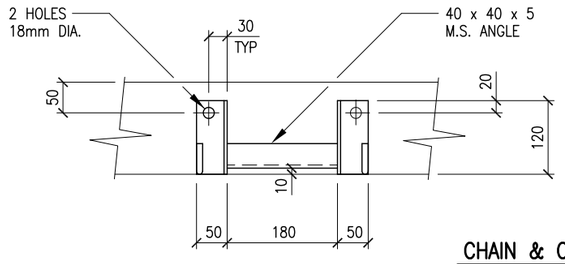
NOTE

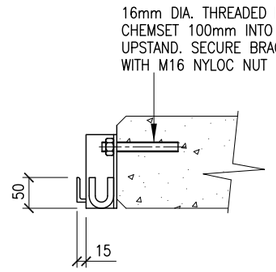
THIS DRAWING TO BE READ IN CONJUCTION WITH STANDARD DRAWING 2012216.004



PLAN

SCALE. 1:5 (A3)

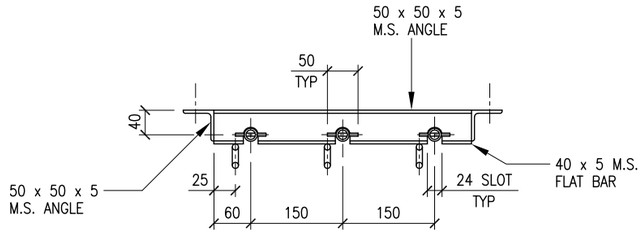




CHAIN & CABLE HOLDER BRACKET

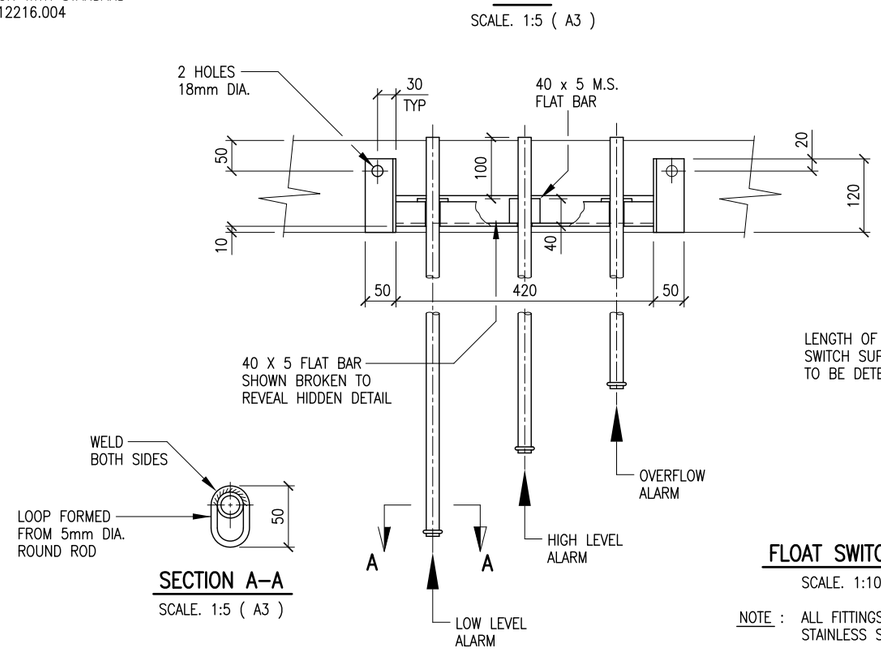
SCALE. 1:10 (A3)

NOTE : ALL FITTINGS TO BE TYPE 316 STAINLESS STEEL



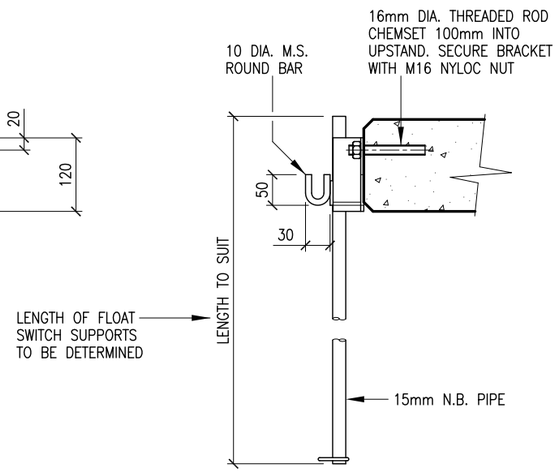
PLAN

SCALE. 1:5 (A3)



SECTION A–A

SCALE. 1:5 (A3)



FLOAT SWITCH BRACKET

SCALE. 1:10 (A3)

NOTE : ALL FITTINGS TO BE TYPE 316 STAINLESS STEEL

L:\---\EGCADFI\2015\STANDARD WASTEWATER DRAWINGS\2012216.005 .DWG

ISSUE	DATE	AMENDMENT	BY	APPD.
–	06:15	CONSTRUCTION ISSUE	L.C.	J.D.

DESIGNED	J.D.	06–15
DES. CHECKED	S.D.	06–15
DRAWN	L.C.	06–15
DWG. CHECKED	I.M.	06–15
PROJECT LEADER	J.D.	06–15
INFRAST'R APP'D	A.S.	06–15

SIGNATORY 1
OPERATIONS
SIGNATORY 2
INFRASTRUCTURE

Watercare

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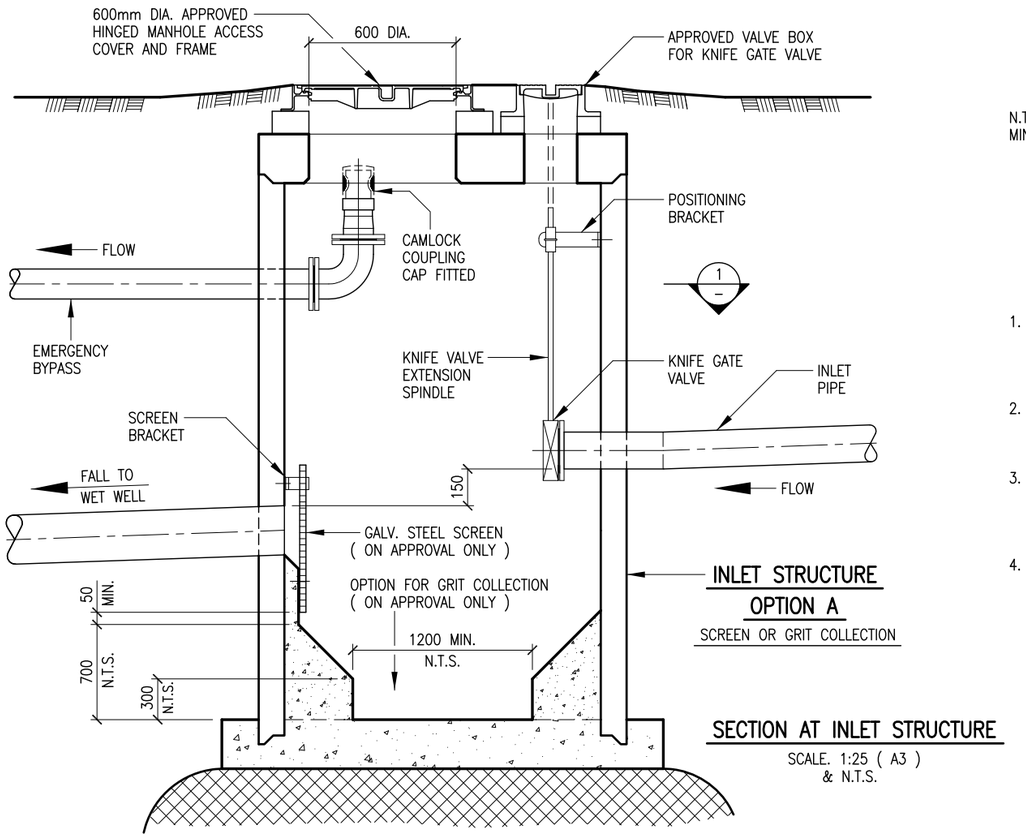
WASTEWATER RETICULATION STANDARD
PUMPING STATION WET WELL
WET WELL BRACKETS

DRAFT

CAD FILE 2012216.005	DATE 26–06–15
ORIGINAL SCALE A1 AS SHOWN	CONTRACT No. –
REF. No. –	ISSUE –
DWG. No. 2012216 .005	–



INLET STRUCTURE OPTION A

SCREEN OR GRIT COLLECTION

SECTION AT INLET STRUCTURE

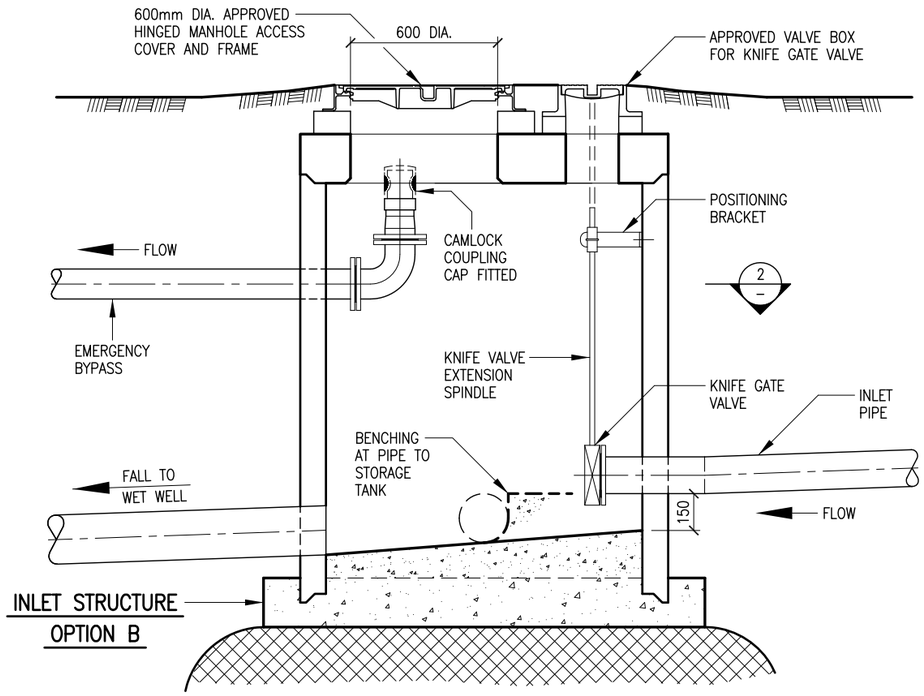
SCALE. 1:25 (A3) & N.T.S.

KEY

N.T.S. = NOT TO SCALE
MIN. = MINIMUM

NOTES

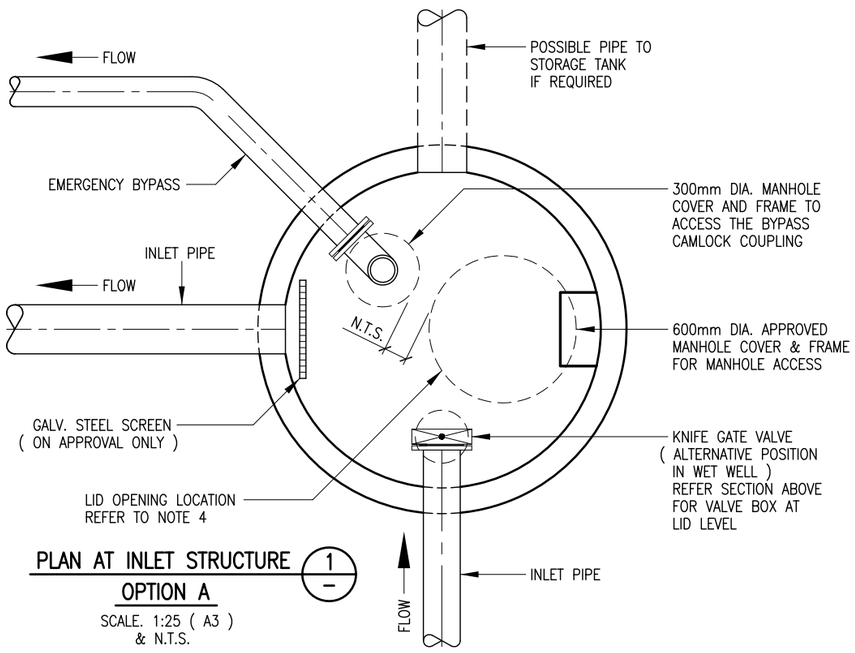
1. THIS DRAWING TO BE READ IN CONJUNCTION WITH STANDARD DRAWINGS 2012216.001 TO .003
2. DETAILS ON THIS DRAWING SHEET ARE DIAGRAMMATIC. PIPE SIZES AND INVERT LEVELS VARY.
3. THE TYPICAL DETAIL SHALL BE OPTION B. OPTION A REQUIRES SPECIFIC APPROVAL FROM WATERCARE.
4. LID OPENING LOCATION BY DESIGN. ALL LIDS TO BE DESIGNED TO HN-HO-72



INLET STRUCTURE OPTION B

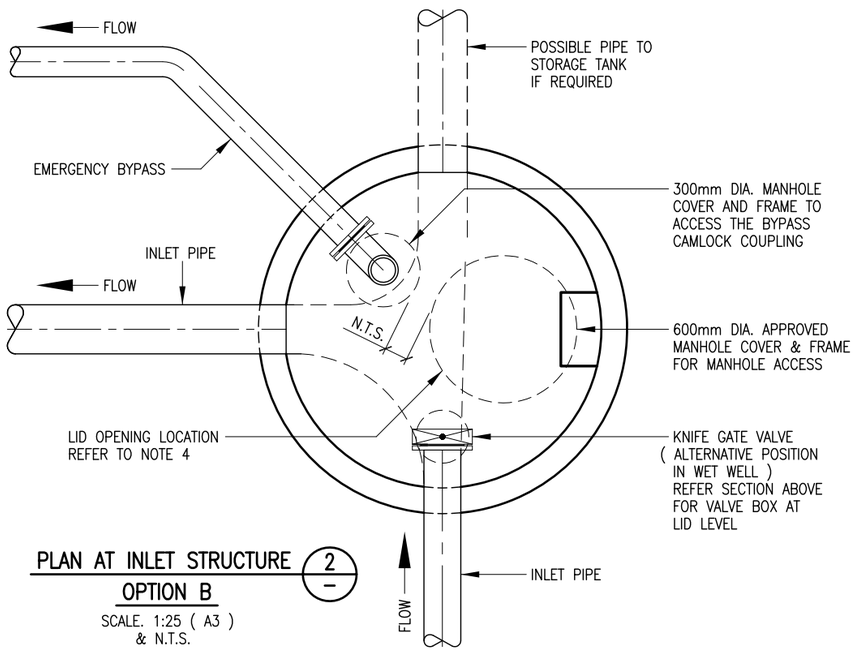
SECTION AT INLET STRUCTURE

SCALE. 1:25 (A3) & N.T.S.



PLAN AT INLET STRUCTURE OPTION A — 1

SCALE. 1:25 (A3) & N.T.S.



PLAN AT INLET STRUCTURE OPTION B — 2

SCALE. 1:25 (A3) & N.T.S.

L:\---\EGCADFI\2015\STANDARD WASTEWATER DRAWINGS\2012216.006 .DWG

ISSUE	DATE	AMENDMENT	BY	APPD.
–	06:15	CONSTRUCTION ISSUE	L.C.	J.D.

DESIGNED	J.D.	06-15	SIGNATORY 1
DES. CHECKED	S.D.	06-15	OPERATIONS
DRAWN	L.C.	06-15	
DWG. CHECKED	I.M.	06-15	SIGNATORY 2
PROJECT LEADER	J.D.	06-15	INFRASTRUCTURE
INFRAST'R APP'D	A.S.	06-15	

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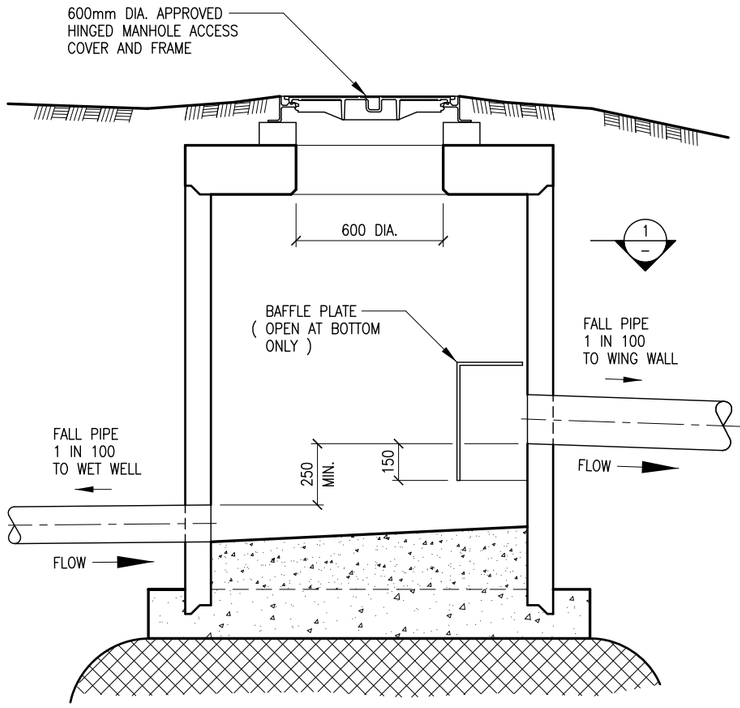
WASTEWATER RETICULATION STANDARD PUMPING STATION INLET STRUCTURE

DETAILED PLAN AND SECTION – OPTIONS A & B

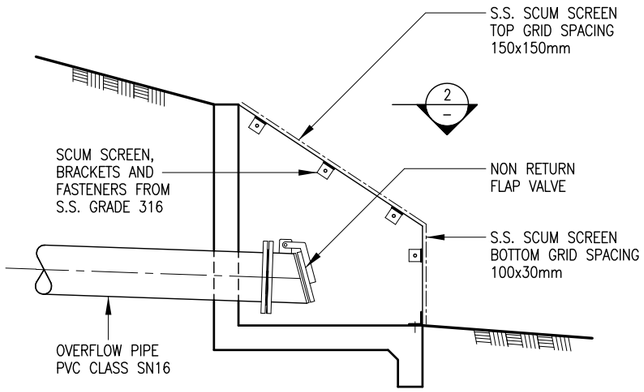
DRAFT

CAD FILE 2012216.006	DATE 26-06-15
ORIGINAL SCALE A1 AS SHOWN	CONTRACT No. –
REF. No. –	ISSUE –
DWG. No. 2012216 .006	–



SECTION AT OVERFLOW M.H.

SCALE. 1:25 (A3)
& N.T.S.



SECTION AT OVERFLOW WING WALL

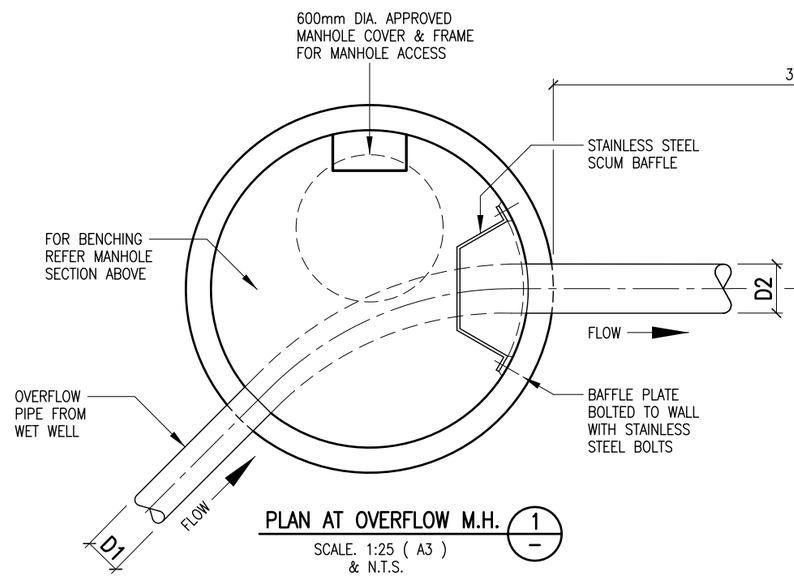
SCALE. 1:25 (A3)
& N.T.S.

KEY

S.S.	=	STAINLESS STEEL
N.T.S.	=	NOT TO SCALE
MIN.	=	MINIMUM

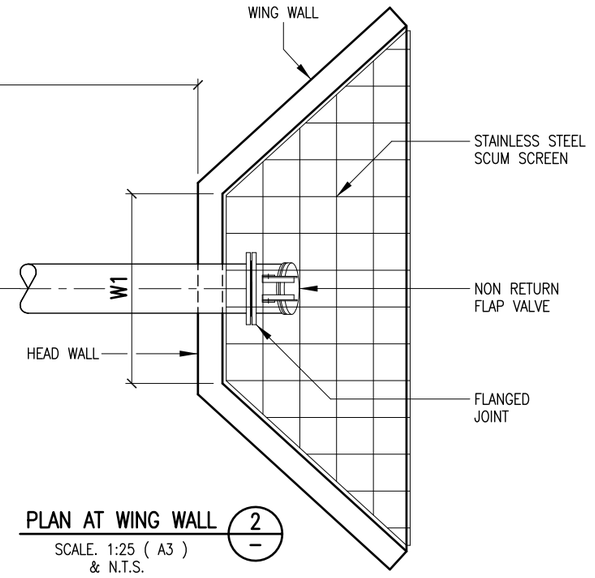
NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH STANDARD DRAWING 2012216.001
2. DETAILS ON THIS DRAWING SHEET ARE DIAGRAMMATIC. PIPE SIZES AND LEVELS VARIES.



PLAN AT OVERFLOW M.H. 1 –

SCALE. 1:25 (A3)
& N.T.S.



PLAN AT WING WALL 2 –

SCALE. 1:25 (A3)
& N.T.S.

WING WALL SIZING TABLE			
D1	D2	W1	NOTE
150	225	300	OTHER WING WALL PARAMETERS TO SPECIFIC DESIGN
225	300	450	
300	375	800	

L:\---\EGCADFI\2015\STANDARD WASTEWATER DRAWINGS\2012216.007 .DWG

ISSUE	DATE	AMENDMENT	BY	APPD.
–	06:15	CONSTRUCTION ISSUE	L.C.	J.D.

DESIGNED	J.D.	06–15	SIGNATORY 1
DES. CHECKED	S.D.	06–15	OPERATIONS
DRAWN	L.C.	06–15	
DWG. CHECKED	I.M.	06–15	SIGNATORY 2
PROJECT LEADER	J.D.	06–15	INFRASTRUCTURE
INFRAST'R APP'D	A.S.	06–15	

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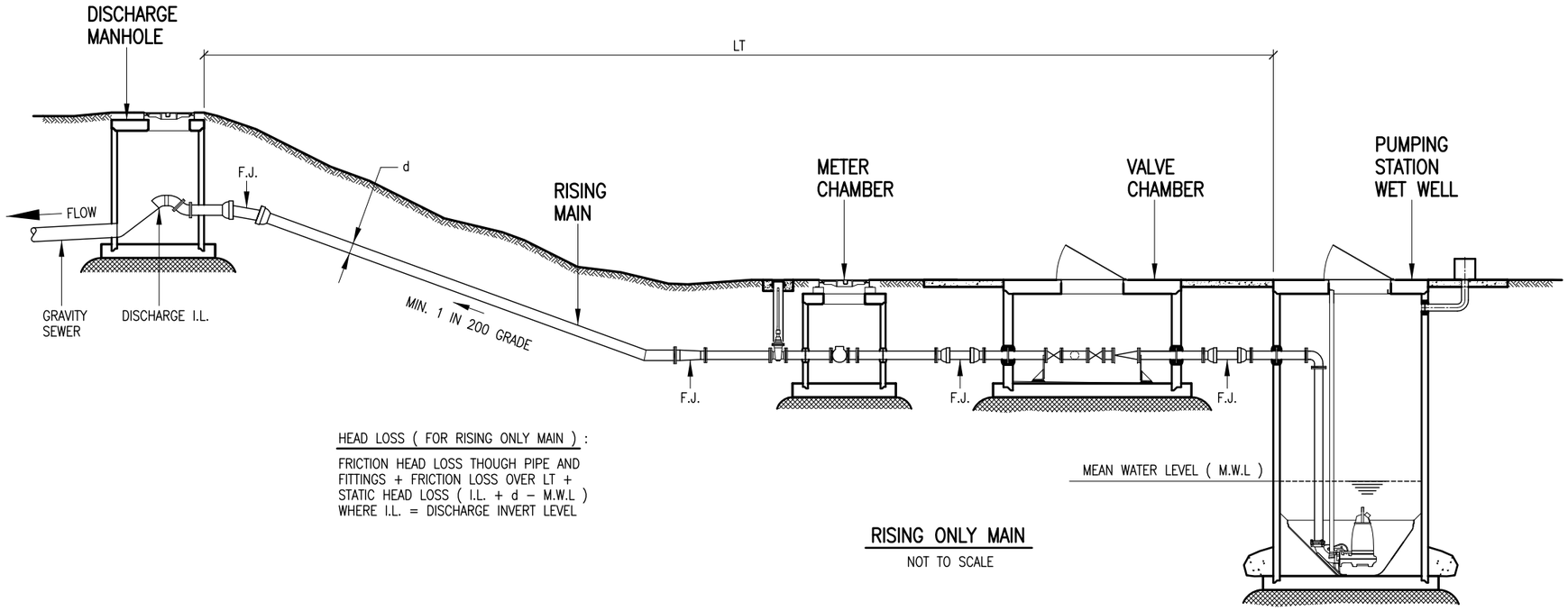
WASTEWATER RETICULATION STANDARD
PUMPING STATION OVERFLOW MANHOLE & WING WALL
DETAILED PLAN AND SECTION

DRAFT

CAD FILE 2012216.007	DATE 26–06–15
ORIGINAL SCALE A1 AS SHOWN	CONTRACT No. –
REF. No. –	ISSUE –
DWG. No. 2012216 .007	–



HEAD LOSS (FOR RISING ONLY MAIN) :

FRICTION HEAD LOSS THOUGH PIPE AND FITTINGS + FRICTION LOSS OVER LT + STATIC HEAD LOSS (I.L. + d – M.W.L) WHERE I.L. = DISCHARGE INVERT LEVEL

RISING ONLY MAIN

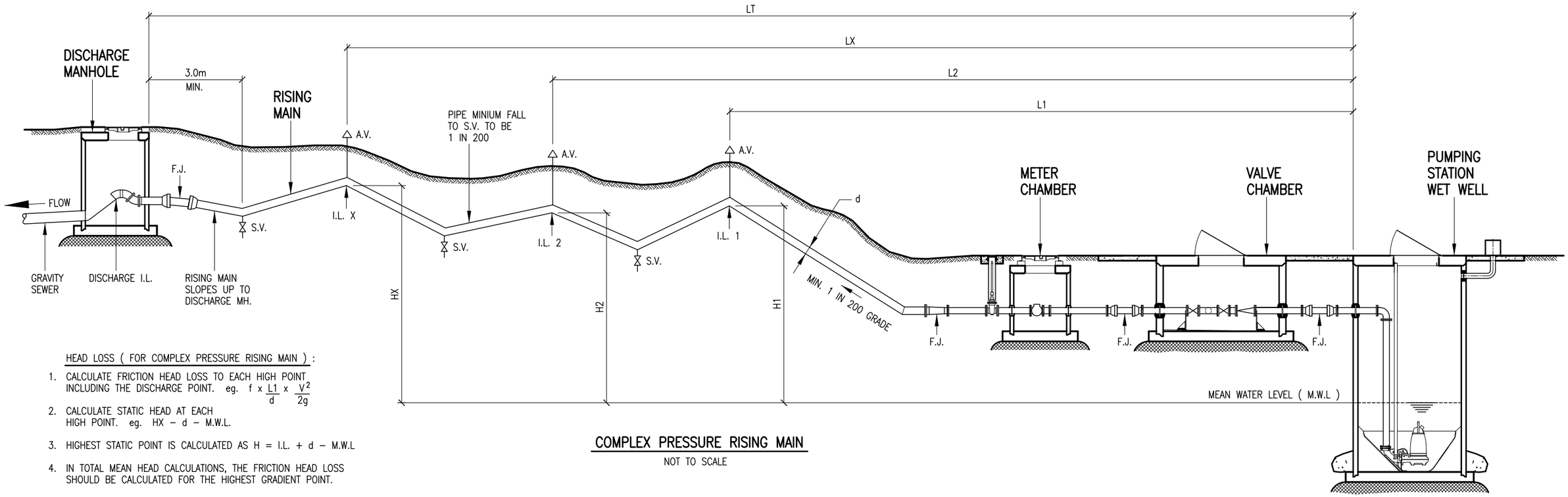
NOT TO SCALE

NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH STANDARD DRAWINGS 2012216.001 & 002
2. DETAILS ON THIS DRAWING SHEET ARE DIAGRAMMATIC. PIPE SIZES AND INVERT LEVELS VARY.

KEY

M.W.L.	=	MEAN WATER LEVEL
A.V.	=	AIR RELEASE VALVE
S.V.	=	SCOUR VALVE
F.J.	=	FLEXIBLE JOINT
I.L.	=	INVERT LEVEL
MH.	=	MANHOLE
MIN.	=	MINIMUM
f	=	COEFICIENT OF FRICTION
d	=	INTERNAL DIA. OF PIPE
g	=	GRAVITY (9.81m/sec.)



HEAD LOSS (FOR COMPLEX PRESSURE RISING MAIN) :

1. CALCULATE FRICTION HEAD LOSS TO EACH HIGH POINT INCLUDING THE DISCHARGE POINT. eg. $f \times \frac{L1}{d} \times \frac{V^2}{2g}$
2. CALCULATE STATIC HEAD AT EACH HIGH POINT. eg. HX – d – M.W.L.
3. HIGHEST STATIC POINT IS CALCULATED AS H = I.L. + d – M.W.L
4. IN TOTAL MEAN HEAD CALCULATIONS, THE FRICTION HEAD LOSS SHOULD BE CALCULATED FOR THE HIGHEST GRADIENT POINT.

COMPLEX PRESSURE RISING MAIN

NOT TO SCALE

L:\---\EGCADFI\2015\STANDARD WASTEWATER DRAWINGS\2012216.008 .DWG

ISSUE	DATE	AMENDMENT	BY	APPD.
–	06:15	CONSTRUCTION ISSUE	L.C.	J.D.

DESIGNED	J.D.	06–15
DES. CHECKED	S.D.	06–15
DRAWN	L.C.	06–15
DWG. CHECKED	I.M.	06–15
PROJECT LEADER	J.D.	06–15
INFRAST'R APP'D	A.S.	06–15

SIGNATORY 1
OPERATIONS
SIGNATORY 2
INFRASTRUCTURE

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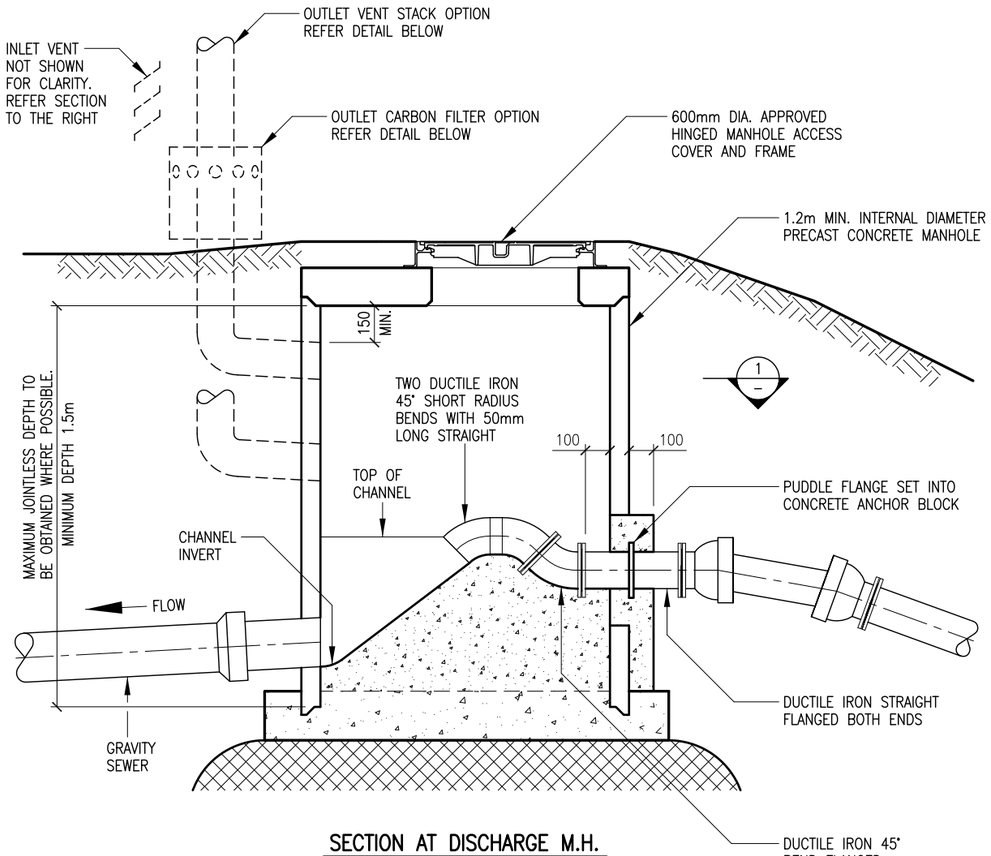
WASTEWATER RETICULATION STANDARD
PUMPING STATION RISING MAIN
TYPICAL LAYOUT SECTIONS

DRAFT

CAD FILE 2012216.008	DATE 26–06–15
ORIGINAL SCALE A1 AS SHOWN	CONTRACT No. –
REF. No. –	ISSUE –
DWG. No. 2012216 .008	–



SECTION AT DISCHARGE M.H.

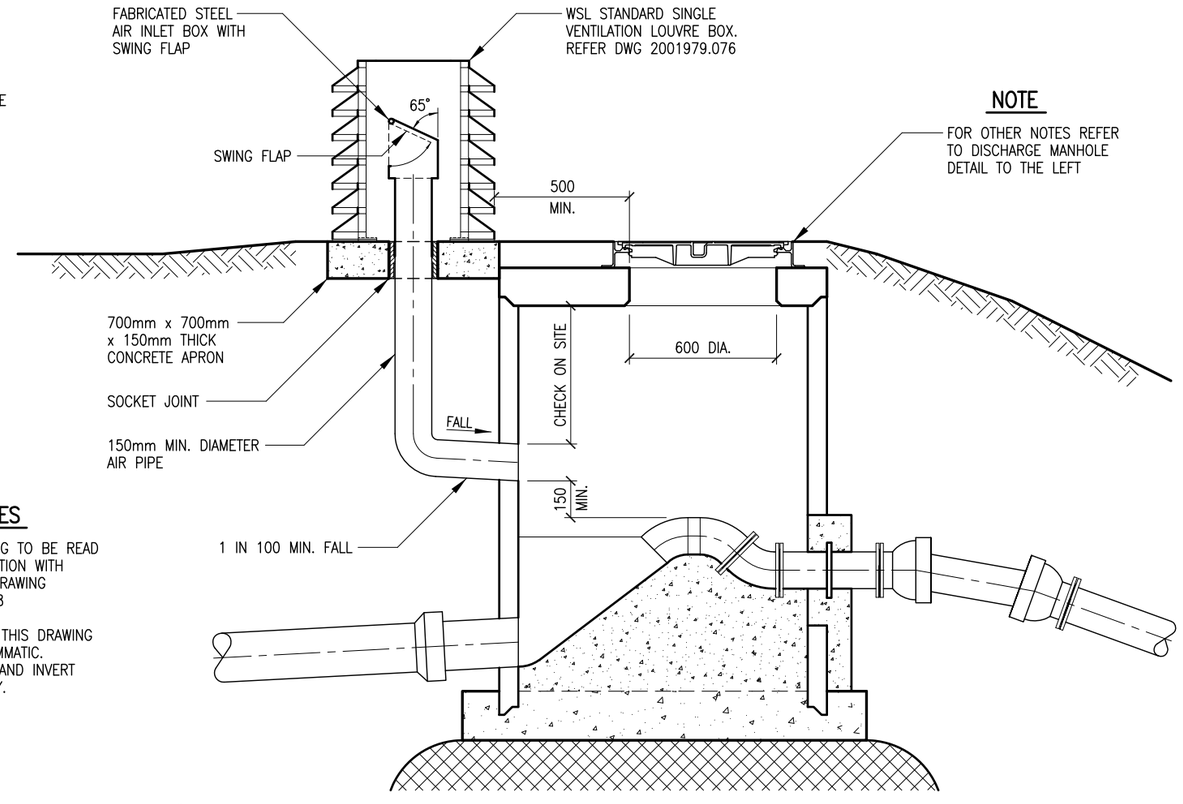
SCALE. 1:25 (A3)
& N.T.S.

KEY

N.T.S. = NOT TO SCALE
MIN. = MINIMUM

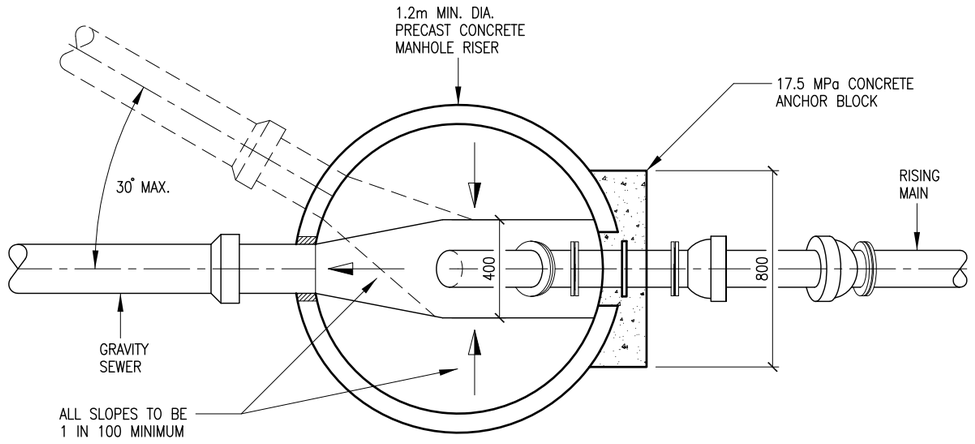
NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH STANDARD DRAWING 2012216.008
2. DETAILS ON THIS DRAWING ARE DIAGRAMMATIC. PIPE SIZES AND INVERT LEVELS VARY.



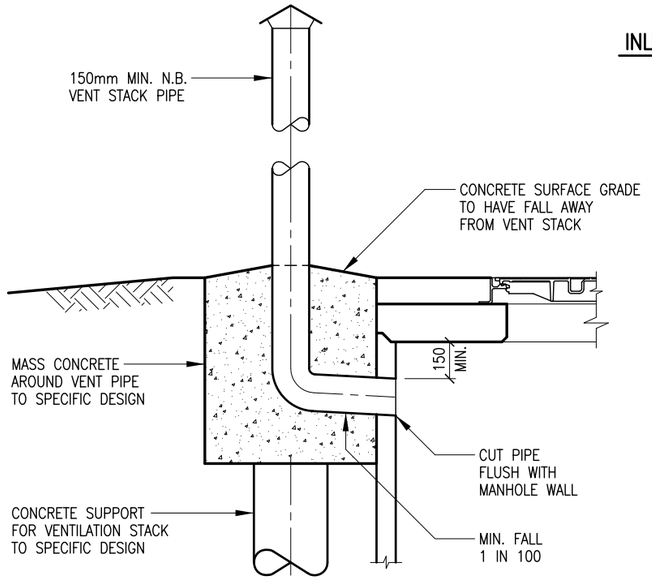
INLET VENT AT DISCHARGE M.H.

SCALE. 1:25 (A3)
& N.T.S.



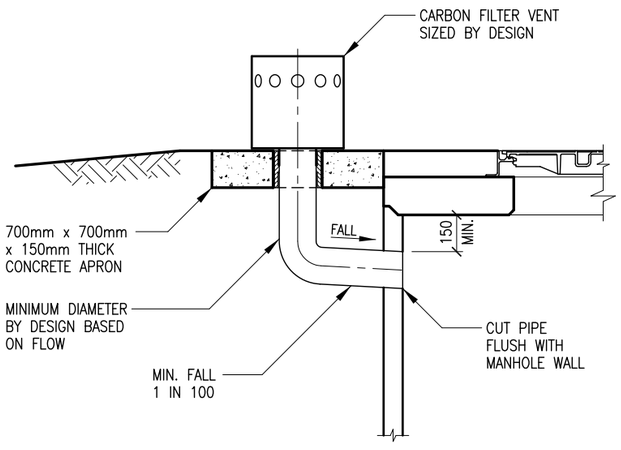
PLAN AT DISCHARGE M.H. (1)

SCALE. 1:25 (A3)
& N.T.S.



OUTLET VENT STACK OPTION

SCALE. 1:25 (A3)
& N.T.S.



OUTLET CARBON FILTER VENT OPTION

SCALE. 1:25 (A3)
& N.T.S.

L:\---\EGCADFI\2015\STANDARD WASTEWATER DRAWINGS\2012216.009 .DWG

ISSUE	DATE	AMENDMENT	BY	APPD.
–	06:15	CONSTRUCTION ISSUE	L.C.	J.D.

DESIGNED	J.D.	06–15
DES. CHECKED	S.D.	06–15
DRAWN	L.C.	06–15
DWG. CHECKED	I.M.	06–15
PROJECT LEADER	J.D.	06–15
INFRAST'R APP'D	A.S.	06–15

SIGNATORY 1
OPERATIONS
SIGNATORY 2
INFRASTRUCTURE

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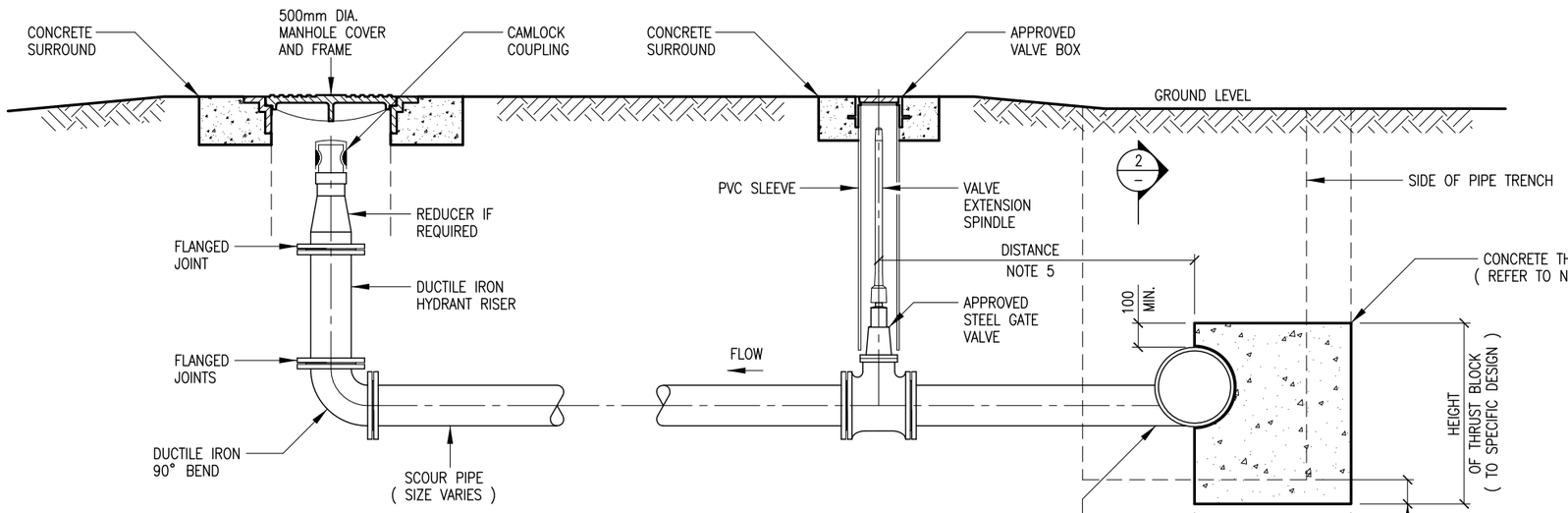
WASTEWATER RETICULATION STANDARD
PUMPING STATION RISING MAIN
DETAILS OF DISCHARGE MANHOLE AND VENTILATION OPTIONS

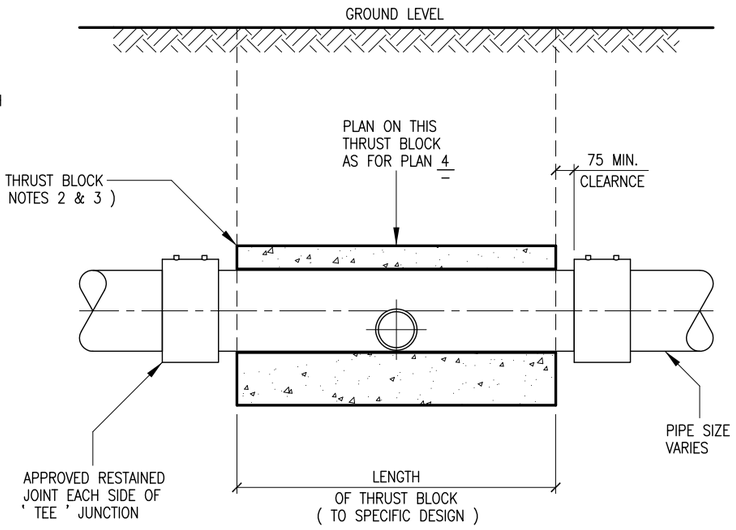
DRAFT

CAD FILE 2012216.009	DATE 26–06–15
ORIGINAL SCALE A1 AS SHOWN	CONTRACT No. –
REF. No. –	ISSUE –
DWG. No. 2012216 .009	–



ELEVATION AT PRESSURE SCOUR ' TEE ' JUNCTION — 1

SCALE. 1:25 (A3) & N.T.S.



SECTION AT PRESSURE SCOUR ' TEE ' JUNCTION — 2

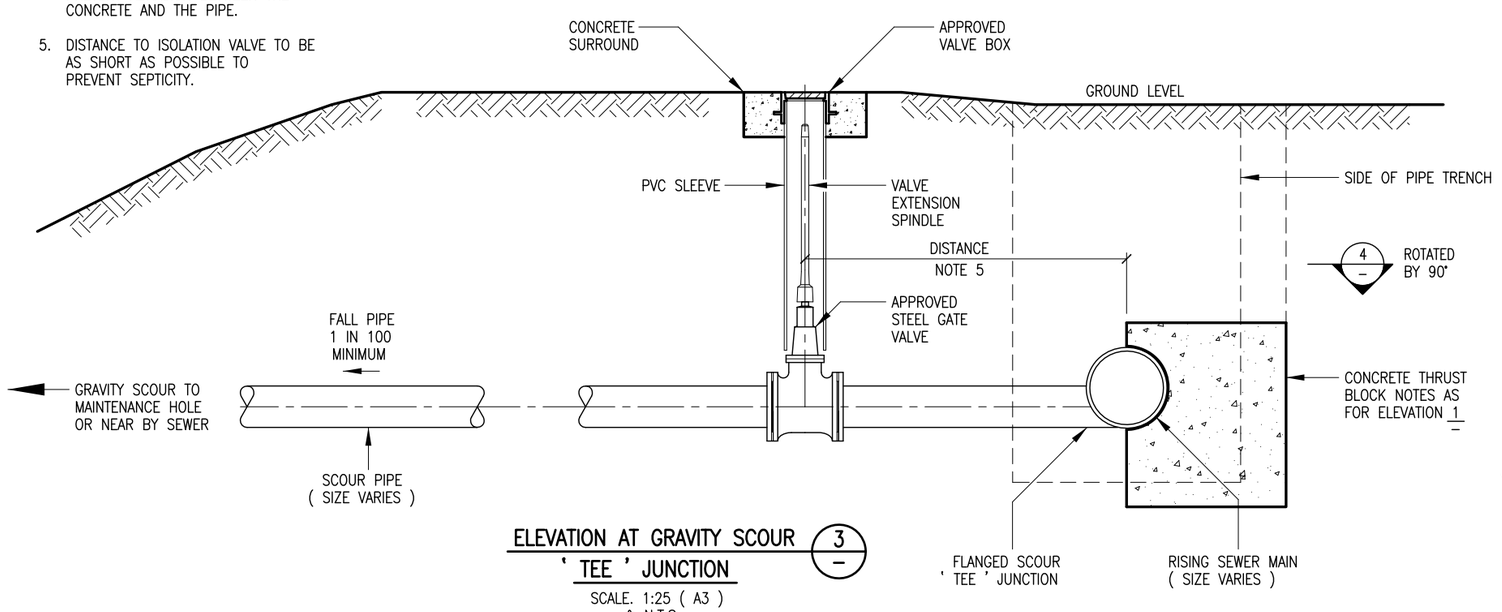
SCALE. 1:25 (A3) & N.T.S.

NOTES

1. DETAILS ON THIS DRAWING ARE DIAGRAMMATIC. PIPE SIZES AND PIPE DEPTHS VARY.
2. THRUST BLOCKS SHALL BE SIZED FOR THE SPECIFIC SOIL BEARING CAPACITY TAKING INTO ACCOUNT THE MAXIMUM PUMPING PRESSURE AND FLOW VELOCITY.
3. THRUST BLOCKS SHALL BE CAST AGAINST THE UNDISTURBED CUT FACE OF THE EXCAVATION.
4. WHERE THE PIPE COMES IN CONTACT WITH THE THRUST BLOCK THE PIPE SHALL BE WRAPPED IN A PROTECTIVE MEMBRANE TO PREVENT ABRASION BETWEEN THE CONCRETE AND THE PIPE.
5. DISTANCE TO ISOLATION VALVE TO BE AS SHORT AS POSSIBLE TO PREVENT SEPTICITY.

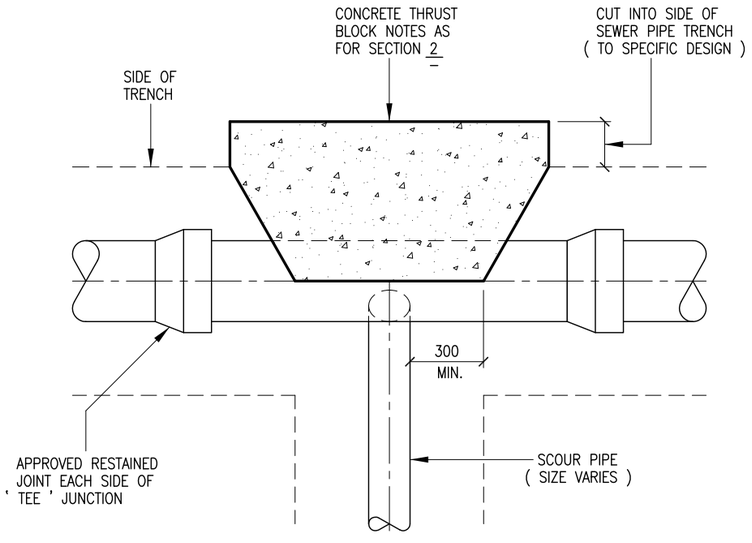
KEY

N.T.S. = NOT TO SCALE
MIN. = MINIMUM



ELEVATION AT GRAVITY SCOUR ' TEE ' JUNCTION — 3

SCALE. 1:25 (A3) & N.T.S.



PLAN AT GRAVITY SCOUR ' TEE ' JUNCTION — 4

SCALE. 1:25 (A3) & N.T.S.

L:\---\EGCADFI\2015\STANDARD WASTEWATER DRAWINGS\2012216.010 .DWG

ISSUE	DATE	AMENDMENT	BY	APPD.
–	06:15	CONSTRUCTION ISSUE	L.C.	J.D.

DESIGNED	J.D.	06–15	SIGNATORY 1
DES. CHECKED	S.D.	06–15	OPERATIONS
DRAWN	L.C.	06–15	
DWG. CHECKED	I.M.	06–15	
PROJECT LEADER	J.D.	06–15	SIGNATORY 2
INFRAST'R APP'D	A.S.	06–15	INFRASTRUCTURE

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WASTEWATER RETICULATION STANDARD
PUMPING STATION RISING MAIN
PRESSURE & GRAVITY SCOUR ARRANGEMENTS

DRAFT

CAD FILE 2012216.010	DATE 26–06–15
ORIGINAL SCALE A1 AS SHOWN	CONTRACT No. –
REF. No. –	ISSUE –
DWG. No. 2012216 .010	–

11. Appendix B: Example of a Factory Acceptance Testing (FAT)

Digital inputs

Digital Inputs												
Terminals	Tag Description	Identification	Message		Alarm Delay		Sign Off				Notes
Slot 6			Signal On	Signal Off	Duration (s)	Yes / No	AD Riley	HEB	GHD	WSL	
0601	1 Spare										
0602	75-PU-03-RemIn 2 Auto Selected	Sodium Hypo Dosing Pump Auto Selected									
0603	75-PU-03-EStopIn 3 E/S Operated	Sodium Hypo Dosing Pump E/S Operated			0 s						

Digital outputs

Digital Outputs									
Terminals	Tag Description	Identification	Message		Sign Off				Notes
Slot 9			Signal On	Signal Off	AD Riley	HEB	GHD	WSL	
0901	1 Spare								
0902	2 Spare								
0903	75-PU-01-AutoStart 3 Auto Start / Stop	Water Carrier Pump Auto Start / Stop							
0904	75-PU-01-AvailLamp 4 Auto Available	Water Carrier Pump Auto Available							
0905	75-PU-03-AutoStart 5 Auto Start / Stop	Sodium Hypo Dosing Pump Auto Start / Stop							

Analogue inputs

Analogue Inputs													
Terminals	Tag Description		Analogue Signal Checks						Sign Off				Notes
Slot 3		Range	0%		50%		100%		AD Riley	HEB	GHD	WSL	
			Kingfisher	iFix	Kingfisher	iFix	Kingfisher	iFix					
0301+	14-AI-142 1 Inlet Turbidity	0-20 NTU											
0301-	14-AI-142 2 Inlet Turbidity												
0302+	75-PI-01 3 Carrier Line Pressure Transmitter	0-600 kPa											

Analogue outputs

Analogue Outputs												
Terminals	Tag Description	Analogue Signal Checks						Sign Off				Notes
Slot 11		0%		50%		100%		AD Riley	HEB	GHD	WSL	
		Kingfisher	iFix	Kingfisher	iFix	Kingfisher	iFix					
1101+	75-PU-03 Speed 1 Speed Reference											
1101-	75-PU-03 Speed 2 Speed Reference											
	3											

Modbus

Modbus													
			Analogue Signal Checks						Sign Off				Notes
		Alarm Delay (s)	0%		50%		100%		AD Riley	HEB	GHD	WSL	
Tag Description			Kingfisher	iFix	Kingfisher	iFix	Kingfisher	iFix					
14-FIT-01 Watermaster													
Range	0-50 L/s												
Instantaneous Flow													
Totaliser													
Fault		15 s											
95-FIT-101 Watermaster													
Range													
Instantaneous Flow													
Totaliser													

Processor module

Serial Port 3					
			Message		**Alarm Value**
	Tag Description	Delay (s)	**Signal On**	**Signal Off**	
	14-AIT-143 Chlorine Analyser				
	Range 0-2 mg/L				
	Analyser Fault (PV Bad)	30			
	Chlorine Analyser HiHi	30	AI-313-HiHi		2 mg/L
	Chlorine Analyser Hi	30	AI-313-Hi		1.5 mg/L

Derived Alarms

Digital Inputs											
Terminals	Tag Description	Identification	Message		Alarm Delay		Sign Off				Notes
			Signal On	Signal Off	Duration (s)	Yes / No	AD Riley	HEB	GHD	WSL	
	75-PU-03 StartStop Fail	Sodium Hypo Dosing Pump Control Fail			30						
	75-PU-01 StartStop Fail	Water Carrier Pump Control Fail			30						
	Comms Failure				60 s						

12. Appendix C: Example of an I/O test sheet

STWKO - Sodium Hypochlorite
Schedule of I/O and Modules - DCS Software

											INPUTS/OUTPUTS Induce Device OFF/ON State or 4mA/20mA						
Module	**Description**	**Tag**	**I/O Type**	**Controller**	**Card**	**Ch**	**I/O Enabled**	**I/O to Module Check**	**Module to I/O Check**	**Module to Screen Check**	**View I/O Channel Correct**	**View Graphics Correct**	**Field Device Action (eg. close/open) Graphics Status (e.g. green/red) OFF/4mA**	**ON/20mA**	**By (Initial)**	**Date**	**Notes**
STWKO75_VF321	Hypochlorite Tank Blower 3 Motor Watts	75-VF-321J	AI	STWKO_01_DCS_02	11	4											
STWKO75_VF321	Hypochlorite Tank Blower 3 Available	75-VF-321A	DI	STWKO_01_DCS_02	18	1											
STWKO75_VF321	Hypochlorite Tank Blower 3 Isolator On	75-VF-321X	DI	STWKO_01_DCS_02	18	2											
STWKO75_VF321	Hypochlorite Tank Blower 3 Fault	75-VF-321F	DI	STWKO_01_DCS_02	18	3											
STWKO75_VF321	Hypochlorite Tank Blower 3 Running	75-VF-321R	DI	STWKO_01_DCS_02	18	4											
STWKO75_VF321	Hypochlorite Tank Blower 3 Remote Start/Stop	75-VF-321S	DO	STWKO_01_DCS_02	23	7											
STWKO75_GDT01	Electrolyser H2 Gas Monitor 1	75-GDT-01	AI	STWKO_01_DCS_09	02	7											
STWKO75_VF312	Hypo Tank Blower 2 Motor Watts	75-VF-312J	AI	STWKO_01_DCS_09	02	8											
STWKO75_TT231	Electrolyser 3 Hi Electrolyte Temp	75-TT-231	AI	STWKO_01_DCS_09	05	7											
STWKO75_TT234	Electrolyser 3 Brine Temperature Low	75-TT-234	AI	STWKO_01_DCS_09	05	8											
STWKO75_GDT02	Electrolyser Room Gas Detector 2	75-GDT-02	AI	STWKO_01_DCS_09	06	1											
STWKO75_FA16	Extract Fan motor watts	75-FA-16J	AI	STWKO_01_DCS_09	06	2											
STWKO75_VF322	Sodium Hypo Tank Blower 4 motor watts	75-VF-322J	AI	STWKO_01_DCS_09	06	3											
STWKO75_HG23F	Electrolyser 3 Fault	75-HG-23F	DI	STWKO_01_DCS_09	19	2											
STWKO75_HG23	Electrolyser 3 Available	75-HG-23A	DI	STWKO_01_DCS_09	19	3											
STWKO75_HG23	Electrolyser 3 Running	75-HG-23R	DI	STWKO_01_DCS_09	19	4											
STWKO75_AAV231	Valve AAV 231 Postion A Feedback	75-ZSA-231	DI	STWKO_01_DCS_09	24	1											
STWKO75_AAV231	Valve AAV 231 Postion B Feedback	75-ZSB-231	DI	STWKO_01_DCS_09	24	2											
STWKO75_FSL233	Electrolyser 3 Low Outlet Flow	75-FSL-233	DI	STWKO_01_DCS_09	24	3											
STWKO75_LSL231	Electrolylser 3 Low Level	75-LSL-231	DI	STWKO_01_DCS_09	24	4											
STWKO75_FSL231	Electrolyser 3 Low Soften Water Flow	75-FSL-231	DI	STWKO_01_DCS_09	24	5											
STWKO75_FSL232	Electrolyser 3 Low Brine Flow	75-FSL-232	DI	STWKO_01_DCS_09	24	6											
STWKO75_AAV211	Valve AAV 211 Postion A Feedback	75-ZSA-211	DI	STWKO_01_DCS_09	25	1											

13. Appendix D: Template for Functional Description (FD) – level 1

CODE
NAME WASTEWATER PUMPING STATION

LEVEL 1 FUNCTIONAL DESCRIPTION

AREA 80 – WASTEWATER PUMPING

Functional Description Reference: *CODE*_80_FD_001					
Rev #	**Date**	**Description**	**By**	**Checked**	**Approved**

Table of Contents

XXXX
XXXX
XXXX

1 Process Overview and Theory

1.1 Process Overview

This functional description covers the following facility:

Facility Codes:	*CODE* *Name* Wastewater Pumping Station
Area Code:	80
Alarm Groups:	TDN (Transmission Wastewater Networks), CODE_80
Security Areas:	TDN, (Operator), TDN_SUPR (Supervisor), TDN_ENGR (Engineer)
Region:	Area
Zone:	n/a

The full name of all equipment in this document is *CODE*_PP_{AAAA_VVV}. Where PP is the Process Code, AAAA is the Equipment Type and VVV is the Equipment Number.

Note: This pumping station was formerly referred to as XXXX

Plant Location and Access

NAME WW PS is located at the xxxx. See Figures 1 through # for site maps, site photos and a GIS view of the site.

Directions from XXXX:

XXXX

Directions from XXXX:

XXXX

The site latitude and longitude are: - *XXXX, YYYY*

Figure 1 Site location – map

Figure 2 Site location – Street View.

Figure 3 Auckland GIS topographical view showing pumping station and wastewater pipework.

Drawing and Document References

Drawing Set *XXXX*	*NAME* Wastewater Pumping Station Electrical Drawings
Drawing *XXXX*	*NAME* Wastewater Pumping Station P&ID
*CODE*_80_FD_002	*NAME* Wastewater Pumping Station - Level 2 Functional Description
WSL SSS	Watercare Software Standard Specification

1.2 Process Theory / Process Principles

A SCADA site view is provided in Figure 4 that details site equipment and process flow and the process information is listed in Table 1.

Figure 4 SCADA interface for NAME WWPS site (Provided by Watercare)

The pumping station, including pumps and pipework is designed for a peak flow of *XXXX* l/sec. The station has two, *XXXX* pumps, both with *XXXX* mm intake pipes. Each pump has a low speed capacity of at least *XXXX* l/s, which meets the required duty minimum (*XXXX* l/s), thus leaving one pump as a standby pump. When placed into high speed mode, Pump 1 and Pump 2 (tested in *XXXX*) achieved *XXXX* l/s and *XXXX* l/s respectively. Pumps may be operated in automatic or manual mode, but normally will be run on auto control, auto duty select. Auto duty select rotates the pump duties so that each pump runs approximately the same amount of hours. If manually operated, it is possible to run both pumps together. There are *XXXX* rising mains, 295mm and *XXXX* mm diameter of type *XXXX* and *XXXX* (respectively. There is/is no storage tank at this pumping station of size *XXXX*.

Table 1: *XXXX* wastewater pumping station process information

Process Information			
Pumps Installed	**Number**		
	Make, Model		
	Intake Diameter (mm)		
	Outlet Diameter (mm)		
	Power Rating		
	Motor Speed		
	Pumps on Variable Speed Drives		
Pump Design (Maximum)	**Head**		
	Flow		
	Pumps Programmed to run for Peak Operation		
Station Actual Flow	**Present Estimated**		
	Duty Pump Minimum		
	Minimum Threshold for High Wet well Alarm Suppression		

Rising Main Details	**Diameter**		
	Length		
	Material		
	Isolation		
	Anti-Vac/Air Release		
Station Levels (Height above wet well floor)	**Wastewater Invert**		
	Overflow Level(Depth below 2mRL Tide Level)		
	Anticipated O/F Depth During Spring Tide Condition		
	Approx. RL of Ground at Station		
Flow Measurement	**Meter Type**		
	Location		
	Make, Model		
Wet well Details	**Calculated Wet well Volume to Overflow**		
	Calculated Wet well volume to HLA		
	Calculated Wet well volume to 1st Pump Start		
	Calculated Wet well volume to All pump Stop		
	Overflow Point		
	Approximately Dry Weather Storage Times		

1.3 Principles of Operation

NAME pumping station operates #, *XXXX* pumps. Pumps are started and stopped according to wet well level. One pump may run at a time.

Level Settings

Detailed Wet well set points for pump operation are outlined in Table 2.

Table 2: Wet well set points for pumping operation

Approximate operating levels from the bottom of the wet well	
Wet well low level alarm	
All pumps stopped	
1st sequence start	
2nd sequence start	
3rd sequence start	
Wet well high level alarm[1]	
Static Overflow Level	

Note 1: Flow threshold value for high wet well alarm suppression is XXXX l/s. Refer to section 5.1.1

Emergency Stop Operation

All pumps at the site are fitted with emergency stop safety circuits to comply with NZ electrical regulations. Pump operation is halted following activation of any of its associated emergency stop push buttons. Push buttons are located on the pump's respective motor starter cell at the MCC and also adjacent to the pump where the pump is located.

Typically pumping operation will cease as a consequence of the main power within the starter cell being directly interrupted immediately following activation of the emergency stop. An exception to this is where automatic valves are located on the pump discharge. Here a delay timer maintains pump operation (following emergency stop activation) allowing the discharge valve to close before stopping the pump. Upon emergency stop activation a critical alarm is generated and the pump is interlocked out to prevent auto restart when the emergency stop pushbutton(s) are reset.

For recommended operator alarm response refer to standard operating procedures.

Resetting an emergency stop once operated, is undertaken in one of two ways (dependent upon the method employed to interrupt the main power.

***Step 1** - In both cases the emergency stop pushbutton(s) must be released. This is achieved by twisting the latched pushbutton.*

***Step 2** –Where interruption of the main power within the starter is effected by "Tripping" the main circuit breaker, the circuit breaker must be reset and then turned back on.*
Where interruption of the main power within the starter is effected by opening of a main contactor a "RESET" pushbutton is provided on the front of the motor starter which must be pressed following Step 1.

***NOTE:** UPON OPERATING THE STARTER CELL RESET PUSHBUTTON OR TURNING ON A CIRCUIT BREAKER AFTER RESETTING IT-A PUMP MAY RESUME OPERATION IF IT IS SELECTED FOR REMOTE -(AUTOMATIC) OPERATION.*

2 Process Plant

2.1 Process Equipment

The facility consists of the following primary process equipment as detailed in Table 3.

Table 3: Pumping Station Equipment

Equipment Type & Number (Asset)	Equipment Description	Capacity/ Range	Failsafe State	Control Module Type(s)	Notes
Pumps					
80_PU_01	Pump 1	*XXXX*	OFF	MTR_Control1 AI_Standard2	*XXXX*
80_PU_02	Pump 2	*XXXX*	OFF	MTR_Standard1 AI_Standard2	*XXXX*
Analogue Equipment					
80_LIT_011	Wet well Level (Bubbler)	*XXXX*	n/a	AI_Standard1	*XXXX*
80_FIT_X01	Station Flow	*XXXX*	n/a	AI_Standard1 FQI_Standard1	*XXXX*
06_EIT_X02	Battery Voltage	*XXXX*	n/a	AI_Standard2	*XXXX*
Digital Equipment					
80_LSH_014	Wet well High	n/a	OFF = Alarm	DI_Standard1	*XXXX*

Equipment Type & Number (Asset)	Equipment Description	Capacity/ Range	Failsafe State	Control Module Type(s)	Notes
80_LSHH_111	Station Flooded	n/a	OFF = Alarm	DI_Standard1	*XXXX*
80_PSL_011	Bubbler Air Pressure Low	n/a	OFF = Alarm	DI_Standard1	*XXXX*
06_EAL_X01	Mains Failure	n/a	OFF = Alarm	DI_Standard2	*XXXX*
80_FA_X01	Wet well Ventilation	n/a	n/a	-	*XXXX*
80_SEC_X01	Station Security	n/a	n/a	SEC_Alarms1	*XXXX*

3 Routine Automatic Operation

3.1 Pumps 1 & 2 (80_PU_01, 80_PU_02)

There are # *XXXX* pumps that pump from the wet well to the Rising Main. One pump may run at a time. The pumps are controlled with *soft starters* via *MODBUS RS485*.

Note: There is a delay when switching between speeds to prevent the soft starter tripping.

Automatic Operation

1. The pumps are started and stopped based on the wet well level. The system logic is illustrated in Figure 6.

Pump duty operation logic

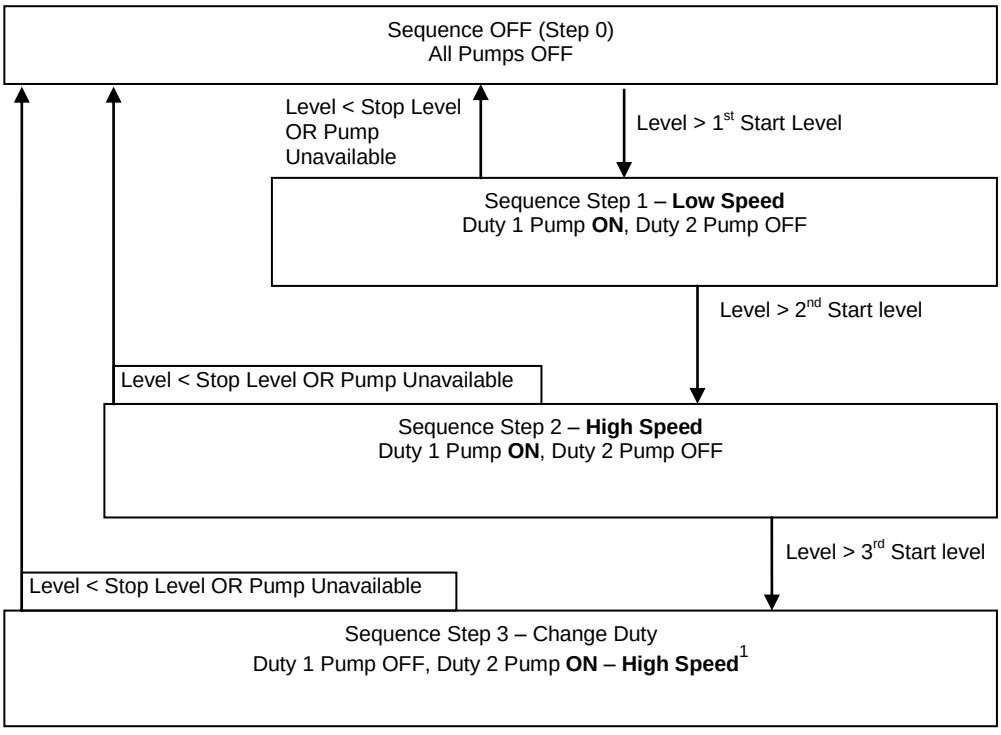

Figure 6 Pump duty operation logic for Pumps 1 & 2

Note 1: As step 3 occurs on an increasing wet well level, duty 2 pump will be set to high speed also.

2. Pump duties are selected by *the duty selector switch located on the control panel and can be overridden by the central SCADA (see section 13.1).* The duty selector, duty sequence and duty pump behaviour are detailed below in Tables 4a through 4c.

Table 4a: Pump duty selection guide

Duty Selector Position	Duty 1	Duty 2 (standby)
1 – 2	Pump 1	Pump 2
2 – 1	Pump 2	Pump 1
Auto Select	*Automatic duty selection is carried out by the RTU, so the pump duty is alternated 1-2 to 2-1 every start, thus providing even running time on both pumps.*	

2. When the Duty Selector switch is in position (Duty 1-2) and the wet well level is increasing:

Table 4b: Pump duty sequence guide on increasing wet well level

1st Sequence	*Pump 1 starts and runs at Low speed*
2nd Sequence	*Pump 1 changes to High speed*
3rd Sequence	*Pump 1 stops* *Pump 2 starts to run at high speed*

On a decreasing wet well level:

Table 4c: Pump duty sequence guide on decreasing wet well level

Pumps stopped.	*The pump that is running stops when the stop level is reached in the wet well*

3.2 Wet well Ventilation

The wet well ventilation *is disabled whenever the level of the wet well is above the level of the duct: 5 metres*.

4 Failures

4.1 Station Pumps (80_PU_01, 80_PU_02)

Interlocks

- Control Fail
- Flow Low
- Emergency Stop (Hard-wired with feedback)

4.2 Station Pumps Low Flow (80_FI_X01)

- *If a pump has been running for more than 60 seconds and the station flow (80_FI_X01) is low, then a flow low alarm is raised.*

- *A flow low alarm will stop the pump, which will lead to a change of duty pump. If both pumps have flow low alarms, the pump that is currently running will continue to run.*
- *The flow low alarm requires a manual reset from the site control panel.*

4.3 Mains Power Failure (06_EAL_X01)

- *On Mains Failure, equipment will go to fail-safe states*
- *Critical Mains Failure alarm*
- *Control modules alarms on site to be supressed*

Emergency Generator Requirements

Size Required: ***XXX*** **kVA**

5 Alarms

5.1 Process Alarms

The following table, Table 5, is a list of all the station alarms for the *NAME* site.

Table 5: Station alarms with accompanying settings.

Alarm Trigger Description	Equipment No.	Units	Default	Delay (sec)	Priority	Control Action / Notes
Wet well Level High	80_LI_011_Hi	*m*	*2.60*	*90*	*Critical*	*Note 1*
Wet well Level High	80_LAH_014_A	*n/a*	*n/a*	*90*	*Critical*	*Note 1*
Wet well Level Low	80_LI_011_Lo	*m*	*0.50*	*300*	*Critical*	*Note 1*
Wet well Overflow	80_LI_011_OFlow	*m*	*6.20*	*30*	*Critical*	*Note 1*
Wet well Level Signal Fault	80_LI_011_Fault	*n/a*	*n/a*	*60*	*Warning*	*Note 1*
Station Flow Signal Fault	80_FI_X01_Fault	*n/a*	*n/a*	*60*	*Warning*	*Note 1*
Station Flooded	80_LAHH_111_A	*n/a*	*n/a*	*30*	*Critical*	*Note 1*
Pump 1 Tripped & Wet well Level High	80_PU_01_Tripped AND (80_LI_011_Hi OR 80_LAH_014_A)	*n/a*	*n/a*	*0*	*Warning*	*Change Pump Duty*
Pump 1 Flow Low	80_PU_01_Running AND 80_FI_X01_Lo	*n/a* *l/s*	*n/a* *30*	*60*	*Warning*	*Change Pump Duty*
Pump 1 E-Stop	80_PU_01_EStop	*n/a*	*n/a*	*0*	*Critical*	*Change Pump Duty*
Pump 1 Tripped	80_PU_01_Tripped	*n/a*	*n/a*	*0*	*Warning*	*Change Pump Duty*
Pump 1 Control Fail	80_PU_01_CtrlFail	*n/a*	*n/a*	*30*	*Warning*	*Change Pump Duty*

Alarm Trigger Description	Equipment No.	Units	Default	Delay (sec)	Priority	Control Action / Notes
Pump 1 Starts / Hour	80_PU_01_StPHr	*starts*	*15*	*0*	*Warning*	*Note 1*
Pump 2 Tripped & Wet well Level High	80_PU_02_ Tripped AND (80_LI_011_Hi OR 80_LAH_014_A)	*n/a*	*n/a*	*0*	*Warning*	*Change Pump Duty*
Pump 2 E-Stop	80_PU_02_EStop	*n/a*	*n/a*	*0*	*Critical*	*Change Pump Duty*
Pump 2 Flow Low	80_PU_02_Running AND 80_FI_X01_Lo	*n/a* *l/s*	*n/a* *30*	*60*	*Warning*	*Change Pump Duty*
Pump 2 Tripped	80_PU_02_Tripped	*n/a*	*n/a*	*0*	*Warning*	*Change Pump Duty*
Pump 2 Control Fail	80_PU_02_CtrlFail	*n/a*	*n/a*	*30*	*Warning*	*Change Pump Duty*
Pump 2 Starts / Hour	80_PU_02_StPHr	*starts*	*15*	*0*	*Warning*	*Note 1*
Sump Pump Tripped	80_PU_11_Tripped	*n/a*	*n/a*	*0*	*Warning*	*Note 1*
Sump Pump Starts / Hour	80_PU_11_StPHr	*starts*	*15*	*0*	*Warning*	*Note 1*
Sump Pump Control Fail	80_PU_11_CtrlFail	*n/a*	*n/a*	*30*	*Warning*	*Note 1*
Wet well Hi Pumps Not Available (80_SITE_X01_NotAvail)	NOT 80_PU_01_SeqAvail AND NOT 80_PU_02_SeqAvail AND (80_LI_011_PV > 80_LI_011_LevelHiSP)	*n/a*	*n/a*	*300*	*Critical*	*Note 1*
Station Inactive (80_SITE_X01_InActive)	NOT 80_PU_01_Running AND NOT 80_PU_02_Running	*n/a*	*n/a*	*3600*	*Warning*	*Note 2*

Note 1: For recommended operator alarm response refer to standard operating procedures.
Note 2: Refer section 5.1.2 Station Inactive Alarm

Wet well Level High Alarm Disable (80_LAH_014)

If flow is equal to or greater than the design flow (*XXXX* l/s), the wet well level high alarm to SCADA is disabled. If flow reduces for any reason or the flow meter fails and the level remains high, the wet well high alarm will be set again. The wet well high indication at the station is never disabled.

Station Inactive Alarm

The time the station is inactive (no pumps are running) is measured. If the current inactivity period exceeds the inactivity time set point, a station inactive alarm is raised.

5.2 System Alarms

The following table, Table 6, is a list of all the station alarms for the *XXXX* site.

Table 6: System alarms with accompanying settings.

Alarm Trigger Description	Equipment No.	Units	Default Setting	Alarm On Delay (sec)	Priority	Control Action / Notes
Mains Failure	06_EAL_X01_A	*n/a*	*n/a*	*30*	*Critical*	*Supress Alarms*
Battery Voltage Low	06_EI_X02 _Lo	*VDC*	*22.5*	*30*	*Critical*	*Note 1*
Security - Intruder Detected	05_SEC_X01 _Intruder	*n/a*	*n/a*	*0*	*Critical*	*Note 1*
Security – Disarmed (after hours)	05_SEC_X01 _Disarmed	*n/a*	*n/a*	*0*	*Critical*	*Note 1*
SCADA to RTU Comms Fail	01_RTU_X01_Comms	*n/a*	*n/a*	*900*	*Critical*	*Set in SCADA*
RTU Card Fault	01_RTU_X01_IOFault	*n/a*	*True*	*60*	*Critical*	*Note 1*

Note 1: For recommended operator alarm response refer to standard operating procedures.

6 Off-Normal Functions

6.1 Pumps (80_PU_01, 80_PU_02)

In Remote Manual, each pump can be controlled from its SCADA faceplate. The pump mode selection is for each pump and is selected from the pump faceplate (80_SITE_X01). Pump Mode and Remote Manual operation is restricted by SCADA security (supervisor level).

In Local, each pump can be controlled from the local control panel.

6.2 Sump Pump (80_PU_11)

In Remote Manual, the pump can be controlled from its SCADA faceplate. Remote Manual operation is restricted by SCADA security.

In Local, the pump can be controlled from the local control panel.

6.3 Analogue Instruments

All analogue instruments have a Calibrate and an OOS function. Wet well Level (80_LY_011) - Bubbler Purge

Every 6 hours the bubbler purge solenoid is turned on for 30 seconds. The wet well level signal is locked at its last value for this period to allow readings to stabilise.

Note: The station flow (80_FI_X01) is also held during this period.

7 Process Diversions/Overflows

Station overflow is from incoming network wastewater into *XXXX* pipe discharging to *XXXX*.

8 Shutdown Sequences

There are no shutdown sequences for this facility.

9 External Inputs and Outputs

There are no external inputs and outputs (inter-station RTU communications) for this station.

10 Derived Variables

10.1 Pumping Station

The following table, Table 7, is a list of all the pumping station derived variables, associated tag names, units and control modules that calculate the variable value for the *NAME* site.

Table 7: Derived variables with associated details.

Description	Equipment No(s).	Units	Capacity / Range	Control Module Type(s) / Calculation	Name of HMI Display(s)
Flowmeter Pumped Volume Running Total (m^3)	80_FQI_X01_Total	m^3		FQI_Standard1	Site mimic AI Faceplate
Flowmeter Pumped Volume Running 24h period (m^3)	80_FQI_X01_Total24h	m^3		FQI_Standard1	Site Mimic, AI Faceplate
Flowmeter Pumped Volume Running 15m peroid (m^3)	80_FQI_X01_Total15m	m^3		FQI_Standard1	Site Mimic, AI Faceplate
Wet well Volume	80_SITE_X02_Volume	m^3		SITE_Volume1 CALC_DPVol2	AI Faceplate
Wet well Remaining Volume	80_SITE_X02_RemVol	m^3	Hold	SITE_Volume1 CALC_RemST1	Site Mimic, AI Faceplate
Wet well Time to Overflow	80_SITE_X02_TimeOF	min	0 - 500	SITE_Volume1 CALC_RemST1	Site Mimic, AI Faceplate
Wet well Overflow	80_LI_011_OFlowLvl[2]	m	0 - 8.00	CALC_OverflowLevel1	Site Mimic
Site Current	80_IQ_X01_PV	A	0 - 200	AI_Standard2	Status Tab on Site Information Popup

Description	Equipment No(s).	Units	Capacity / Range	Control Module Type(s) / Calculation	Name of HMI Display(s)
Main Pump 1 Run Time per Hour	80_PU_01_RTPHr	min	0 - 60	MTR_Stats1	Motor Faceplate
Main Pump 1 Starts per Hour	80_PU_01_StPHr	Count	0 - 20	MTR_Stats1	Motor Faceplate
Main Pump 1 Running Hours	80_PU_01_RunHours	h	0 - 32000	MTR_Stats1	Motor Faceplate
MTR_Stats1Main Pump 2 Run Time per Hour	80_PU_02_RTPHr	min	0 - 60	MTR_Stats1	Motor Faceplate
Main Pump 2 Starts per Hour	80_PU_02_StPHr	Count	0 - 20	MTR_Stats1	Motor Faceplate
Main Pump 2 Running Hours	80_PU_02_RunHours	h	0 - 32000	MTR_Stats1	Motor Faceplate

Note 1: The wet well lip level is the level where an overflow will occur
Note 2: The full range of the wet well height is specified so trending information provides a complete picture for historical analysis.

Wet well Volume Calculation

Time to overflow and remaining tank volume is calculated using standard control modules.

Volume is calculated as indicated below in Table 8.

Table 8: Wet well volume lookup table

Wet well depth m	Volume m^3	Wet well depth m	Volume m^3
0.01	*0.00*	*3.51*	*234.00*
1.87	*19.30*	*3.66*	*247.00*
2.04	*30.34*	*3.78*	*260.00*
2.11	*41.63*	*3.90*	*273.20*
2.18	*53.05*	*4.02*	*286.40*
2.24	*64.48*	*4.10*	*299.60*

11 System Redundancy

11.1 Process Equipment

The following are the main process equipment with redundancy:

- PU_01 - Pump 1 with PU_02 - Pump 2

11.2 Control System

The following are the main control system equipment with redundancy:

- RTU Power supply – battery backed

12 Isolation Schemes

There are no specific isolation schemes for this pumping station.

13 Operator Interface

13.1 Central SCADA

The primary control for this facility is via the central SCADA system via the following graphic(s):

Name	Description	Relevant P&ID
*CODE*_80.gfxSiteScreen	*CODE*_80 - *NAME* WW PS	*XXXX*

The central SCADA polls each of the site RTUs on a radio channel on a regular basis to receive RTU time stamped status updates and alarm events using DNP3 over UHF radio ethernet.

The RTU records alarm events and changes to instrument readings greater than a threshold in its on-board logs. During communication all new RTU logs are retrieved to populate the central SCADA trends and alarm and events history. Backfilling occurs if there has been a disruption in SCADA to RTU communication. In between SCADA update polls, critical alarms at any RTU are sent as unsolicited messages from the RTU to the SCADA to display as soon as possible on the alarm banner.

Duty Selection

Pump duties are normally selected by the central SCADA. Selecting a duty other than Auto Select has the effect of inhibiting the standby pump(s) from running.

13.2 Local SCADA

A local SCADA is located at the Pumping Station. The process graphics for the local SCADA are identical to the central SCADA. However only the local process information is available and no control is permitted from the graphics.

The local SCADA maintains a local historian and alarms. Alarms are not synchronised with the central SCADA

14 Control System Functionality

14.1 Standard Control Modules

Refer to *WSL Software Standard Specification* for software standards applied for this facility.

14.2 Time Synchronisation

The RTU requests a time synchronisation from the *DNP3 Master* on power up and once per day at 3:15am. The central SCADA's communication driver sends the control network time on next poll.

14.3 Control System Hardware

The facility is controlled by a *Kingfisher CP-30 RTU* connected to the central SCADA system via *Trio E-series radios, photos of which are shown in Figures 5*. Refer to the electrical drawings for RTU input/output modules and configuration.

Figure 5 Kingfisher RTUs and Trio E Series Radio

14.4 Serial Communications

There are no RTU to serial device communications at this site.

14.5 Security System (05_SEC_X01)

The site is fitted with a *TECOM Challenger security panel*. Staff has to disarm the security system before entering the site and arm the site when leaving. There are five digital signals provided from the security panel to the site RTU:

- Intruder
- Authorised Entry
- Movement
- Smoke Detected
- Security Disarmed

There are two outputs from the RTU to the security panel to override or reset the system:

- Security Reset – This will arm the security system
- Security Disarm – This will disarm the security system

Central control room notifies the security company to check site if there is an intruder or smoke detected alarm.

15 Historical Process Data

The signals as logged in SCADA and RTU are detailed in the following table, Table 9.

Table 9: Signal tags with associated units, tag descriptions and triggers.

Tag	Units	Tag Description	Trigger
*CODE*_01_RTU_X01.CommsFailA		*CODE* *NAME* Comms Fail Alarm	
*CODE*_01_RTU_X01.CommsLost		*CODE* *NAME* Comms Lost	
*CODE*_01_RTU_X01.CommsLostA		*CODE* *NAME* Comms Lost Alarm	
*CODE*_01_RTU_X01.FailedReads.Roc.Rate		*CODE* *NAME* TOPServer Failed Reads	
*CODE*_01_RTU_X01.FailedWrites.Roc.Rate		*CODE* *NAME* TOPServer Failed Writes	
*CODE*_01_RTU_X01.PendingWrites		*CODE* *NAME* TOPServer Pending Reads	
*CODE*_01_RTU_X01.PendingReads		*CODE* *NAME* TOPServer Pending Writes	
*CODE*_01_RTU_X01.RxBytes.Roc.Rate		*CODE* *NAME* TOPServer Topic Rx Bytes	
*CODE*_01_RTU_X01.SuccessfulReads.Roc.Rate		*CODE* *NAME* TOPServer Successful Reads	
*CODE*_01_RTU_X01.SuccessfulWrites.Roc.Rate		*CODE* *NAME* TOPServer Successful writes	
*CODE*_01_RTU_X01.TxBytes.Roc.Rate		*CODE* *NAME* TOPServer Topic Tx Bytes	
*CODE*_01_RTU_X01.Watchdog		*CODE* *NAME* Comms Watch Dog	
*CODE*_05_SEC_X01.Intruder		*CODE* *NAME* Site Security Intruder Alarm	
*CODE*_06_EI_X02.PV		*CODE* *NAME* Battery Voltage Analogue present value	
*CODE*_06_EI_X02.PVAvg		*CODE* *NAME* Battery Voltage present value 15m average	

14. Appendix E: Example of an Operations and Maintenance Manual – index pages

Table of Sections

Revision	Description	By	Date

Section 1
Operations

Table of contents

Section 2
Hazards and controls

(Hazards and controls register)

Section 2
Maintenance

Maintenance tables

1. Table of weekly tasks
2. Table of monthly tasks
3. Table of two monthly tasks
4. Table of four monthly tasks
5. Table of six monthly tasks
6. Table of annual tasks
7. Table of two yearly tasks
8. Table of three yearly tasks
9. Table of five yearly tasks

Section 3
Pumps, valves and instruments

Cross referenced to P&ID drawing(s): XXXX

Item	Size	Description	Serial No./ model code	Supplier
FIT1	*300*	*Magnetic flowmeter*	*MagMaster*	*ABB*

Section 4
Control System

Table of contents

Section 5
Testing and commissioning records

(Electrical, I/O's, Pumps, rising main performance, odour control, vibration, noise)

Section 6
Equipment data sheets

(Contains information specific to equipment, including supplier literature on operation, maintenance etc.)

Section 7

Consents
Land Transfer and Title
Easement

(Copies of final documents)

Section 8

Drawings

(as-built drawing sets for civil, mechanical and electrical & control)