Design Principles for

Wastewater Pumping Stations

DP-13

Ver. 0.6

Date: 1 November 2021

Revision	Description	Released by	Date
0.1	Draft	J de Villiers	30/10/2017
0.2	Final draft	J de Villiers	28/2/2018
0.3	Working draft for comment	J de Villiers	22/6/2018
0.4	Draft to include hybrid and wet-well options. Document restructured. Internal review	J de Villiers	28/09/2020
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0.6	Draft for public consultation	J de Villiers	1/11/2021

Reviewed by:

Rev. 0.5 – Internal working group

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Glossary: Terms and abbreviations

Accept(ance)	a sign-off by Watercare that it is in general agreement with a proposal. This sign-off does not transfer the designer's liability to Watercare.
ADWF	Average dry weather flow.
AEE	Assessment of environmental effects.
BEP	Best efficiency point, typically at about 85% of the pump shut-off head. This is the pump design point.
CS1, CS2, CS3, CS4	Watercare engineering compliance statements for design and construction.
dB	Decibels.
DN	Nominal metric diameter designation conforming to the International Standards Organization.
ΣDDT	Trichloride-2,2-bis(*p*-chlorophenyl)ethane, synthetic organic compound used as an insecticide.
EDC	Engineered discharge consent.
FD	Functional description completed to Watercare's template.
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.
NES	National Environmental Standard.
ppb	Parts per billion.
ppm	Parts per million.
PN	Nominal internal pressure that a component can safely withstand.
P&ID	Piping and instrumentation diagram.

Rising main	Pressurised wastewater pipe through which wastewater is elevated to a point of discharge.
SCS	Soil contaminant standard.
VOC	Volatile organic compound.
Wet well or storage tanks washer	Automated wash-down system to clean the wet well or storage tanks.
WGS84	World geodetic system. WGS84 is the latest reference coordinate system used by global positioning systems (GPS).

PART A – PREAMBLE AND GENERAL DESIGN REQUIREMENTS

1. Introduction

Design and construction of pumping stations need to be completed by competent persons to the minimum requirements as set out in this standard.

This standard covers the planning and design principles for wastewater pump stations. Construction and material standards are universally referenced across Watercare, but this document will specify specific considerations where appropriate. The civil and mechanical design of transmission rising mains are covered in the Principles for the Design of Transmission Water and Wastewater Pipelines (DP-07), and for network mains in the Code of Practice for land development and subdivision: wastewater (COP-02).

Wet well only submersible pumping stations should be considered in the first instance as these configurations require lower capital outlay and have a reduced carbon footprint. This document also provides guidance and highlights the considerations for the different pumping station configurations to suit the application and site.

The electrical standards and standard pumping control templates are available separately and shall be read in conjunction with this standard. Watercare's telemetry requirements are location based and require input from Watercare to identify the applicable standards and/or site requirement at the pump station site.

For the design of pumping stations by land developers the developer should consult with Watercare as early as possible to ensure compliance with the process stages outlined in Part A, Section 6.1. Failure to follow this process will delay obtaining Watercare's approval.

2. Referenced standards

2.1.Standards list

This standard must be read in conjunction with the Watercare, national and international standards listed below. Where conflict or ambiguity exists, this standard shall take precedence. Where there is conflict between referenced standards, the higher level of standard shall take precedence.

2.2. Watercare standards

DP-07 Design principles for transmission water and wastewater pipeline design

DP–10 Safety in Design guide

DP-11 Health and Safety in Facility Design guidelines

DP-12 Architectural design guidelines

7363 – Watercare CAD manual

AI- Data and Asset Information standard

MS – Material supply standard

DP-09 Electrical design standard

DW18 - Pump station electrical drawing set

DW05 – Access structure drawings for wastewater infrastructure

CG – General civil construction standard

ME – General mechanical construction standard

EC - General electrical construction standards

COP-03 Code of Practice for commissioning

2.3. National and international standards

NZS 1170 Structural design actions

Part 5 Earthquake actions – New Zealand

Part 5 Supp 1 earthquake actions – New Zealand - Commentary

AS/NZS 4219 Seismic performance of engineering systems in buildings

NZS 3101 Concrete structures

NZS 3106 Design of concrete structures for the storage of liquids

AS 3996 access covers and grates

AS/NZS1657 Fixed platforms, walkways, stairways and ladders. Design, construction and installation
AS 1418

AS 1418 Cranes, hoists and winches

AS 4991 Lifting devices

NZS 3640 chemical preservation of round and sawn timber

AS/NZS 3000 Wiring rules

AS/NZS 61439 Low voltage switchgear and controlgear assemblies

ISO 9906 Rotodynamic pumps – Hydraulic performance acceptance tests

WSA 04 Sewage pumping station code of Australia

2.4. Other publications

Roberts, R, New Zealand Geotechnical Society, 2017, New Zealand Ground investigation specification, Volume 0, 1, 2 and 3.

Worksafe NZ, Approved Code of Practice for cranes.

3. Design deliverables

Design work shall be completed by Chartered Professional Engineers or a suitably qualified engineer who have their work reviewed by a Chartered Professional Engineer in accordance with the Watercare compliance statement policy. Any design produced may be subjected to review by a Chartered Professional Engineer.

The designer must consider the design under the full operational requirements and apply good engineering practice that reflects:

- Compliance with New Zealand legislation, the most recent national standards, regulations and local conditions
- Watercare 40:20:20 policy adoption
- Watercare standards as included and referenced in this standard
- Historical information that may impact on the design
- Community and customer expectations
- Other information or specific conditions as provided by Watercare

The design shall not re-draw or amend a current approved Watercare standardised design. Specific design drawings shall cross-reference to the standard Watercare design and constructions standards. Where template designs are provided, they shall be amended for material components only.

The following comprehensive documents shall be provided to Watercare for evaluation of the design:

a) Geotechnical reporting on the suitability of the land for the life of the asset
b) Basis of design report describing options and selection of design
c) Risk analysis
d) Design report
e) Material schedules
f) Project execution plan
g) Site specific specification for construction
h) Nominated minimum levels of construction supervision
i) Drawings showing location, detailed long sections, pipe grades and sectional details
j) Functional descriptions (FD) of the transmission system function in network
k) O&M manual draft
l) Standard operating procedure (SoP) draft
m) New assets register in accordance with Watercare's data and asset information standards
n) Design compliance statement – See Watercare compliance statement policy

4. Criticality and infrastructure flexibility principles

4.1. Design life

The design life for transmission pumping stations system and associated structures is expected to provide 100 years of service life within an acceptable level of service (quality and capacity of service) offset against an acceptable cost of maintenance of the service at this level. Some components may require maintenance or intervention before the 100-year service life, such as instrumentation or pump replacements, and must be included in the overall lifecycle cost of the pump station. Alternative life expectancy may be specified depending on the projected operation of the pump station.

Generally, pumping station structures shall allow for the following minimum design life:

i. Storage tanks 100 years
ii. Pipework (pressure and gravity) 100 years
iii. Valves and meters 30 years

iv. Electrical equipment 25 years

v. SCADA and control 15 years

Note: *Further information on life cycle cost and optimal point of replacement can be found in the International Infrastructure Maintenance Manual (IIMM, 2015)*

4.2. Function classes and criticality

Transmission pump stations and the associated infrastructure within the pumping station site shall have a minimum function class of 3.

Note: *Refer to the New Zealand Ground investigation specification for the level of geotechnical information to be applied*

Function class		Description	Design Safety Factors				Seismic return period factor (NZS1170) R_u
			Peak ground acceleration	Liquefaction /subsidence	Landslide/ lateral movement	Surface loading	
3	Critical	Pump stations servicing large numbers of customers (>10,000 people) failure could cause significant economic impact or substantial hazard to human life, the natural environment and properties.	1.8	1.35	1.6	1.5	1.8
4	Essential lifeline	Pump stations that are essential to maintain service post natural disaster or man-made mishap and are intended to remain in service.	2.3	1.5	2.6	2	1.8

4.3. Resilience and redundancy

Resilience of pumping stations include site specific flexibility as well as the wider system that the pumping station is functioning within to sustain a level of service and absorb or adapt to changing conditions when there is a failure at the pumping station.

4.3.1. Resilience measurements {Table based on the IIMM, 2015 example table 3.2.8}

Dimension	Principle	Indicators	Assessment method
Technical vulnerability	Robustness	Maintenance regime i.e. preventative or run-to-failure	Audit against best practice
		Asset renewal strategy is up to date	Audit against standards
		Design standards are followed and reviewed	Audit against best practice
		Spare capacity in the network system	Audit / system modelling
		Condition rating of exiting asset/system	Audit
	Redundancy	Supply of backup equipment/components are identified, and suppliers hold stock	Supplier audit
		System diversion plans are in place, kept up to date with new assets/system changes	System modelling and audit of plan
		Capacity from alternative source	System modelling
	Modularity / flexibility	Modular systems, interchangeability	Standard design / best practice
		Future allowance for upgrade, improvements and strengthening	Audit against best practice
Organisational vulnerability	Variation readiness	Qualifications of staff are appropriate to roles and responsibilities	Audit
		Staff quantity and resources are adequate to deal with reactive changes	Audit
		Continual development of staff	Survey / audit
		Communication is clear with protocols in place	Survey
		Information on systems and assets such as drawings and operational manuals are readily availability	Survey / audit
		Readiness/response planning are in place and practiced	Audit
		Funding availability to effect operational variance	Audit

Dimension	Principle	Indicators	Assessment method
		Insurance are up to date and with appropriate risk cover	Audit
	Leadership / culture	Decisive decision making	Survey
		Situational awareness	Survey
		System knowledge	Survey
		Innovative thinking	Survey
	External partners	Ability to leverage on external knowledge	Survey
		Partnerships, design and service delivery arrangements	Audit
		Behavioural/communication barriers that could restrict productive solutions	Survey

4.3.2. Scoring

Scores are assigned based on the assessment outcome for the individual fields listed under section 4.3.1 and collated under the principle categories and rolled up as averages for technical and organisational averages.

Score	Description
1	Poor, not adaptive, complete loss of level of service
2	Marginal, adaptive but with system constraints or reduced level of service
3	Good, adaptive
4	Excellent, very adaptive/diverse with multiple redundancy options

4.3.3. Risk

Risk shall be assessed in accordance with the current Watercare Risk Management Framework.

5. Safety and hazard mitigation

5.1. Safety in Design guidelines

Refer to the Watercare Safety in Design standard for output requirements and to complete HAZOP analysis.

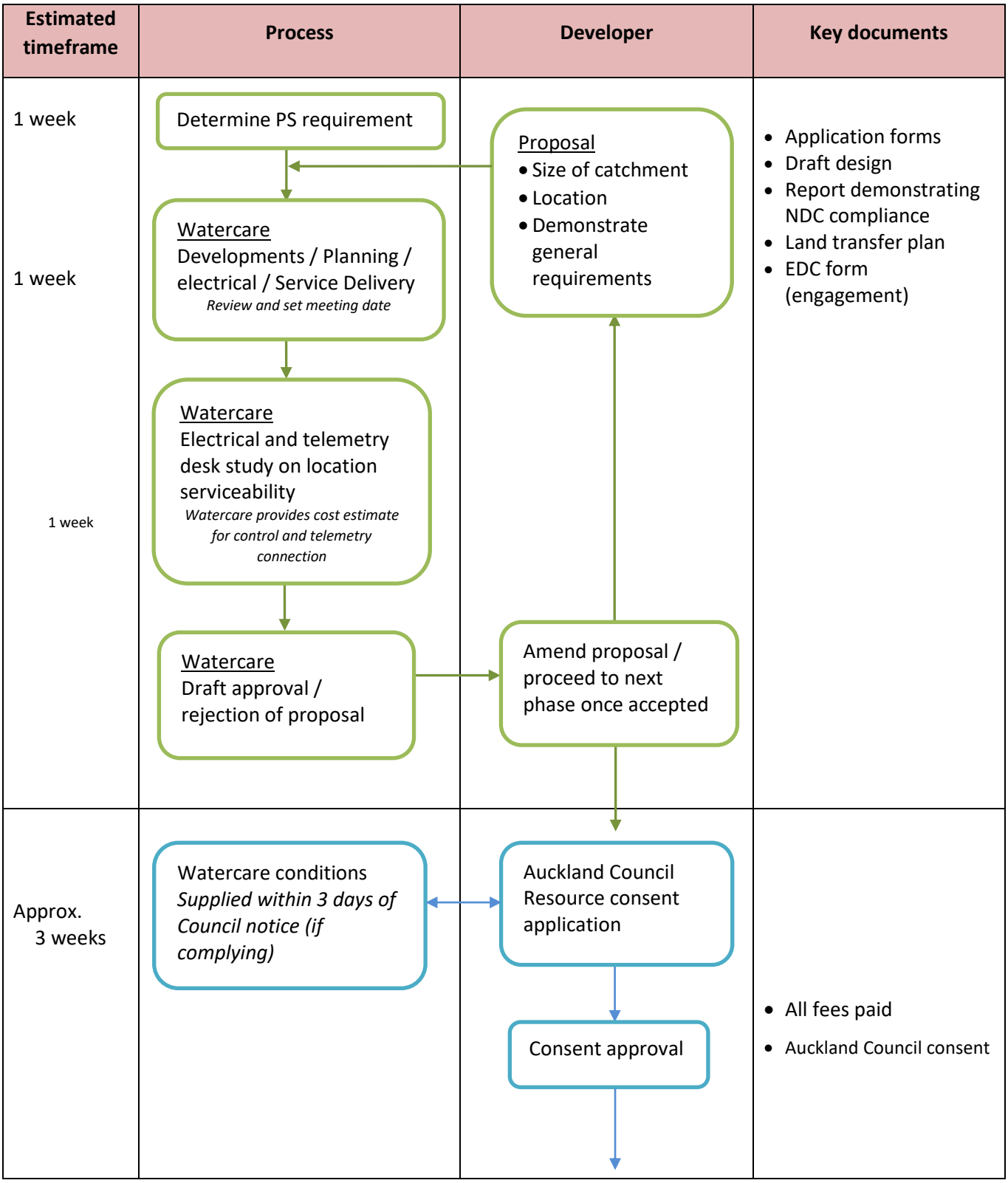
5.2. Safety in Facilities Design guidelines

Refer to Watercare Health and Safety in Facilities guidelines for the functional safety outputs required at pumping stations.

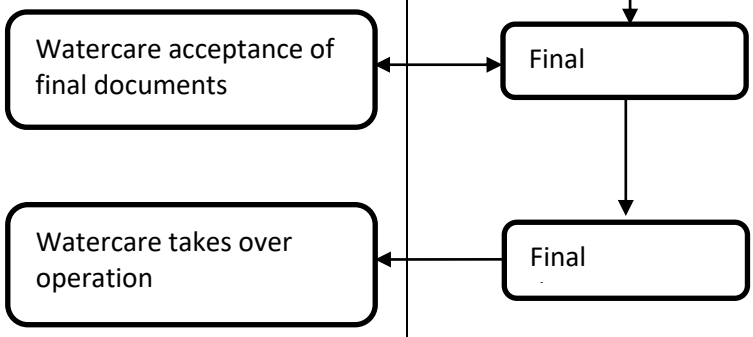
6. Design process pumping stations

6.1. Developer-led pump station design

There are several operational and technical considerations for the developer to discuss with Watercare before beginning the consenting process with Council. The following flow chart is a guideline on the expected timeframes and requirements at each stage of the process:

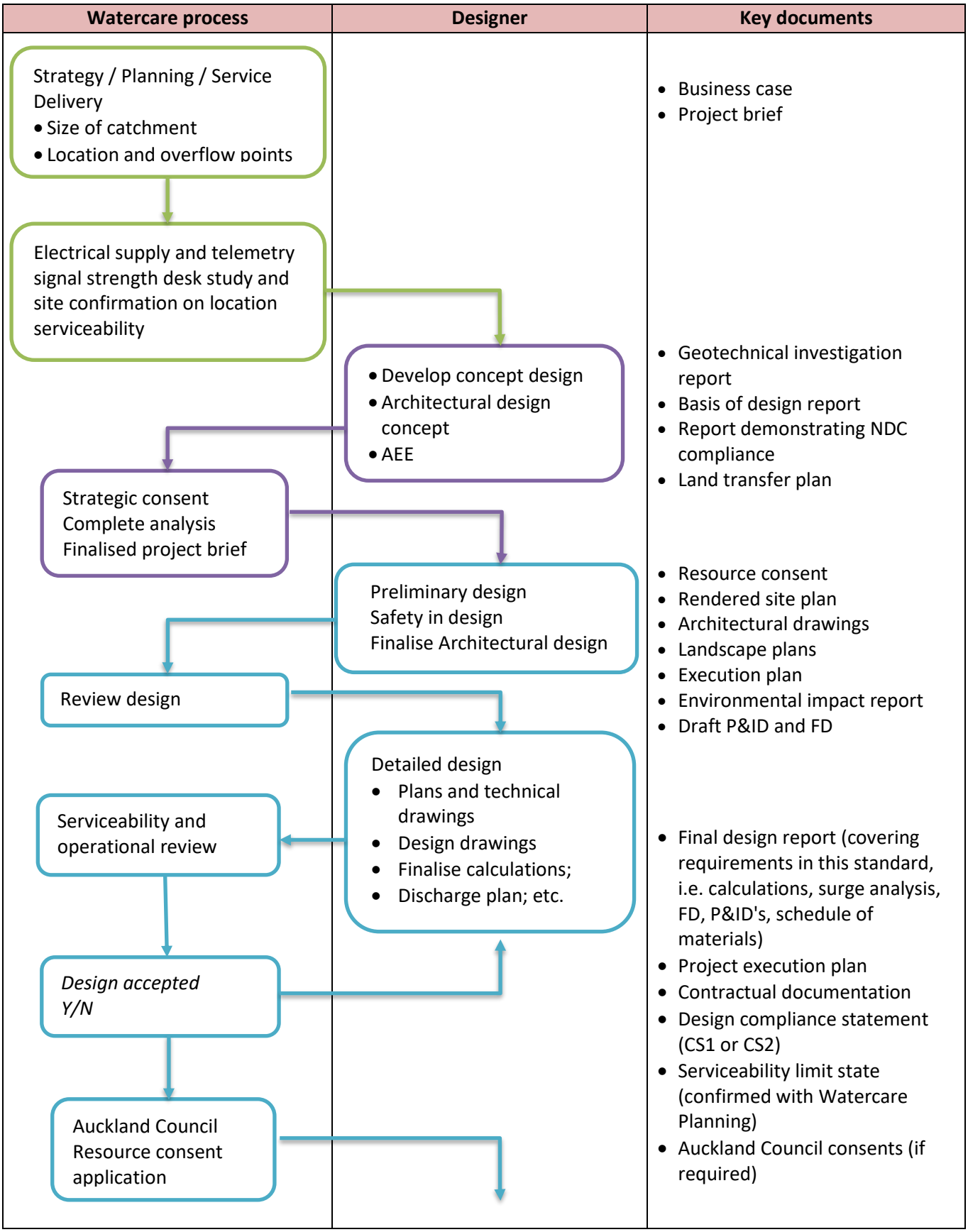


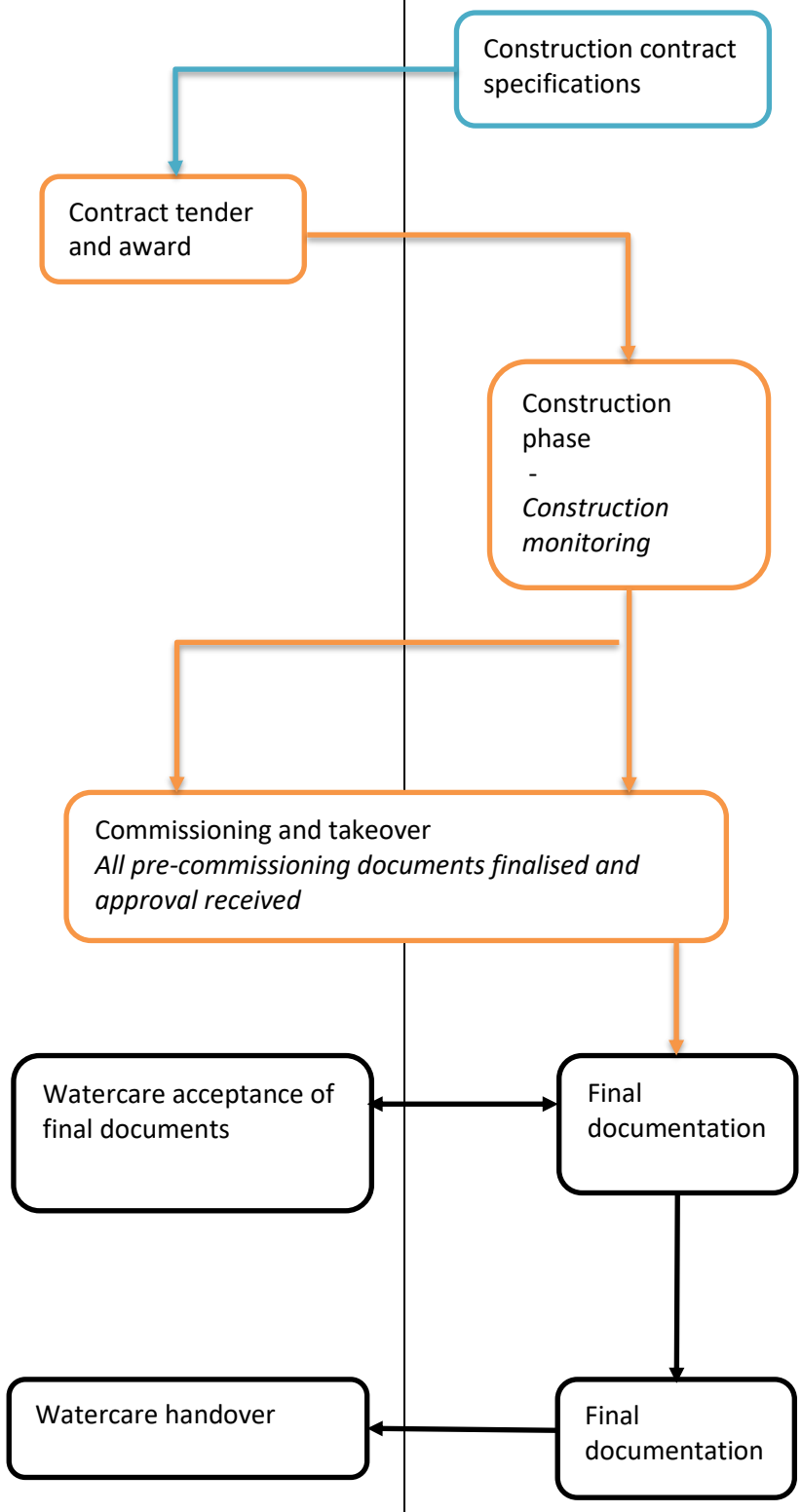
Estimated timeframe	Process	Developer	Key documents
Minimum 2 weeks	Technical review *Design to be finalised* Watercare acceptance *Design accepted (internal process)*	<u>Complete design</u> • Plans and technical drawings • Design drawings • Calculations; • Discharge plan and reports.	• Final design report (covering requirements in this standard, i.e. calculations, surge analysis, FD, P&ID's, schedule of materials) • Design compliance statement (CS1 or CS2, ref. section 6) • Serviceability limit state, ref. section 6 b) (confirmed with Watercare) • Engineering design approval
		Developer constructs pumping station	• Construction QA/QC
Minimum 2 weeks	<u>Watercare review:</u> Documentation and compliance of construction with approved design. Pre-commissioning site visit. Developer corrects any issues		• Prelim as-built drawings • Electrical compliance • Signed-off pre-commissioning test results of structures and pipework. Refer section 9 • Draft Operations and Maintenance Manual. Refer Appendix C • Factory acceptance testing (FAT). Refer Appendix B • Commissioning plan • Construction QA/QC sign-off
Minimum 4 weeks		Commissioning (witnessed by Watercare) *All pre-commissioning documents finalised and approval received*	• Commissioning plan • Approval to connect

Estimated timeframe	Process	Developer	Key documents
			• Post-construction residual risks register • Operations and Maintenance Manual • Final Functional Description (FD) supplied separately to the O&M manual. Refer Appendix B and C • Electrical Certificate of Compliance • Design drawing sets, as-built drawings and survey data • Asset certificate • Engineering compliance statements (CS3 and CS4) • Agreed to transfer of liability

6.2. Watercare-led pump station design

The following flow chart is a guideline on the expected stages for developing the pump station design:



Watercare process	Designer	Key documents
		• Prelim as-built drawings • Electrical compliance • Signed-off pre-commissioning test results of structures and pipework. • Draft Operations and Maintenance Manual. • Factory acceptance testing (FAT). Refer Appendix B • Pre-commissioning plan • Construction QA/QC sign-off (CS3 and CS4 with supporting documentation) • 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 compliance statements • Agreed to transfer of liability • Training

7. Pumping station planning considerations

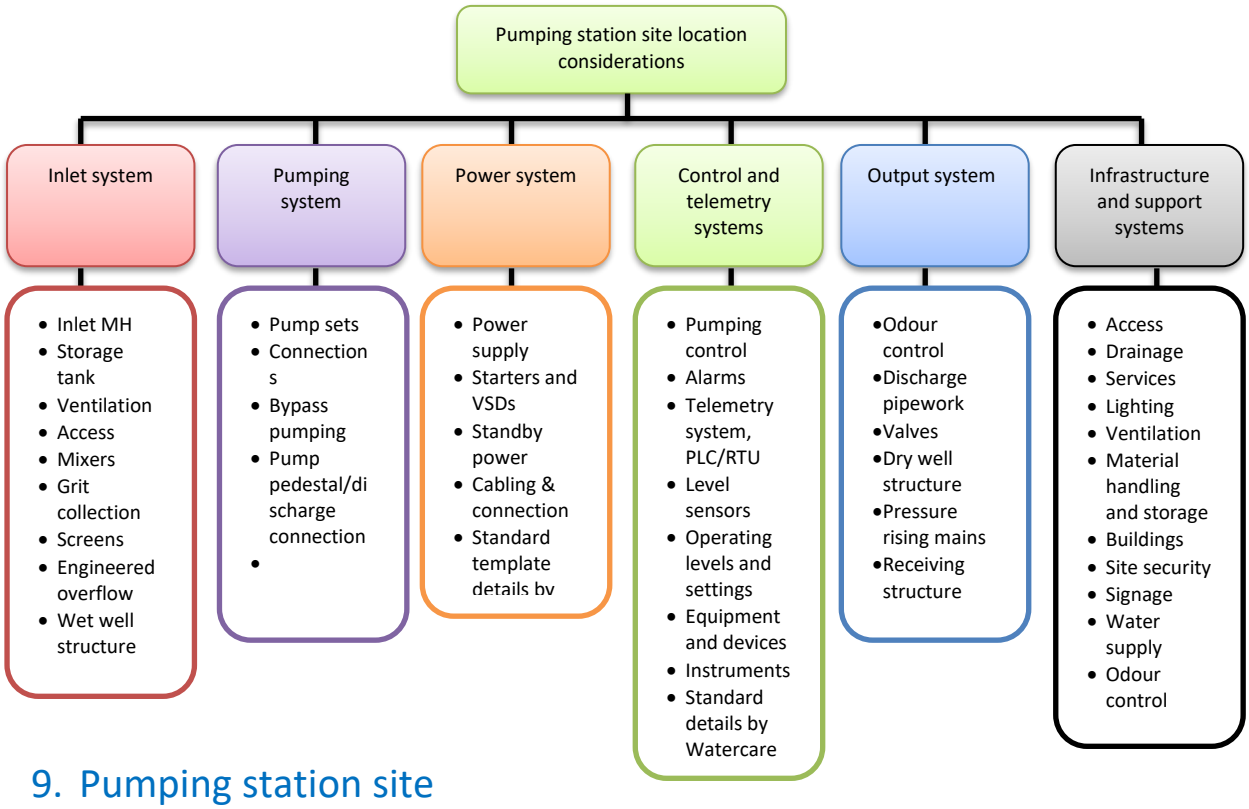
The feasibility study shall consider technical, environmental and financial criteria over the entire design life of the system.

When planning and designing for a pumping station; consideration shall be given to pumping station placement including:

- Future expansion / upgrades that will allow the existing infrastructure to accommodate overall increase in the capacity of the pumping station and other staged infrastructure
- Running costs, life-cycle and ongoing maintenance costs
- The impact on existing pumping stations requires a full system integrated design
- Septicity within the pump station and connected pipework, odour issues and corrosion of equipment and pipes
- Environmental and health and safety risks
- Dry-weather storage capacity

8. Design output format

The design considerations for review by Watercare shall follow the following output format:



9. Pumping station site

Pumping stations shall be sited on public land or a dedicated lot for the exclusive purpose of housing the station and all related structures and equipment. By their nature, pumping stations are typically sited in low lying areas or coastal areas.

The site must provide adequate space for service vehicle movements and future expansion as may be predicted.

A reverse sensitivity (or non-sensitivity) covenant must be placed on the titles to be issued for any adjoining lots within a minimum of 20 metres from the pumping station lot boundary. Factors that determine the covenant distance to be greater than 20 metres shall be based on the nature of the pump station operations, the pump station size and its location.

Land developers must notify all prospective purchasers' of the lots that are adjacent to the pumping station of its location and associated structures. Examples of such plans could be the development plan (scheme plan) that the developer lodges with council under s223.

The pumping station general site layout shall have:

a) A level aspect within the boundaries of the pumping station.

b) 24hr all-weather vehicle access, adequate parking and adequate manoeuvrability and hard stand areas to access all components for maintenance and replacement.

c) Odour control system(s) shall be required at the pumping station and have a minimum of 12m horizontal clearance from the adjacent property boundaries.

d) A minimum ADWF storage capacity to satisfy the conditions of the NDC (see Appendix A) and an engineered overflow.

Note: *Watercare requires a typical ADWF storage capacity of 4 hours, or best practicable option (BPO) to meet the requirements of the NDC. Watercare's assessment of suitable storage may be influenced by operational resilience, the upstream connecting network and the catchment interconnectivity and may therefore require the capacity to be increased.*

e) Dedicated underground mains power supply.

f) A dedicated control room or cabinet to house electrical equipment as specified in the Watercare electrical and control standards. Control rooms and cabinets shall be a minimum of 500mm above the 0.5%AEP flood level.

g) The infrastructure must be designed to remain in service under a 0.5%AEP event.

h) Building doors, switchboards, control cabinets and chamber cover-plates are to be provided with adequate clearances for maintenance access.

i) Electrical connection facilities for the provision of a temporary generator.

j) Dedicated utility service ducting.

k) The pump station inlet structure.

l) Wet well configuration with associated outlet valves and metering.

m) Chemical storage and handling facility if required

n) Landscaping and planting as required by consent conditions or as otherwise specified by Watercare during the design review. Refer to Watercare architectural design guidelines.

9.1. Site ground conditions

Ground investigations shall be completed in accordance with the New Zealand Ground investigation specification, 2017 (http://www.nzgs.org/library/nz-ground-investigation-specification).

All data collected shall be uploaded to the New Zealand Geotechnical Database in AGS4 format at: ***https://www.nzgd.org.nz***

Contaminated sites should be avoided. Where a contaminated site has been confirmed, written approval to proceed shall be obtained from the Auckland Council. The following issues shall be addressed in the request for approval:

- The nature of the contamination;
- Compliance with statutory requirements;
- Options to de-contaminate the area;
- Selection of pipeline materials to achieve the required life expectancy of the wastewater main;
- Safety of construction and maintenance personnel; and

Any contaminants in the soil, including topsoil on the site, shall be at the lesser levels of the health-based or environmental related protection values as described below:

- Health based protection values:

  NES Soil contaminant standards (SCS) for residential land use (no produce, if applicable) as derived in accordance with Ministry for the Environment Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health (Chapter 7). In the absence of a derived NES Soil SCS, then a standard following the hierarchy outlined in the Ministry for the Environment, Contaminated Land Management Guidelines No 2 shall be adopted.

- Environmental related protection values:

  Auckland Council Air Land and Water (ALW) Plan criteria for discharges as described in Rules 5.5.41.

- No asbestos containing material or volatile organic compounds in site soils.

No free (or separate) phase liquid contaminants and groundwater contaminant concentrations, except for volatile organic compounds, which must be below the Australian and New Zealand Guidelines for Fresh and Marine Water Quality at the level of protection for 80% of freshwater species. Concentrations of volatile organic compounds shall be below typical laboratory screening detection limits (0.5 mg/L or lower).

The following table sets out the acceptance criteria for contaminant free sites:

Contaminant	Acceptance level (mg/kg)
Arsenic	<24
Cadmium	<7.5
Chromium	<400
Copper	<325
Lead	<250
Mercury	<0.75
Nickel	<105 [1]
Zinc	<200 [1]
Benzo(a)pyrene equivalent	<2.15
Pyrene	<1
ΣDDT	<0.7
VOCs	Below laboratory detection limit

[1] Can use upper limit background concentration in Auckland region (i.e. 320 for Nickel and 1160 for Zinc) if the soil is volcanic source

A site investigation including soil sampling and testing must be undertaken and a report submitted to Watercare in accordance with the requirements of the Ministry for the Environment, 2011, Contaminated Land Management Guidelines No. 1 - Reporting on Contaminated Sites in New Zealand. Testing shall be conducted by a NATA/IANZ accredited laboratory.

Soil testing data is required at the position for the proposed pumping station. Depending on the size of the proposed site additional soil testing at more than one location may be required if a single sample is not considered representative of the site.

10. General design considerations

The general design considerations include:

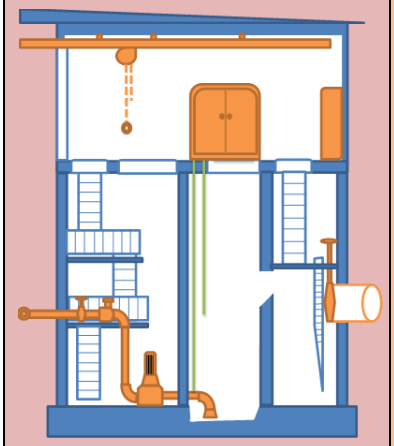
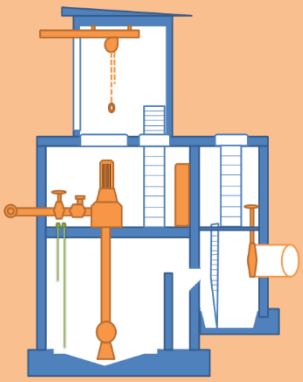
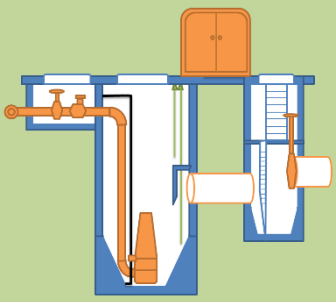
a) Determine pumping system demands for transmission pump stations in accordance with DP-07 Design principles for transmission water and wastewater pipeline design, Part B, and for network pump station refer to COP-02.

b) Determine the station lifting height requirements, flow losses through pipework and fittings to calculate the total head.

c) Develop the system curve that considers:

- The flow velocity at initial flows and ultimate state flows including any staging.
- Friction losses, minor losses and static head.

d) Determine suitable type of pumping station.

Wet well / drywell	**Hybrid**	**Submerged**
Pumps are situated in a dry well adjacent to a wet well. Typically, submersible pumps are dry mounted to protect against flooding 	Pumps (self-priming) are dry mounted over the top of a wet well and can be either above ground or below ground 	Submersible pumps are mounted inside the wet well 

The below table and flow chart in Figure 1 provides high-level guidance on typical application of the three major layout types. The preferred pumping arrangement is a wet well only submersible pumping station to align with Watercare's 40/20/20 goals.

The pumping station arrangement shall ultimately be determined by pump size, lifting considerations and any special considerations to be determined in conjunction with Watercare at the commencement of the project (for example site location and proximity to public).

The selection of pumping arrangement shall generally follow the following flow chart, noting that the flow chart does not include hybrid type pumping stations, which may be suitable in the following scenarios:

- <200l/s flow
- <40m total dynamic head
- <6m suction side lift

Note: When larger pumps are considered a suitable material handling solution must be provided. Consideration must be given to the above ground footprint, safety, and storage of any on-site devices and the site layout equipment to be brought on site. The diagram shows typical selection criteria.

Please refer to the below flow chart to help optimise the pumpstation type selection:

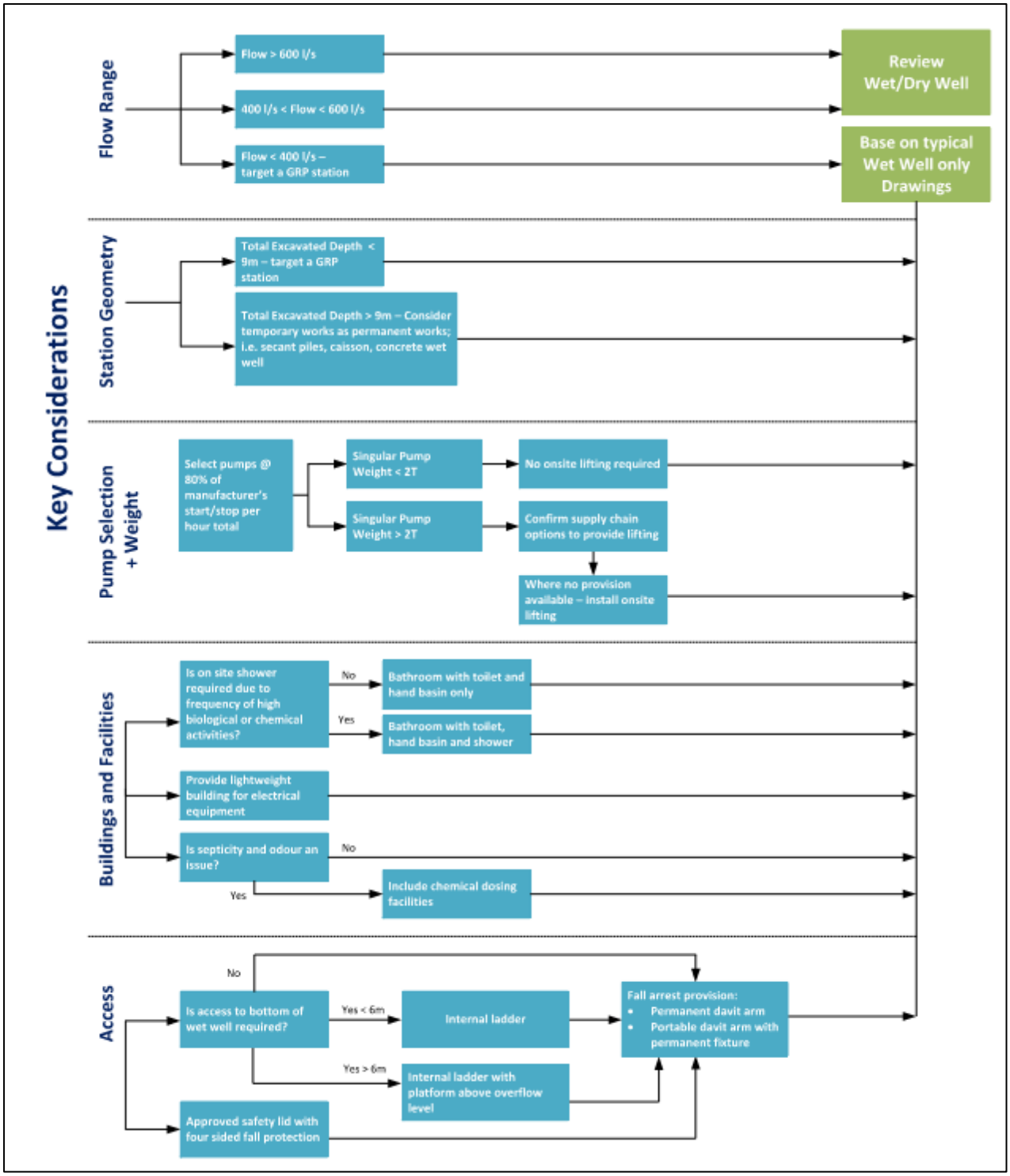


Figure 1: Design process flow chart for selecting submerged or wet well/dry well pump station

e) Determine type of pump

Pump application type			
Wet well/dry pump; Submerged	Rotodynamic	Centrifugal	Single or double entry volute
			Two stage volute
			Multistage split or barrel case
		Mixed flow	Volute
			Bowl
Hybrid	Rotodynamic	Centrifugal	Self-priming
Low lift – generally not used in networks. More prudent at treatment facilities	Positive displacement	Rotary	Progressive cavity
			Screw
			Gear
		Reciprocating	Piston

f) Pump station wet well material: Typically, GRP for smaller submersible pump stations. Concrete for dry well/wet well type pumping stations and for pumping stations at depth requiring specialist construction methods (i.e. secant piles, caisson). Hybrid stations may be concrete, GRP or a combination of both.

g) The general principles for pipe layout and structural design shall be reflected in accordance with the requirements of DP-07 Design principles for transmission water and wastewater pipeline design, Part C and D.

h) A designation schedule of essential infrastructure for post-disaster operational continuity shall be determined in consultation with Watercare and to determine the appropriate serviceability limit state.

i) Determine the operating philosophy and associated SCADA and telemetry requirements.

j) Pumps shall be duty standby for each size of pump (set). Each individual pump shall have its own Motor control equipment.

k) The pumps shall be selected to provide the best possible match for the system requirements. The pump curve, best case system curve and worst-case system curve shall be presented on a single graph. The worst-case system curve shall be based on the maximum static head and an aged pipeline. The best-case system curve shall be based on the minimum static head and a new pipeline. Where pump speeds are varied by VSDs the pump curves at the different speeds of operations shall be presented on the system curves.

l) Voltage and frequency curves shall be included to make sure that the pump selection does not coincide with the rotor's natural frequency and the rate in wavefront rise

does not cause electromagnetic disturbances.

m) The selection of motor starter shall also consider the available power supply.

n) Refer to the table below for typical soft starter and VSD applications.

Soft starters	Variable speed drives
Applications with low or medium starting torques	Applications with high starting torques
Light loaded applications	Speed control and system efficiencies operating at reduced speeds during run mode
Little or no speed control	Continuous feedback for critical position control

o) Overflows shall not exceed the requirements of Watercare's NDC at the expected end of life of the asset. Refer Appendix A.

p) Septicity and odour control measures.

q) Complete geotechnical investigation for structural design, construction considerations and land contamination report. Excessive depth and geotechnical requirements may require alternative temporary works which also form the permanent works, i.e. secant pile walls, caisson structures.

r) Structural design of infrastructure.

s) Pipework and general arrangements of equipment shall take into consideration best practice to minimise the likelihood of corrosion and the need for ongoing maintenance. Refer to Watercare Design principles DP-07 and COP-02, and the Watercare construction standards.

t) The inlet screening static design should be considered in the first instance to reduce the need for maintenance on mechanical components. Acceptable examples such as baffle plates must be considered.

u) Storage drainage is preferred to be gravity in and gravity out.

v) The equipment layout design shall consider safe access and egress, operational ergonomics and minimisation of confined space entry under the expected operational situations.

w) Design of the rising main, or consideration of any existing rising mains the pumping station is being connected to. Refer to Part B, section 11 for rising main design considerations.

x) All drawings shall comply with Watercare's CAD drawing standards.

11. Design review

Once the design has been completed the designer shall undertake a review to ensure compliance with the requirements set out in this standard. The design shall be signed-off by a suitably qualified 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 the standard drawings
- Pump selection
- Plans indicating layout covering pipe size, grade, material types, transfer points and long sections
- Details of air release/vacuum and scour points
- Route selection meets concept/planning design
- Easements as appropriate
- Geotechnical data and considerations are taken into account during design
- Provisions made for future extension as appropriate, including upgrade staging and triggers
- Life cycle cost
- Compliance with referenced standards

12. Construction

Each section, the inlet structure, the wet well with pumps and the outlet system shall be constructed but not connected until individually tested, unless suitable isolation is available to complete individual tests before testing and commissioning the system (refer to section 14 on commissioning).

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

a) General civil construction standard

b) General mechanical construction standard

c) General electrical construction standard

d) Material supply standard

13. Pumping station asset data

Pumping station data shall be captured in accordance with Watercare Data and Asset Information standard and the Watercare CAD manual and as specified in the project specific Exchange of Information Requirements (EIR).

Note: *As a minimum, redline mark-ups will be accepted for commissioning in anticipation of the final asbuilts being provided at handover.*

14. Testing and Handover

14.1. Commissioning

This section shall be read with Watercare's Code of Practice for Commissioning.

All pre-testing and quality assurance checks 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 the commissioning in conjunction with the third-party professional(s) that is responsible for the commissioning works.

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

- Preliminary as-built drawings
- Electrical compliance
- 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 Watercare Code of Practice for Commissioning (COP-03)
- Redline mark-up as-built drawings
- Training
- Commissioning plan
- Applicable construction quality control signed off

The commissioning plan shall include, but is not limited to:

- HAZOP study
- Testing of all control system inputs and outputs (I/O's), see Watercare Code of Practice for Commissioning (COP-03)
- Wet well level sensors and height adjustment
- Alarm status
- Pump control units
- Remote control and data transmission (RTU and PLC checks)
- Data logging and analysis
- Pump flow rates and rising main performance
- Noise and vibration level conforming during operation
- Odour control testing (following operational time) where required

Following the commissioning of the pumping station, any odour control systems installed 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 under still atmospheric conditions.

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

14.2. Rejection of materials or products

All materials specified shall be accepted or standardised equipment as appropriate. 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 no additional cost to Watercare.

14.3. Handover documents

Watercare shall take over the pumping station when all of the below documentation is finalised and supplied and in accordance with the Watercare Code of practice for commissioning (CoP-04) and the Data and Asset Information Standard (AI) documents:

a) Post-construction residual risks register

b) Signed construction quality control sheets

c) Operations and Maintenance Manual, see Watercare's Data and Asset Information standard

d) Final Functional Description (FD) (supplied electronically and separate to the O&M manual), see Watercare's Data and Asset Information standard

e) Electrical Certificate of Compliance

f) Provisional takeover certificate (following commissioning)

g) Design drawing sets, as-built drawings, models and survey data

h) New assets register including for associated linear assets in accordance with Watercare's Data and Asset Information standard

i) Final handover certificate on completion of all as-built information and any outstanding retention items

j) Engineering compliance statements for design, construction and construction monitoring

Where materials have not been supplied by Watercare, all product and material warranties and guarantees shall be transferred to Watercare.

PART B – TYPICAL PUMP STATION DESIGN PARAMETERS

1. Material selection

All materials shall comply with Watercare's material supply standards. The following specific considerations shall be considered at key infrastructure:

1.1. Wet well

a) The wet well design shall consider high corrosion and sulphide attack on concrete surfaces. Concrete wet wells shall be constructed from either concrete with resistance to corrosive attack i.e. calcium aluminate, polymer concrete and be protected with a suitably painting system, or alternative materials such as polyethylene and GRP.
b) Where painted coatings are used the designer must complete the product schedule in the Material Supply standard and provide this to the coating supplier to support the coating selection. The selected coating system must have a life expectancy without maintenance more than 50 years.

1.2. Inlet and outlet pipework

a) Inlet pipework to the wet well shall be selected to the appropriate design class from the materials listed in the Watercare Material Supply standard.
b) Pump intake pipework from the wet well to the pump intake shall be internally and externally corrosion protection to withstand high H2S levels and shall have a high abrasion resistance rating in excess of 25 years. Refer to the Watercare Material supply standard for the suitable epoxy coating system.
c) Inlet and outlet pipework material must be selected for longevity, corrosion and erosion preventions properties, but also for ease of maintainability. Typical selection is ELS (epoxy lined carbon steel) or stainless-steel pipe.

1.3. Pipe Material

a) Pipe material shall be supplied in compliance with the applicable Watercare material standard.
b) The minimum pipe pressure rating shall be PN16 and any other component valve or fitting shall have a minimum pressure rating of PN16.
c) The maximum pressure design shall consider pipe and fittings to be pressure de-rated based on the material maximum cyclic pressure range (MCPR).
d) The maximum operating pressure shall be less than the MCPR.

1.4. Valves

a) Valves and componentry shall be suitable for use with wastewater and the installed environment.
b) Valve installations shall be constructed with adequate support that will allow the valves to be freestanding, should any other component be removed.
c) The pipework design shall allow for removal of valves and where required dismantling joints shall be used.
d) Isolation and non-return valves shall be the same diameter as the pipework they are being installed on.
e) Isolation valves shall be operable from ground level where buried unless inside the dry well.

1.5. Non-return valves

a) Non-return valves shall be of the swing check type with a rubberised steel disc, or a pump control valve and as accepted by Watercare. The selection must take into consideration any pumping surge.

1.6. Isolation valves

a) Isolation valves shall be of the metal seated gate type. Isolation valves shall be installed on each pump intake (for wet well/dry well pumps) and on the pump discharge downstream of the non-return valves.

1.7. Air release valves

a) Air release valves where installed on the rising main, shall be double acting and as accepted by Watercare.

b) The air valves shall be in an accessible chamber that is vented. Air valves must be designed for connection of a suitable air treatment facility and where required and fitted with a vent stack that ensure no noticeable odour at the nearest property boundary. H_2S shall be less than 0.004ppm measured at the filter outlet.

2. Receiving structure (discharge manhole)

a) The rising main shall discharge into a fit-for-purpose manhole structure that will dissipate the energy of the rising main prior to transition into the gravity system.

b) The rising main shall discharge into the discharge manhole on a rising gradient. The rise into the receiving structure shall be a minimum of 3m long. No other connections shall be made into the discharge manhole.

c) The fall through the chamber between the top of the rising main pipe entry and the outlet pipe shall be a minimum of 150mm.

d) The rising main and manhole outlet shall not be more than 30 degrees out of alignment. Where drop structures are considered, a specific design should be undertaken.

e) Refer to Part D, section 10 for odour control options.

3. Grit Collection and Screens

1. In areas where grit collection or pre-treatment by screening is required, the system shall be incorporated into or upstream of the inlet structure.
2. Penstocks or knife-gate valves shall be installed upstream of screens to allow isolation for cleaning.

4. Pumping Station Inlet System

4.1. General

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 when required.

c) Be able to facilitate bypass pumping and selective isolation by penstock or similar suitable valve for maintenance.

d) Isolation valves shall be accessible for operation without the need for confined space access.

e) The inlet structure shall be configured to minimise incoming flow turbulence and prevent build-up of debris.

4.2. Inlet structure material preference

a) The inlet structure shall be constructed from either concrete with resistance to corrosive attack i.e. calcium aluminate, polymer concrete; be protected with a suitable painting system; or be constructed from corrosion resistant material (i.e. GRP or PE). The designer must complete the project schedule in the Material Supply standard and provide this to the coating supplier to support the coating selection.

5. Wet well inlet

The inlet between the inlet structure and wet well shall have the following features:

a) An 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 intakes.

b) Discharge from the inlet structure will not flow directly onto a pump intake and be arranged such that the inflow into the wet well during high flow does not cause eddies (e.g. deflector or flow diffuser).

c) The inlet height shall not exceed 1.5m above the bottom operating water level to limit air entrapment and shall be graded towards the pump takes.

6. Wet well

a) Structural design shall be to the selected function class. Refer to Part A, section 4.2.

b) The wet well level shall be monitored.

c) The base of the wet well shall be shaped and angled to prevent septicity and “dead zones” where solids can accumulate.

d) Allow adequate clearance from well sides and base to pump intakes in accordance with the pump manufacturer’s installation recommendations.

e) 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. 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. Ventilation shall not be directed through the dry well or control room

f) An air treatment facility shall be installed at ground level. The ventilation system shall be designed to provide an appropriate ventilation velocity. Refer to Part D, section 10 for biofilter and carbon filter requirements. The design of the air treatment facility shall be site specific with consideration to frequency of operation and replacement of filter media or chemicals.

g) Watercare standard design details shall be used for all lids, see drawing set DW05. Hatches shall comply with AS3996 to the appropriate class.

h) All access hatches shall be fitted with a hinged safety grille underneath the lockable access hatch. Safety grilles shall be tested to comply with AS3996 class A. Perimeter protection shall be provided on all four sides of the opening for fall protection.

6.1. Size of the wet well and levels

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

a) The maximum retention time of wastewater during normal operation shall be 2 hours.

b) The wet well operating range (pump start to the minimum level above pump intakes) to prevent settling (typically 1m) and limit the pump starts to no more than 80% of the pump manufacturer's maximum recommended starts per hour.

c) The maximum top water level shall be determined by examination of the upstream surcharge level. The maximum top level is only reached when the duty pump is unable to manage the inflow. Standby pumps are switched on at this level and may be staged for more than one standby pump.

d) The overflow level is set above the maximum top water level. The overflow alarm is activated at this level and all pumps running. See section 7 below for overflow arrangements.

e) The volume between pump start and pump stop shall be determined by pump capacity and be set to limit the frequency of pump starts. The pump start level shall pump intake minimum submergence to avoid vortices from forming in the wet well and provide the required NPSH

f) A hydraulic model shall be carried out to test the wet well design for uniform hydraulic distribution over the pump station operational range.

g) Internal access platforms to support entry to the wet well via ladders shall be located above the overflow level.

7. Pump station overflow

The pump station overflow may be placed at the pump station or another nearby suitable location in a purpose-built overflow manhole and include the following requirements:

a) The overflow shall be from the inlet structure.
b) The overflow location and level (impact on well storage size) shall be determined through an environmental impact assessment with resource consent requirements and conditions in mind
c) The overflow shall be into an overflow structure with connecting outfall that must be accessible by a sucker truck.
d) The outlet from the overflow manhole shall be fitted with a stainless-steel baffle plate or concrete where maintainable, to prevent scum discharge to the environment.
e) Drainage fall shall be away from the overflow manhole to allow draining back to the wet well
f) The outfall outlet shall be fitted with a non-return flap valve or similar.
g) The outfall shall be constructed with a wing wall and fitted with a stainless-steel grid. The stainless-steel grid bar spacing shall be minimum 25mm to prevent blockages and not be more than 100mm spacing. It must be designed to allow ready access for maintenance and cleaning.
h) The specific design shall take into consideration energy dissipation and erosion control in the receiving environment.

8. Wash/pump-out

a) The scour valve locations shall be at the lowest points of the pipeline.
b) The number of scour valve locations shall be decided based on the length of the rising main at adequate intervals to reduce drain down time for repair and maintenance.
c) Scour valve locations shall provide access for sucker trucks
d) The chamber shall be provided with a sump for installation of a portable drainage pump

9. Ventilation

a) All components, fixings, supports, etc. shall be fabricated from corrosion resistant materials. Preferred materials include stainless steel 316, PVC and GRP as applicable.
b) Galvanised steel is not acceptable.
c) Refer to Part D, section 10 for air quality treatment.

10. Pumping System

10.1. 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, see section 10.2 below.
d) 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 pipe.
e) Levels and profile of the rising main and discharge point. See section 11 below.
f) High points - to account for possible characteristics controlled by intermediate highpoints along the rising main.
g) Combined detention times for wet well and rising main(s) not exceeding 8 hours where possible for initial flows.
h) Shear velocity to prevent slime build-up in rising mains that will increase flow resistance over time
i) Capacity restriction in the receiving sewer

10.2. Pump selection

a) Common pump arrangements are vertical centrifugal pumps in a dry well or wet well with direct motor drive, or self-priming surface mounted pumps. Submersible pumps in dry wells should be considered for transmission applications where surface and dry well flooding can occur. Dry-mounted submersible pumps require consideration of the specific cooling method. Wet mounted pumps are to be glycol cooled.
b) Pump with motor decibel rating shall be less than 80dB.
c) Pump selection shall be within ±5% of the pump best efficiency point (BEP) at the peak dry weather flow rate (PDWF) which equates to half the peak wet weather flow rate (PWWF) or the most frequent flow rate that the pump station will be operating at. The design flow capacity of a pump station is generally sized to match the PWWF. The pumps shall, however, be selected to also operate withing the acceptable operating range (AOR) of the pumps at the PWWF.
d) Where possible the minimum overall pump efficiency shall not be less than 70%. (depending on the pump and impeller type). Lower efficiency may be considered in the following exceptional circumstances:
    i. There is no other pump available for the specified duties or

ii. The anticipation of excessive impeller clogging, and the associated maintenance outweighs the energy saving costs of selecting a more efficient impeller type or pump selection.

e) Pump head curves with very flat head flow characteristics can make the pump difficult to control due to small changes in system resistance that can create large changes in flow rate (i.e. 'hunting'). The use of variable speed drives (VSD) in these scenarios shall require prior approval from Watercare.

f) Consideration to pump wear over the pump maintenance cycle to achieve flow design criteria.

g) Standby capacity shall be enough to maintain the pumping station operation in the event of duty pump failure or maintenance. Where a single duty pump provides the design flow capacity an equal capacity pump shall be provided for standby. Where three pumps of equal capacity are operating in parallel to provide the design flow capacity, a fourth pump of the same capacity shall be provided as standby. For large or critical pumping stations a minimum of two or more standby pumps shall be provided.

h) Where the pumping station has a wide range of flows rates different pump sizes should be considered to minimize power costs. The number and size of standby pumps should be assessed based on the ultimate flow conditions and available storage.

i) Phased pump installations should be considered to better align with growth projections. Reduced/trimmed impellers could be used initially, and variable speed drives should be considered. Adequate space shall be allowed for additional pumps or larger replacements if required with a phased installation.

j) Pump stop/start shall not typically exceed more than 80% of the pump manufacturer's recommended maximum starts per hour at ADWF. Pumps shall be duty cycled on each successive pumping cycle.

k) Select pumps where pump curve intersects with the system curve (Figure 1) allowing an

l) Refer to Watercare electrical standards for VSD and soft starter requirements.

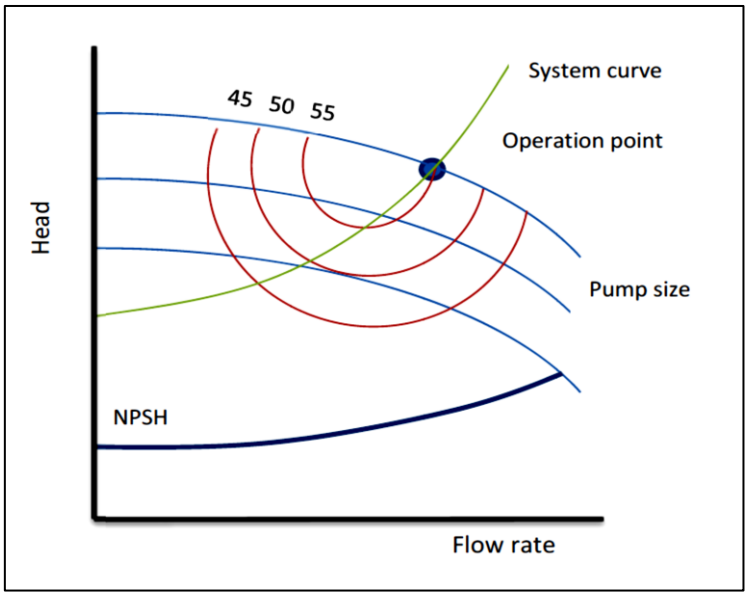


Figure 1: Pump selection by combining system curve and pump curve to determine the best efficiency point.

10.3. Pump product requirements

The pump shall comply with the standards as listed and amended in Watercare's material supply standard.

11. Rising main

11.1. General

a) The length of the rising main must be kept as short as possible.
b) The rising main shall be designed in accordance with Watercare Standard DP-07
c) Rising mains shall not be situated in private properties.
d) The rising main layout shall include a connection for bypass pumping.

11.2. Hydraulic design

The rising main pipe shall be designed in combination with the pumping system (see section 10 above) and include:

a) Length of the main and overall allowable detention time of up to 8 hours.

b) Maximum allowed number of pump starts and the impact of cyclic fatigue on the selected rising main material.

c) Withstand surge pressures not less than 200kPa. Pressure surges shall be within the amplitude of the acceptable limits throughout the system. The surge analysis shall consider 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.

   Pressure surge solutions may include:

   - Fast closing non-return valves.
   - Controlled ramping up and ramping down of pumps.
   - Slow-closing non-return valves.

   This control method is before the pump stops. In such situations the pump control needs to be co-ordinated, especially for power failure scenarios. Such non return valves will be hydraulically controlled to shut between 20-30 seconds, or actuated valves could be used.

   - Pressure relief valve

d) Withstand a transient pressure of at least 80kPa below atmospheric pressure. Negative pressures can be prevented by:

   - Pump inertia/flywheel to continue pump rotation for a short period after power failure.
   - Surge tank.
   - Double acting air relief valves.
   - Air vessel.

e) The minimum flow velocity shall be 0.9m/s. The minimum flow velocity shall be calculated at the expected start of the service life. The design shall be carried out based on full-bore flow

f) The maximum rising main flow velocity shall not be more than 3m/s at ultimate service at PWWF and not more than 2m/s at the PDWF or the flow rate at which the pump station normally or most frequently operates at.

g) The dynamic and static head.

h) Head loss shall be calculated using the Darcy-Weisbach equation with frictional coefficients determined using the Colebrook-White equation. A pipe roughness of 0.3mm shall be used in calculating the Colebrook-White friction factor (f). A Colebrook-White friction coefficient of 0.3 shall be used

i) Minor losses due to fittings, valves and other obstructions shall be determined using the component manufacturer's value with a 10% inaccuracy factor. Where no data is available refer to Watercare's design principles for transmission pipeline systems on manufactured fitting losses.

11.3. Rising main levels

a) The rising main shall, wherever possible, rise continuously from the pumping station and terminate at its upper end into the receiving structure.
b) Rising and falling mains (complex rising mains) shall be considered only when continuously rising mains are not feasible
c) The minimum rising or falling grade shall be 0.5%.

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

d) Peaks and low points shall be minimised.

e) Peaks shall be constructed with a double acting air release valve structure. The air release chamber shall be fitted with suitable ventilation and treatment of foul air at the expected air flow rate.

f) Low points shall be prominent and shall incorporate a scour valve with pump-out arrangement that allows for safe access by a sucker truck and staff, refer to section 8 above.

g) Scour valve and air release valve chamber access shall where practical be in the back berm of the road corridor (the first 1m width of the road berm adjacent to the road carriageway is defined as the front berm).

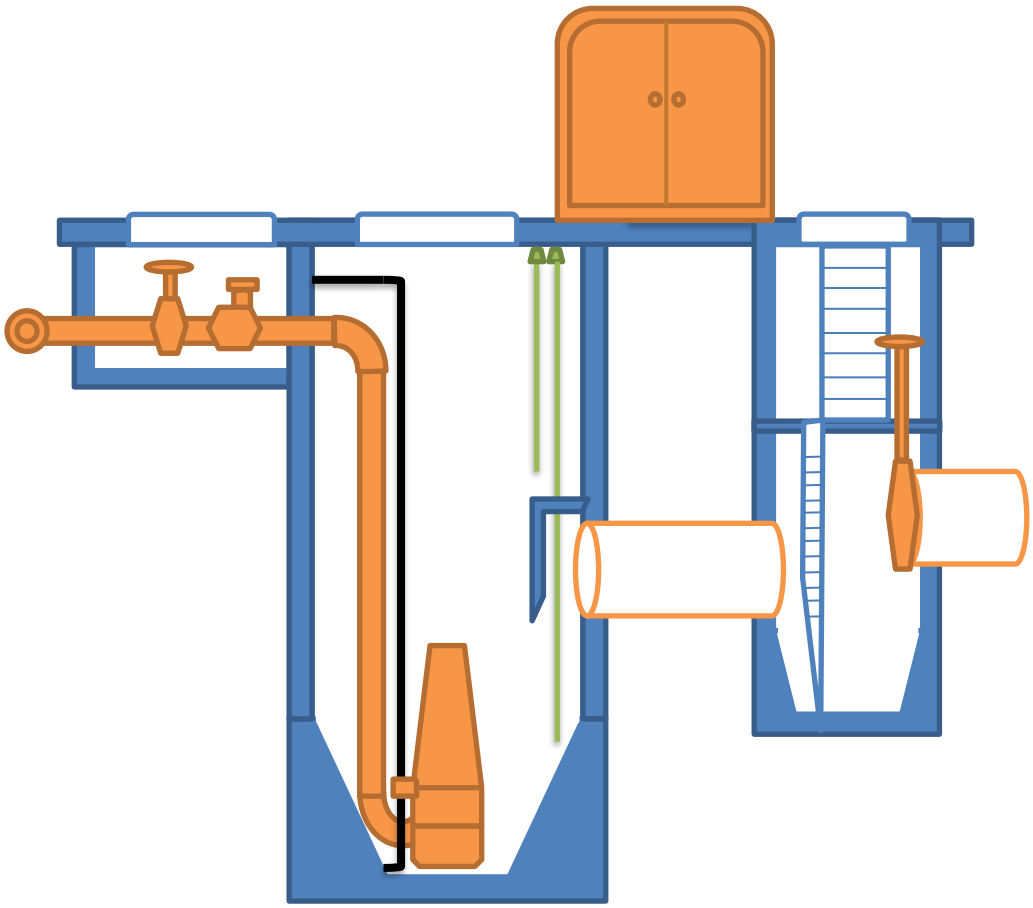
11.4. Parallel rising mains

a) Under exceptional circumstances, parallel pumping may be considered. For existing systems where the design basis is for a completely new parallel system or where the existing systems are redesigned and replaced a specific design philosophy must be developed and approved by Watercare.
b) All pipelines operating in parallel shall be duty mains. Standby mains are not accepted due to operational constraints with maintenance and septicity in the standby mains.
c) The operating points for parallel pumping stations shall be considered for the full system to set individual pump duty points based on the pumping head for each pumping station or pump set. 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.
d) Where the common rising main is a complex rising main the graphical determination shall be supported by modelling software. Watercare prefers that the modelling information is provided in *InfoWorks*.

PART C – PUMP STATION TYPE SPECIFIC CONSIDERATIONS

1. Wet well only submerged pumping stations

These pump stations are very cost effective and can aid in meeting Watercare's 40:20:20 goals. These pump stations are generally suitable where the flow is less than 400l/s or the pump weight is less than 2T and can easily be lifted from the surface level.



There are several drawbacks to consider with the ongoing operation and maintenance of this pump station type when considered for transmission pump stations:

- Onsite handling of large heavy pumps
- Stability of the guide-rails
- Pumps must be transported away for cleaning and repair
- Repairs are more expensive and take longer
- Preventative pump monitoring is less accessible

1.1 Access and handling

Also see Part E, section 6

a) Removable davit up to 1 ton should be provided. Alternative options must be provided if any component is heavier than the capability of the davit.

Note: When larger pumps are considered for this application a suitable on-site lifting solution must be provided. Consideration must be given to the above ground footprint, safety and storage

of the solution or transport and manoeuvring on site. Suitable solutions may include external gantry cranes or jib cranes.

b) Man-access to the valve chamber and grit chambers are required.

c) Lid clearance should be provided to lifting any equipment from the surface

d) Pump guiderails shall be Schedule 80 Grade 316 stainless steel to prevent corrosion. The guiderails shall have adequate support brackets to prevent rails from bending or buckling.

e) Pump lifting chains are to be tethered to the wet well opening with sufficient chain length to allow loop at top of wet well.

f) Access shall be provided to the wet well invert for operations. This includes any platforms required for ladders. The landing platform shall be above the high-high water level and access below the platform to the invert of the wet well shall preferably be by portable ladder or fixed installed slide down or fold down ladder from the platform. Fixed installed ladders below the high-high level would increase the risk of trapping floating debris and rags.

1.2 Monitoring and control

Also see Part D.

a) Control cabinets must be installed above ground.
b) Cable ducting must not be continuous from the wet well to the control cabinets to prevent gasses from entering the control cabinet.

1.3 Pump Intake

a) The centre-to-centre clearance between pump intakes shall be designed in accordance with industry standards and as required by the pump manufacturer to prevent vortices, air entrapment and pre-swirl.
b) The side clearance from the centre of the pump intakes to the well walls shall be designed in accordance with industry standards and as required by the pump manufacturer
c) Height of the pump intake off the wet well floor shall be in accordance with the pump manufacturer's specification.

1.4 Pump Selection

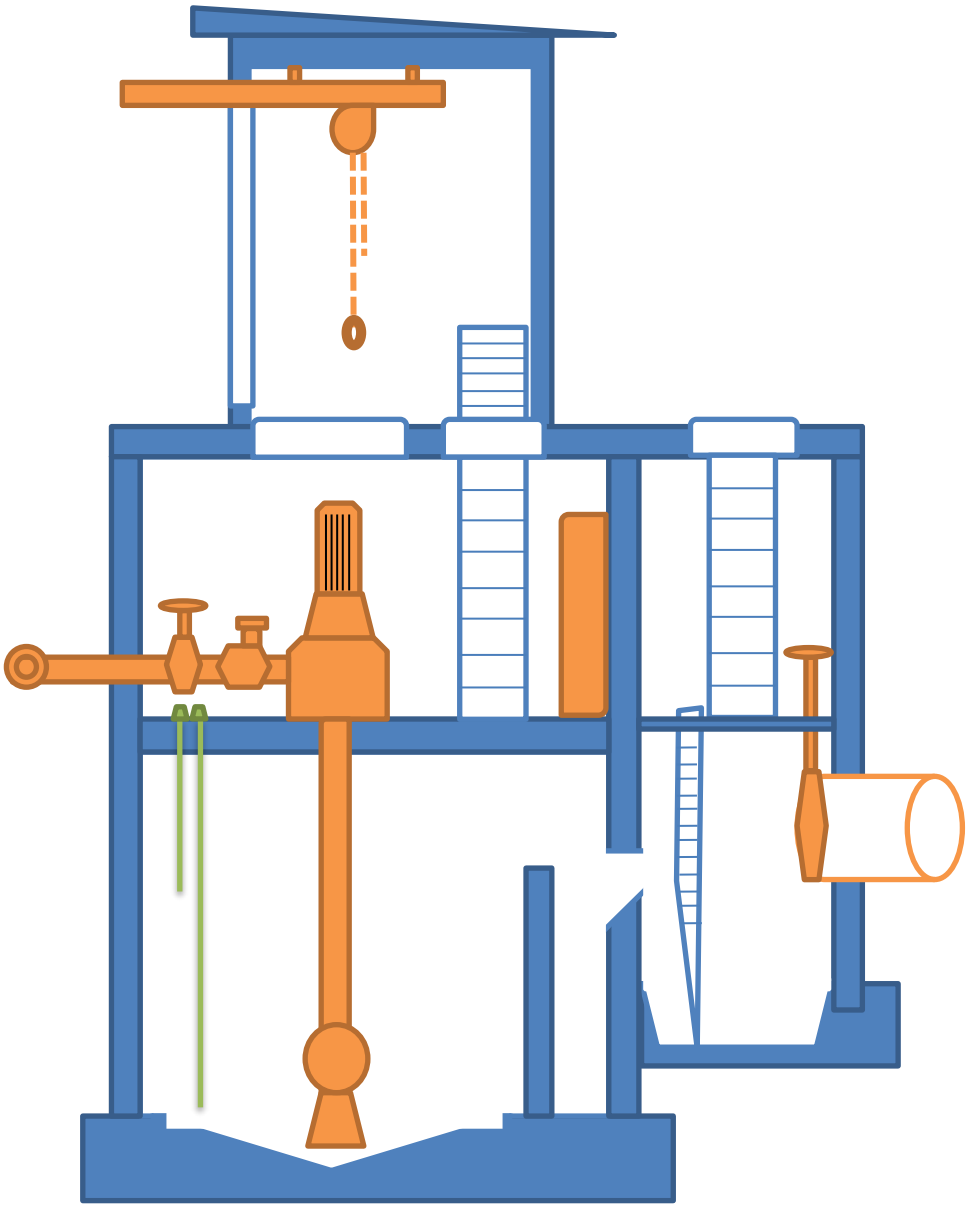
a) Pump selection will be a pump with proven anti-clog performance

1.5 Wet Well Material

a) GRP is preferred for wet wells 4.5m in diameter or less, and less than 9m deep due to cost and carbon benefits, and benefits of off-site fabrication. GRP structural design is to be by the GRP tank vendor. A structural loadings memo is to be provided to the manufacturer outlining the structural design requirements.
b) For very deep wet wells (>9m) and wet wells in ground conditions that require extensive temporary works (i.e. secant piles), consideration should be given to designing temporary works to be incorporated into the permanent works (i.e. secant pile walls or caisson). Corrosion resistance is to be applied as per Section 4.2, Part B.

2. Hybrid pumping stations

Pumps are either top mounted to a wet well or in a below ground chamber over the wet well just under the ground surface. These solutions are limited to the available NPSH and requires that the suction lift typically be less than 6m deep. These pumps systems need to be automatically primed (self-priming) and are usually available up to 200l/s delivery and head up to 40m (albeit higher head pumps generally have lower flows).



2.1 Access and handling considerations

Also see Part E, section 6

a) Staircase access is preferred. Step ladders may be considered if the control room is situated directly under the surface and where the headroom is not more than 2.5m.

b) Hatches must be provided to allow replacement of any single component within the pump station.
c) Gantry rails may be used to allow travel of components to a suitable hatch.
d) Where inlet screens are used access must be separate to the motor room and ventilation may not be shared.

e) Removable davit up to 1 ton should be provided. Alternative options must be provided f any component is heavier than the capability of the davit. With hybrid pumping stations where minor above ground infrastructure is permissible a housing shaft with travelling gantry may be used.

Note: When larger pumps are considered for this application a suitable on-site lifting device must be provided. Consideration must be given to the above ground footprint, safety and storage of lifting equipment

f) Man-access to the valve chamber and grit chambers are required.

g) Clearance around the lid should be provided to lift any equipment from surface deployed lifting equipment.

2.2 Pump priming

a) Vacuum pump priming is preferred. The priming system must be individual per pump.
b) A fail to prime protection must be installed per individual priming system that will allow the next pump to be started in the event of priming failure.

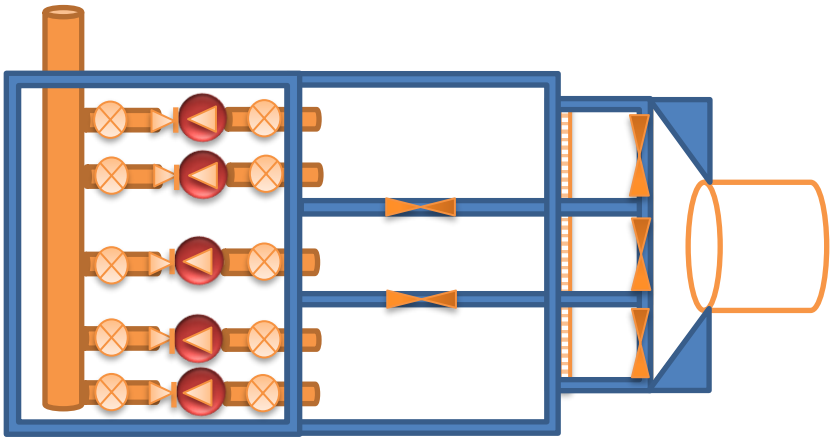
2.3 Monitoring and control

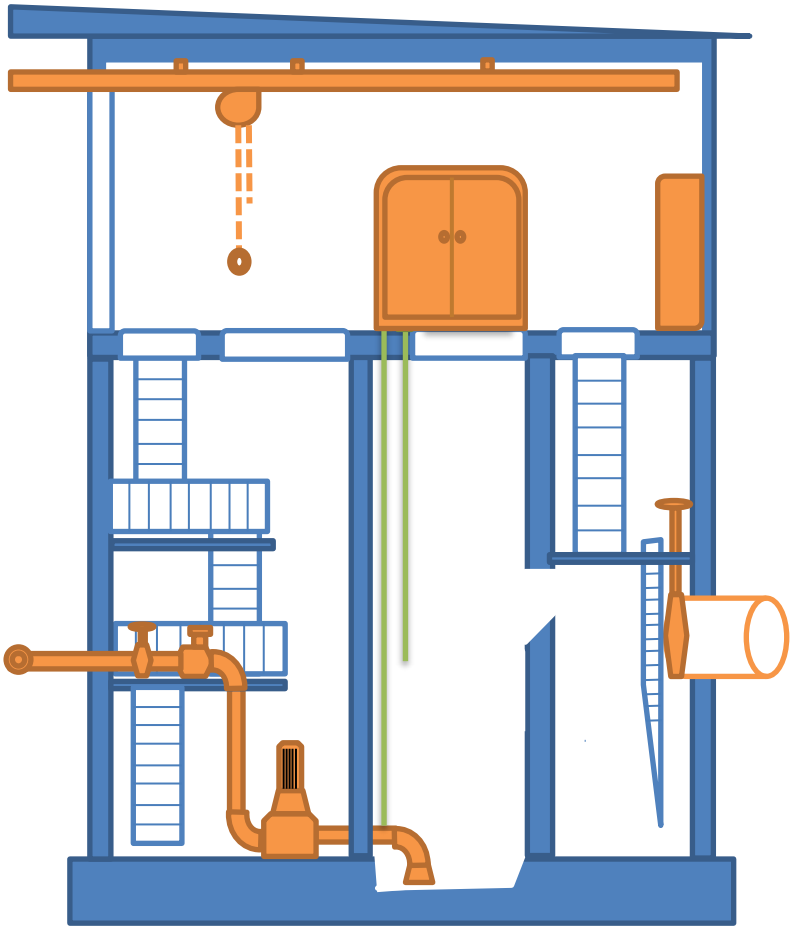
Also see Part D.

a) Control cabinets can be installed above or below ground in the motor room. A below ground motor room must be separate and designed such that there is no risk of flooding.
b) Where the installation is below ground provision must be made for adequate air handling and sump drainage.

3. Wet well / dry well pumping stations

This type of pump station is generally considered for design flows over 400l/s to 600 l/s, or where pump weights are greater than 2 tonnes.





3.1 Wet well

a) The wet well shall be divided into two or more compartments with penstock isolation between wet well chambers and individual inlets, outlets and isolation.

b) Penstock valves are suitable for inlets in the wet well.

c) Benching shall be formed (fluted) to guide flow towards the pump suction, not pass solids from one pump suction to another and to achieve self-cleaning.

d) Access to the wet well needs to be provided by staircase to landing platforms that are designed to AS/NZS1657.

3.1.1 Pump intakes (wet well outlet pipework)

a) The pump intake pipe shall be formed with a long radius bend facing downwards and a bell-mouth.

b) The centre-to-centre clearance between pump intakes shall be a minimum of 1.5 times the external pipe diameter, or as otherwise required by the pump supplier to prevent vortices, air entrapment and pre-swirl.

c) The side clearance from the centre of the pump intakes to the well walls shall be minimum 0.8 times the external pipe diameter, or as otherwise required by the pump supplier.

3.2 Dry well

The drywell needs to provide adequate clearances around machinery and equipment for visual inspection, routine maintenance and replacement with the following consideration:

a) Structural design shall be to the selected function class.
b) General clearances around valves and pipework as stipulated in the Watercare Design principles for transmission water and wastewater pipeline design, DP-07 Part C, and as described by the Health and Safety in Facility design guidelines.
c) Adequate space for future replacement with larger diameter pipework and components.
d) The discharge manifold layout shall be designed to prevent solids settling and building up within pipework .
e) Suitable drainage must be included to maintain the chamber in a dry condition from any seepage. The floor must be graded to a sump location with sump pump that discharges above the flood level.
a) 3.1.1 Sump pumps shall be duty standby and monitored.
b) The drywell sump shall be fitted with a level alarm.

3.3 Access and handling considerations

Also see Part E, section 6

a) The drywell building shall be fitted with a running gantry that is able to lift any equipment from the installed position onto the back of a truck.
b) Access shall be made available for truck hard-stand and suitable service doors to allow equipment or vehicle handling.
c) Access shall generally be by staircase.

PART D – ELECTRICAL, CONTROL AND TELEMETRY

1. Electrical, Control and Telemetry

Electrical, control and telemetry design and installation shall comply with the Watercare electrical and control standards and template drawing set DW18 for pumping stations.

1.1. Electrical

Additional to the electrical standards the following requirements for establishing electrical power on site shall also be completed:

- Sites owned by Watercare shall be coordinated for connection through Watercare. Early engagement with the mains provider is required.
- Where mains electricity is not available at the site a new installation point (ICP) will be provided.
- Mains electricity shall be of sufficient capacity considering future expansion.
- Unless otherwise approved, substations on an electrical consumer's premises shall be for the sole supply of the Watercare facility.
- 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.
- Any easement requirements for electrical mains and transformers must be referred to Watercare.

1.2. Control system and Telemetry

a) Watercare will complete a connection suitability study for the location, to establish the telemetry requirements for the proposed pumping station site. A desk study will determine if there is an available connection for the location.

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

c) Should there be no communications available, or the signal strength is less than -90dB a specific design will be required.

d) The telemetry and radio system shall be from a Watercare standardised supplier, refer to Watercare's material supply standard. The installation shall be carried out by a Watercare approved contractor.

e) The designer 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

f) The SCADA software shall be developed and implemented by a Watercare approved developer.

g) Watercare has five different control systems that operate in various areas, they are:

   - Emerson DCS
   - In Touch SCADA
   - IFIX LNT SCADA

- Citect SCADA
- Abbey Systems Powerlink

For Watercare to complete the SCADA the following will be developed and supplied by the designer:

i. A level one Functional Description (FD), to be reviewed and accepted by Watercare before software programming commences.

ii. Liaise with Watercare point of contact in the production of the Electrical/ Control system design.

iii. Process and instrumentation diagrams (P&IDs).

iv. Bill of materials.

v. Confirmed Input and Output lists (I/O).

PART E – INFRASTRUCTURE AND SUPPORT SYSTEMS

1. Water supply

a) A metered water supply with reduced pressure zone backflow preventer (RPZ) shall be installed to allow for wash-down and general cleaning. See G12/AS1 of the Building Code, for the methods and devices required to comply with Watercare's requirements.
b) Where firefighting supply is not within reach as per the New Zealand Code of Practice for Firefighting Water Supplies, then a suitable firefighting supply shall be installed in accordance with the Watercare Code of Practice for Land Development and Subdivision, Chapter 6.

1.1. Ablution facilities

a) The need for toilet and washing facilities shall be agreed with Watercare Operations and provided if required.

2. Lighting

a) Where considered an operational requirement or for safety reasons, site lighting must be specified. The designer must confirm the requirement and location such as to provide adequate lighting and not have obstructive and obtrusive effects. The lighting shall be adequately controlled to prevent annoyance to the neighbouring properties.
b) Lighting shall be provided at the pump station control room and dry well. Lighting shall provide proficient lighting to allow 24-hour operability and functions for maintenance.
c) Fluorescent lights should be avoided and shall be phase shifted to stop strobe effects on machine rotating shafts where accepted to be used.
d) Positioning of lights shall be such that cast shadows or unlighted areas are avoided
e) The design shall consider the types of activities to ensure the safety of people for the task types in the pumping station environment so that any hazards are visible and well lit.

3. Ventilation

a) The ventilation characteristics must be documented.
b) The wet well shall not be ventilated to the dry well or the control room. The wet well ventilation shall be designed in accordance with the inflow velocity and shall achieve a minimum of 12 air changes per hour at a rate to meet the inflow velocity The dry well shall not be ventilated to the control room.
c) The dry well shall have a minimum of 6 air changes per hour.
d) The control room shall have a minimum of 10 air changes per hour within the limitations of AS/NZS61439 and be fitted with replaceable filters. Cooling of the control room shall be provided where ventilation is not sufficient to control the temperature of the room

***Note**: Air changes may be adjusted on review of the requirements of the equipment suppliers.*

4. Site drainage

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

5. Noise control and vibration

a) 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 in the resource consent the maximum shall level be 45 dB $L_{Aeq\ (15min)}$ measured at the pumping station boundaries.

b) 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. Lifting equipment

a) Lifting devices shall comply with AS1418, AS4991 and the Worksafe NZ Approved Code of Practice for Cranes.

b) Adequate access shall be provided for mobile lifting plant around the pumping station installation and suitable hard stand areas.

c) Overhead gantry cranes or jib cranes shall be provided for handling large pumps, motors and valves.

The design of lifting equipment shall reflect:

i. The design safe working load (SWL shall be suitable for the heaviest component in the plant.
ii. Equipment may need to be lifted in part or assembled.
iii. Positioning of equipment and the lifting cover area. In some instances, the layout may require more than one gantry. The positioning shall provide for lifting equipment or parts onto and off trucks.
iv. Structural design required where the crane girders and runways form part of the building design. It should be considered that cranes may be used as part of the temporary works when the pump station is constructed to lift materials and components into the build.
v. Permanent access needs to be provided for overhead cranes. Isolators must be provided adjacent to the crane access.

7. Security, access and fire alarms

a) All cabinets and access manholes not accessible through the main pump station building shall be lockable.

b) All entry points shall be fitted with an alarm that will signal unauthorised access through the Watercare security system. Security systems are to be fitted with a dual communications option that provides alarm to Watercare's security supplier and the Watercare central control room.

c) Fire alarms shall be monitored for high priority pumping stations. Fire alarm systems are to be fitted with a dual communications option that provides alarm to Watercare's service supplier and the Watercare central control room. Lower priority pumping stations may be fitted with a smoke alarm at the control panel only that provides a fire alarm to the Watercare central control room.

d) Access lids shall be to the standard Watercare details and supplied with ‘universal' padlocks and locking bolts and shall allow for replacement with Watercare’s transmission wastewater crox key.
e) Where access lids of larger sizes and traffic loading are required, the design shall comply with AS3996.
f) Pump stations shall be fitted with fire detection equipment to meet the Building Act requirements.

8. Signage

a) Signage shall be provided that identifies the pumping station as the property of Watercare
b) Informative operational, health and safety signage is required at the pumping station perimeter. Refer to Watercare’s mechanical construction standard.

9. Site access road

a) The site access road shall comply with Watercare’s general civil construction standard.
b) Adequate vehicle turning area shall be provided within the site.
c) The access road shall be sealed have a minimum laden load bearing capacity of 25tons (unless otherwise stated) and a minimum width of 3.5m.

10. Odour control

a) Refer to DP-07 Design Principles for Transmission Water and Wastewater Pipeline Systems, for odour control requirements.

Appendix A: Watercare Network Discharge Consent (NDC) executive summary

Introduction

This summary provides a high-level overview of the considerations for complying with the wastewater network discharge permit in the Auckland region.

The consent authorises the discharge of wastewater from Watercare's wastewater networks to land, freshwater and coastal receiving environments in accordance with section 15(1)(a) and (b) of the Resource Management Act 1991, during times of dry and wet weather flow.

The overflows may occur as a result of network blockages and failures; network damage by third parties; failure at pump stations or storage facilities and capacity constraints. Once a pumping station is in operation overflows must be minimised, continuously monitored and inspected.

Existing networks area:

- Discharge from any new engineered overflow point within the existing network is allowed provided that the discharge frequency is not more than two (2) *Wet Weather Overflow Events* per year and the location of the proposed overflow point is not in a Class 1 Recreational Receiving Environment.
- Should the above not be achievable then the Best Practical Option (BPO) methodology and an improvement strategy may be considered to determine an alternative overflow frequency and/or overflow location. This option must be acceptable to Watercare before submitting to Auckland Council. The acceptance does not guarantee approval by Auckland Council
- No discharge is allowed to a *Tangata Whenua Management Area* as identified in the *Regional Plan: Coastal*, or an equivalent area in the Unitary Plan where discharges are a prohibited activity.

Future networks area:

- Discharge from any new engineered overflow point which is zoned for urban activity under the relevant Resource Management Act statutory document, and is within a future network is allowed provided that:
    - The overflow point is located within 500m of a predetermined proposed overflow location as shown on the relevant indicative future urban area map or of a similar location (see map attached below)
    - The overflow point is designed and managed to achieve the discharge frequency of no more than two *Wet Weather Overflow Events* per year, and the location of the proposed overflow point is not in a Class 1 Recreational Receiving Environment
    - A minimum of four (4) hours storage at *Dry Weather Flow* is provided at or near the o*verflow point,* or more as may be specified*.*
- Discharge from any new engineered overflow in the *Indicative Future Urban Area* but not identified in the below map as a predetermined proposed overflow location requires certification from Auckland Council. Watercare's agreement and guidance are required before making the application and should be based on the following criteria:

- The potential overall risk of the discharge is very low or low. This is to be determined by the applicant using Watercare's Methodology for the Assessment of Effects of Wet Weather Wastewater Overflows. The methodology is available from Watercare
- The overflow point is designed and managed to achieve the discharge frequency of no more than two (2) *Wet Weather Overflow Events* per year, and the location of the proposed overflow point is not in a Class 1 Recreational Receiving Environment
- The Best Practical Option (BPO) methodology and an improvement strategy may be considered to determine an alternative overflow frequency and/or overflow location. This option must be acceptable to Watercare before submitting to Auckland Council. The acceptance does not guarantee approval by Auckland Council.
- Direct discharges to the coastal marine area shall be avoided unless an assessment using the BPO methodology demonstrates that this is the most suitable location, taking into account cultural and ecological factors.

- No discharge is allowed to a *Tangata Whenua Management Area* as identified in the *Regional Plan: Coastal,* or an equivalent area in the Unitary Plan where discharges are a *Prohibited Activity.*
- No overflow point shall be located on private property without the written consent of the property owner and other affected parties that they agree to the location of the overflow point.

Future networks outside mapped areas:

Where a discharge application is outside any of the identified areas of the map, the statutory assessment of the application should be based on providing the same conditions of the existing statutory assessment for the NDC with the following criteria:

- Watercare requires that the applications use Watercare's *Methodology for the Assessment of Effects of Wet Weather Wastewater Overflows*, the Best Practical Option (BPO) methodology and an improvement strategy may be considered to determine an alternative overflow frequency and/or overflow location. The methodology and templates are available from Watercare
- For the purpose of gaining consent with Auckland Council, additional considerations may be required under the Auckland unitary plan and if applicable existing regional plans
- Stakeholder reports demonstrating consultation with Watercare, Auckland Council, local boards, Auckland Regional Health Services and Iwi.

Map: Existing network and indicative future urban areas. Up-to-date detailed area maps showing the *Future Network* are available from Watercare on request.