Region of Peel
working with you

Sewage Pumping Station Design Standards

Public Works, Wastewater Division

Version 1.2 – September 24, 2024

Version	Date	Description of Changes
1.1	April 16, 2022	Complete new *SPS Design Standard* to replace the old *Wastewater Pumping Station Design Standards,* Version 7, dated February 2012
1.2	September 24, 2024	Updates to Civil, Buildings, Below-Grade Structures, Process, Mechanical, Emergency and Maintenance Storage, Electrical, Instrumentation and Control plus Requirements for Stormwater Pumping Stations added The following Standard drawings were also updated: SPS-213, SPS-215, SPS-301 through SPS-307, SPS-310 and SPS-312

Table of Contents

List of Tables

List of Appendices

Appendix A: Definitions and Abbreviations

Appendix B: Design Checklist, Conformance Acknowledgement Form and Truck Lifting Chart

Appendix C: Sewage Pumping Station Process Control Narrative

Appendix D: Sewage Pumping Station Standard Drawings

1. Introduction

The Sewage Pumping Station Design Standards document is intended to establish a clear and consistent application of design requirements for sewage pumping station infrastructure for the Region of Peel. This document has been provided for use by Region of Peel staff, consulting engineers, designers, developers, and other proponents involved in the planning and design of new or the rehabilitation of existing sewage pumping station infrastructure.

This document is available for public access and the latest version can be downloaded via the Region's Public Works website. The Region may issue revisions to this document as new information becomes available. Users must check the Region's website for the latest version.

The use of this document is not intended to restrict innovation in design. The Region encourages creativity and application of sound engineering judgement in the design of sewage pumping infrastructure while meeting the objectives of this document. Proponents are expected to exercise professional judgement in the application of these design standards and consider site-specific issues particularly for retrofit projects. It is the Proponent's responsibility to meet all applicable regulatory codes and regulations including the specific scope of work for the project.

The terms "sewage" and "wastewater" shall be considered synonymous for the purposes of this Standard as references are made to both "Sewage Pumping Station" and "Wastewater Pumping Station" in Peel's documents, which shall both be considered equivalent.

The scope of this Standard covers all infrastructure at a sewage pumping station site.

Unless otherwise indicated, stormwater pumping stations and landfill leachate pumping stations shall also comply with this Standard as amended by project specific requirements. Refer to **Section 16** for specific requirements related to Stormwater Pumping Stations.

Proponents are expected to submit a completed Design Standards Conformance Checklist and Acknowledgement Form (provided in **Appendix B**) with their final deliverables to confirm compliance with these design standards.

These Standards describe the ideal preferences for pumping stations that can most readily be accommodated for new facility construction projects. When undertaking facility rehabilitation and upgrade projects, it is recognized that not all the specified Standards can be practically accommodated. And such, it is recognized that each project has its unique challenges and deviation from the design standards may be warranted in some instances. Under such circumstances, the Proponents must obtain the Region's approval for any proposed deviations from the design standards. The Design Standard Deviation Form is provided in the **Region of Peel Project Implementation Procedures Manual (PIPM)**.

2. Reference Documents

The Proponent shall design sewage pumping stations in accordance with the Standards and Guidelines referenced in this document. The Region's standards are generally available online at https://www.peelregion.ca/public-works/design-standards/. Special attention is made to the following Region of Peel documentation:

1. Project Implementation Procedures Manual (PIPM)
2. Process Automation and Instrumentation Design Standards (PAIDS)
3. Wastewater Pump Stations SCADA Standard Design Drawings
4. Wastewater Linear Design Criteria
5. Standard Specifications for Sanitary Sewers
6. Linear Infrastructure CAD requirements
7. Vertical CADD Standards
8. Building Security for Wastewater Pump Stations
9. Wastewater Pumping Station Security Standards
10. Sanitary Sewer and Appurtenances Standard Drawings
11. Wastewater Pumping Station & Forcemain Shutdown and Bypass – Technical Memorandum
12. Wastewater Pumping Station & Forcemains Shutdown and Bypass – Region Requirements
13. Wastewater Pumping Station & Forcemains Shutdown and Bypass – Consultant Requirements
14. Wastewater Pumping Station & Forcemains Shutdown and Bypass – Contractor Requirements
15. Standard Operating Procedures
16. Net Zero Emissions Building Standard for New Construction

3. External Standards and Guidelines

Sewage pumping stations must be designed in accordance with the more stringent of the most recent version of applicable codes and regulations, industry standards, and Peel Standards. Some of the applicable external documents are listed below:

Ministry of Environment, Conservation and Parks (MECP) Documents

- Design Guidelines for Sewage Works
- Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains for Alterations Authorized under an Environmental Compliance Approval

- Environmental Noise Guideline - Stationary and Transportation Sources - Approval and Planning (NPC-300)

Ministry's Standard Operating Policy for Sewage Works

An assessment of the proposed works shall be completed to determine if the works pose a significant drinking water threat and if they do, the design shall incorporate features that mitigate the threat to sources of drinking water, such as those included in the:

- Ministry's Standard Operating Policy for Sewage Works published on the Environmental Registry (Posting #012-2968), as amended from time to time; and
- Source Protection Plan policies pertaining to the works.

National Fire Protection Association (NFPA 820)

Proponents are required to comply with NFPA 820 for the following:

- Support for determination of explosion hazard classification of all areas within a sewage pumping station. See **Section 7.1** for area classifications.
- Recommendations for building materials of construction.
- Number, type, and placement of fire extinguishers.
- Proponents shall take special note of intermittent ventilation allowances for winter operation for energy savings.

The Region has determined that the following exceptions shall apply to the NFPA 820:

- Proponents are to follow **Section 14.18** of this document related to the use and locations of permanent combustible gas detection equipment.
- Ventilation shall not be used as a means for derating a hazardous space.

Hydraulic Institute Standards

The Hydraulic Institute (HI) standards provide guidelines for the design of pumps, piping, and intake structures to maximize the efficiency and reliability of pumping systems. Proponents are expected to incorporate HI standards and guidelines where applicable and feasible. In particular, the following standards are applicable:

- ANSI/HI 9.6.1 Rotodynamic Pumps Guideline for NPSH margin
- ANSI/HI 9.6.2 Rotodynamic Pumps for Assessment of Applied Nozzle Loads
- ANSI/HI 9.6.3 Rotodynamic Pumps Guideline for Allowable Operating Regions
- ANSI/HI 9.6.4 Rotodynamic Pumps for Vibration Measurements and Allowable Values
- ANSI/HI 9.6.6 Rotodynamic Pumps for Pump Piping

- ANSI/HI 9.8 Rotodynamic Pumps for Pump Intake Design
- ANSI/HI 11.6 Rotodynamic Submersible Pumps for Hydraulic Performance, Hydrostatic Pressure, Mechanical, and Electrical Acceptance Tests
- ANSI/HI 14.6 Rotodynamic Pumps for Hydraulic Performance Acceptance Tests

Canadian Standards Association (CSA) B139 - Installation Code for Oil Burning Equipment: as adopted by the Technical Standards and Safety Authority (TSSA)

This Standard covers safety requirements in the installation and use of oil-burning equipment as it applies to permanent and portable diesel standby power installations and associated fuel systems. Design of fuel systems must comply with the latest CSA B139 standards and any other requirements by the TSSA.

Portable generator installations are to follow the direction of CSA B138.2-17 – Portable Oil-Burning Equipment – Installation Requirements. This code is to be used as guidance to meet the installation requirements outlined in CSA B139 (as adopted by the TSSA).

Ontario Provincial Standards Specifications (OPSS) and Drawings (OPSD)

Where Standard details are not covered by other Region Standards, Proponents are to refer to published OPS specifications and drawings for civil works within sewage pumping station site limits.

Arc Flash Assessment

Complete an arc flash risk assessment according to CSA Z462 - Workplace Electrical Safety for all installations.

Occupational Health and Safety Act

It is the Proponents responsibility to minimize potential hazards and provide a safe design for operation staff to access, operate, maintain, and replace sewage pumping station infrastructure.

Pre-Start Health and Safety Review

The Proponent shall conduct a Pre-Start Health and Safety Review to outline measures to control or remove hazards in order to ensure equipment and processes are in compliance with:

- Industrial Establishments Regulation 851, Section 7, R.R.O 1990 of the Occupational Health and Safety Act
- Ontario Electrical Safety Code
- National Fire Protection Association (NFPA)
- Ontario Revised Regulation 833, 1990 (Control of Exposure to Biological or Chemical Agents)

A DRAFT pre-Start Health and Safety Review report shall be prepared at the 90% design stage with the final version completed prior to equipment start-up. Final reports shall be stamped by a Professional Engineer licensed in the province of Ontario.

Table 1: Pre-Start Health and Safety Summary Table

Item	Provisions (Regulation 851)	Circumstances
1	Section 22	Flammable liquids are located or dispensed.
2	Section 24, 25, 26, 28, 31, 32	Any of the following elements in connection with an apparatus: 1. Safeguarding devices that signal the apparatus to stop. 2. Barrier guards that use interlocking mechanical or electrical safeguarding devices.
3	Section 45	Material, articles, or things are placed or stored on a structure that is a rack or stacking structure.
4	Section 63	Risk of ignition or explosion that creates a condition of imminent hazard to a person's health or safety.
5	Sections 51, 53	The construction, addition, installation, or modification relates to a lifting device, travelling crane, or hoist.
6	Sections 127, 128	Risk of exposure to a substance in excess of any exposure limit.

4. Key Design Concepts

Proponents are expected to consider the following key concepts in the design of sewage pumping infrastructure.

4.1. Life Cycle Cost Approach

Selection of equipment, technology, materials, and other design solutions should consider a life cycle cost (LCC) approach that considers factors beyond the initial purchase price of an asset. Typical LCC costs include energy consumption, installation costs, maintenance costs, operational costs, replacement costs, and decommissioning costs. Refer to **PIPM** for more information.

4.2. Health and Safety

Health and safety of operation staff and the public is paramount. The Region has chosen to enhance the health and safety of operation staff by implementing the following minimum design requirements:

Health and Safety Review

- Conduct health and safety review workshops with operation staff at the following design stages: preliminary design, detailed design, and prior to tendering. Complete Risk Assessment for all health and safety risks. Document outcomes and decisions in a technical memorandum and include as an appendix to the final design report.

Confined Space

- In accordance with the published Guideline for working in confined spaces as it relates to Ontario Regulation 632/05 a “Confined Space” means a fully or partially enclosed space,

  (a) that is not both designed and constructed for continuous human occupancy, and

  (b) in which “atmospheric hazards” (further defined in regulations) may occur because of its construction, location or contents or because of work that is done in it.

- If a space that is fully or partially enclosed, the two conditions – (a) and (b) above – must both apply before the space can be considered a "confined space".

- Wet wells, maintenance holes, emergency and maintenance storage structures, valve chambers for Type I and II facilities, and forcemain structures are all considered confined spaces.
- Dry wells and Type III Valve Chambers shall be designed for continuous human occupancy as to eliminate the need for confined space entry. Refer to **Section 10.1** for specific HVAC requirements.
- Refer to **Section 10.1** for electrical classification of spaces.
- Where practically feasible, equipment and instruments shall be accessible from the surface without needing to enter the confined space.
- Provide ladder access into all confined spaces extending to the base of the structure. Stairway access or ladder offsets at platforms are not acceptable due to risk of entanglement of lifeline during rescue.
- For all maintenance hole access into confined space, provide sufficient space to set up a tripod fall arrest and retrieval system.
- Design confined spaces to provide adequate means for surface rescue with a lifeline (i.e., avoid all entanglement risks).
- All confined and controlled spaces shall be appropriately signed and labelled.

Controlled Space

- A controlled space is a fully or partially enclosed space, that is not both designed and constructed for continuous human occupancy and does not have atmospheric hazard potential based on its construction, location, or contents. A controlled space could become a confined space if an atmospheric hazard is introduced because of the nature of the work being performed or other changes to the space.
- Type IV Dry wells and Type III valve chambers are to be designed as a Controlled Space.

Fall Protection

- Permanent fall protection shall be provided for all openings and fall hazards.
- Ladder cage systems are not acceptable.
- Permanent grab bars must be provided above all ladders. Ladder extensions and removable T-handles are not acceptable unless structures are installed within the roadway.

- Ladders shall be vertical for their entire height. Staggered ladders (i.e., offsets at platforms) are not acceptable.
- Every hatch shall be equipped with secondary fall protection grating and travel restraint anchor. Personnel hatches shall also include a davit sleeve.
- Portable safety railings, stored within the building, must be provided so that they can be installed around access hatches for additional fall protection.
- Refer to requirements within O. Reg. 213/91: Construction Projects, specifically section 26 related to fall protection.
- Refer to **Section 8.5** and Standard Drawings in **Appendix D** for more information.

Other Health and Safety Items

- All process areas shall be finished with a slip-resistant surface as specified in **Section 7.2**.
- All buildings shall be equipped with a tempered emergency eye wash system as specified in **Section 10.2.6**.
- Permanent and emergency lighting must be provided as specified in **Section 14.13**.
- Pre-Start Health and Safety Reviews are required for all sewage pumping stations as specified in **Section 3**.

4.3. Redundancy and Reliability

The design shall incorporate a sufficient level of redundancy such that failure of one single component does not result in a total system failure. Selection of process equipment should consider overall reliability and suitability to handle all potential operating conditions.

4.4. Existing Facility Retrofits

Design upgrades to existing facilities in such a way to minimize or eliminate the need for bypass pumping. By-pass pumping should be considered as a last resort to carry out upgrades to an existing facility. Refer to **Reference Documents** for additional requirements related to bypass pumping for Wastewater Pumping Stations.

5. Sewage Pumping Station Design Summary Table

The sewage pump stations within the Region of Peel are classified into four types; Type I, Type II, Type III, and Type IV, according to the classification described in **Table 2**.

Table 2: Sewage Pumping Station Design Summary Table

Station Type	Rated Capacity	Pumps	Wet Well Cells	Valve Chamber	No. of Forcemains
I	Less than or equal to 20 L/s	Two submersible wet well pumps (one standby plus one shelf spare)	Single wet well and upstream bypass maintenance hole	Separate below-grade structure (confined space with ladder access)	One sized for rated capacity
II	Greater than 20 L/s and less than or equal to 60 L/s	Three submersible wet well pumps (one or two standby)	Single wet well and upstream bypass maintenance hole	Separate below-grade structure (confined space with ladder access)	Two each sized for rated capacity
III	Greater than 60 L/s and less than or equal to 500 L/s	Three to four submersible wet well pumps (at least one standby)	Dual wet well	Separate below-grade structure with access house (stairway access, design to ensure non-confined space)	Two each sized for rated capacity
IV	Greater than 500 L/s	Four or greater dry well submersible pumps (at least one standby)	Dual wet well plus dry well	Valve room in building (stairway access, design to ensure non- confined space)	Two each sized for rated capacity

Table 2 Notes:

1. The rated capacity of the station shall be equal to or greater than the anticipated peak instantaneous flow to the station including the response of a five-year storm without the use of standby pumps. See **Section 9.5** for additional details.
2. All station types shall be equipped with a permanent on-site standby power generator. See **Section 13**.
3. Upgrade station to Type IV style if a single pump weight is beyond the lifting capacity of the Region's boom truck. Refer to **Appendix B** for the Region's specific boom truck lifting chart.
4. Refer to Type I, II, III, and IV station schematics in **Appendix D** for more information.
5. Refer to Standard Process Control Narrative (PCN) in **Appendix C** for description of typical pump and forcemain operation.

6. Refer to **Section 11** for emergency and maintenance storage requirements.
7. Provide adequate lighting, ventilation and access to meet the intent of non-confined spaces.

6. Site Considerations

6.1. Site Layout

6.1.1. General

- Complete detailed topographical and minimum SUE QL-B surveys for the site.
- Identify location of all utilities that are within the subject area.
- Do not locate any permanent above-grade structures on easements that are not owned by the Region of Peel.
- Maintain required setback distances from property line for front, side, and rear yards as required by local zoning bylaws.

6.1.2. Fencing and Gates

- Provide appropriate security fencing a minimum of 1.8 m high around the site with consideration for aesthetics where potential public impacts are a concern. Minimum standard shall be black vinyl coated chain link fence as per OPSD 972.130 and OPSD 972.132.
- Provide secure and lockable gates (complete with hold open pin) for access to site.
- Ensure gate location allows space for a single light-duty truck (i.e., operation staff vehicle) to temporarily park in front of the gate without obstructing traffic on roadway. The gate shall be designed to swing inward and in doing so, not prevent access to any required areas on the site. The requirement for motorized sliding gates to be discussed with Peel on a project specific basis.

6.1.3. Access and Parking

- A dedicated access laneway shall be provided to the site. Shared access is not permitted (i.e., via a multiuse trail or shared with public parking area). The entire access driveway shall be located above the 100 year flood elevation.
- Paved surfaces and access laneways shall be designed for allowable loads governed by the Highway Traffic Act in accordance with axle load limits prescribed in the Canadian Highway Bridge Design Code (CSA S6) for the CL-625-ONT design truck.
- Asphalt shall be used for pavements. Do not use patterned concrete, permeable pavers or gravel laneways.

- Provide positive drainage away from all paved surfaces at a minimum slope of 2%.
- Provide adequate access for:
  - Fire trucks.
  - Operational personnel access to all hatches, valves, and chambers.
  - Sewer flushing truck access to inlet maintenance hole, grinder chamber, wet well, and emergency and maintenance storage tank.
  - Vacuum truck access and cleaning of wet well.
  - Forcemain inspection and cleaning.
  - Bypass pumping equipment (temporary pumps, generator, and piping to tanker trucks).
  - Region's boom truck access to inlet maintenance hole, valve chambers, wet well, bypass chamber and emergency, and maintenance storage tank.
  - Fuel delivery truck for access to fuel fill station.
  - Large mobile cranes required for Type IV stations.
- Minimum access road width as specified in the Ontario Building Code (OBC).
- Refer to Standard Drawing 5-1-8 Industrial/Commercial Driveway Entrance Within Urban Road Cross Section.
- Provide parking spaces for at least two light-duty trucks for Type I and II stations and at least four light-duty trucks for Type III and IV stations. Additional parking may be required in accordance with OBC and specific local municipality Site Plan requirements and zoning bylaws.
- Provide adequate space for snow storage and snow clearing on-site.
- Use protective bollards or other suitable devices around structures that could inadvertently be damaged by vehicles or trucks. Steel concrete-filled bollards are to be finished with a yellow HDPE bollard cover or finished with a yellow coating suitable for high visible exterior applications.

6.1.4. Yard Lighting

- Refer to **Section 14** for electrical requirements.

6.1.5. Space for Expansion

- When completing site layout, allow for enough space for future expansion to service the full build-out capacity of the catchment area.

6.2. Yard Piping

- Yard piping includes all watermain, sewer, forcemain and storm drain from approximately 1.0 m from the station building wall to the property line.
- For buried pressure pipe size 100mm and larger, flexible restrained pipe joints shall be provided outside of structures to allow for potential differential settlement.
- Yard piping shall be provided with adequate earth cover to protect against frost damage, especially for pipes that only have intermittent flows or standing water. If inadequate earth cover is available, thermal insulation shall be provided.
- All pressure pipe joints on-site shall be designed for thrust restraint where required without the use of concrete thrust blocks. Restraints shall be designed to withstand applicable test pressures and transient pressures, whichever is higher.
- Provide tracer wires on all buried non-metallic piping and concrete pressure piping. Tracer wire shall be 12-gauge TWU, 7-strand insulated copper wires suitable for buried installation. All spliced or repaired wire connections shall be made with water-tight wire connectors and enclosures. Tracer wires shall be installed along the crown of the entire pipe length and terminated on the inside of the valve chambers or the outside wall of the pumping station. Tracer wire must be easily accessible from above grade, and where tracer wire is not terminated in the valve box or at the access hatch, provide a suitable enclosure for tracer wire end point.
- Provide Type 316 stainless steel bolts and nuts for all fittings and joint restraints for direct buried installations.
- Designer shall consult the project geotechnical report for the corrosive nature of the soils and select the most suitable yard piping material for pipe longevity. The designer shall also determine if additional sacrificial anodes or impressed current cathode protection are required.
- All ferrous materials associated with buried infrastructure including pipe fittings, valves and couplings shall be protected with three-part corrosion protection primer/paste, mastic, and petroleum tape.
- Design must comply with **Region of Peel Wastewater and Water Linear Standards and Drawings**.

6.3. Stormwater

- Locate pumping station entrance floor level and all access hatches at least 300mm above Regional flood line and 100-year flood elevation, whichever is higher.

- The design of grading and stormwater management shall allow the sewage pumping station site to be fully accessible by vehicular traffic during the 25-year flood event.
- Ensure positive drainage away from all structures with a minimum slope of 2%.
- Protect all structures from inflow and infiltration with zero leakage.
- Follow TRCA and CVC Low Impact Development guidelines for stormwater management together with requirements from local area municipalities.

6.4. Landscaping

- Retain the services of a landscape architect and/or arborist to complete a tree survey and condition assessment, develop a tree protection plan during construction and a proposed landscaping plan.
- Landscaping shall be kept to a minimum and comply with the local area municipal requirements.
- Landscaping shall complement the surrounding environment and require minimum maintenance or watering. Select plant species that are slow growing and native to the project site.
- Do not locate trees, including consideration for their maximum growth canopy size, above buried infrastructure, chambers, buildings, or driveways. Small shrubs could be planted instead if needed.
- For stations where aesthetic considerations are to be prioritized, consider the use of vegetative visual screening (trees and shrubbery) on a case-by-case basis.
- Open space should be grassed. Obstacles to lawn mower equipment within these areas should be minimized. Consider slopes and ease of access for lawn mowing and landscape maintenance activities (i.e., grass areas above retaining walls, grass areas inside and outside of security fencing, and gates). Maximum slope for grass areas to be 3:1.

7. Buildings

7.1. Classification

- Building classification under the OBC, Group F, Division 3, except for fuel storage which is Group F, Division 1.
- All buildings shall be designed as Post Disaster.

- All buildings shall be designed in compliance with OBC, National Building Code (NBC) and Canadian Standards Association (CSA) design standards for concrete, masonry blocks and steel.
- All wet wells, maintenance holes, emergency and maintenance storage structures, and forcemain outlet structures shall be electrically classified at Class 1, Zone 1 (Division 1) environments.
- Dry wells and valve chambers shall be electrically classified as Class 1, Zone 2 (Division 2) environments.
- Type IV dry wells and Type III valve chambers shall be designed for continuous human occupancy. Provide at least two means of access/egress to these spaces. Main access shall be by stairs and secondary access/egress can be via ladder.

7.2. General Requirements

- The exterior materials and finishes shall be designed maintenance free.
- The building shall be insulated and complete with vapour barriers.
- Precast concrete buildings will only be considered for Type I and II stations. Prefabricated buildings shall be designed as Post Disaster. All wall panels, roof slab units, and connections shall be designed to resist the governing combination of vertical and lateral loading conditions as specified within the OBC (i.e., crane, snow, wind and seismic).
- Utilize steel reinforced concrete masonry block wall systems or combined with face brick systems or pre-cast insulated concrete wall panels. Do not use exposed wood or gypsum boards on any interior walls or ceiling finishes.
- Interior walls shall have waterproof antimicrobial painted finish.
- All exterior wall surfaces including entrance doors and louvers shall be coated with an anti-graffiti clear coat.
- All floors shall be finished with a slip-resistant surface.
- Refer to **Sections 10, 14 and 15** for HVAC, lighting, electrical, and instrument requirements.

7.3. Signage

- Provide a facility sign near the front door and main gate of each facility that includes the following information:
    - Line 1: Municipal Street Address (example: 1640 Queen Street East)
    - Line 2: Public Works 905-791-7800 ext. 4409

- Do not identify the facility type or name. If the main sign at the building is visible from the road than a second sign at the entrance gate is not needed. Sign height, font and text size as per sample below.

- Post “No Trespassing” warning signs every 15 meters along the fence line.
- Post surveillance monitoring warning signage where applicable.
- Provide appropriate signs identifying anticipated hazards including, but not limited to, chemicals, noise, arc flash, confined spaces, non-potable water, pinch points, rotating equipment, heat, fall hazards, fire extinguisher location, and test label. Safety signage shall follow ANSI/NEMA Z535 and WHMIS requirements.
- Provide building exit signage in accordance with the Building Code.
- Provide a laminated full-size drawing mounted to the wall near the desk depicting the overall process flow diagram of the facility including instrument, valve, and pump asset tags. Include a second laminated full-size drawing showing electrical single line layout of the facility.
- Provide fire plan mounted to interior walls at all doors.
- Consult Engineering Services Division and Operation staff for additional signage requirements.
- Provide sign requirements as per the Electrical Code.
- Additional specific requirements for signs and labels are described in the following sections.

7.4. Layout

- Ensure sufficient separation distance between water service plumbing fixtures and appurtenances and electrical equipment such as MCC and control panels. Preference is to provide separate room for plumbing equipment.
- For Type II, III, and IV stations, interior generators shall be located in a separate room from electrical and control equipment.
- Provide a desk, chair, and storage unit for documents within the building for use by operation staff. Typical documents to be stored on-site include but are not limited to: As-Built engineering facility drawings, operation and maintenance manuals, material safety data

sheets, logbook, and fire plans. Do not locate this furniture in the generator room. Provide a dedicated office room or include within electrical room as agreed upon with Operation staff.

7.5. Roof

- Design aesthetically pleasing metal shingle roofing systems for minimum 50-year life span. All roofing systems shall be warranted for 25 years non-prorated for both material and labour.
- All roofs shall be pitched design and designed to drain rainwater away from the entrance. Flat roofs are not permitted.
- Roof shall be equipped with snow guards.
- Roof trusses shall be either open web steel joists or wooden roof truss with a metal deck or pre-cast hollow core concrete to finish the ceiling.
- Provide personnel access and passive ventilation for the attic space.
- Eavestroughs and downspouts shall discharge to a vegetated surface complete with concrete splash guard. Design discharges to prevent icing of commonly utilized walking or driving areas.

7.6. Doors

- All exterior doors shall be insulated hollow metal and equipped with a touch-bar panic exit device, three sets of heavy-duty hinges, heavy-duty closer mechanism, head and jamb seals, door sweep, threshold, and a kick plate. All door hardware shall be stainless steel.
- All interior doors shall be hollow metal and, equipped with a window panel, a touch-bar panic exit device, three sets of heavy-duty hinges, heavy-duty closer mechanism, head and jamb seals, and a kick plate. Interior doors leading to generator room shall be insulated for noise attenuation. All door hardware shall be stainless steel.
- Minimum door width (exterior and interior) shall be 914mm.
- Entrance doors shall be designed without windows.
- All exterior access doors shall have electronic access control hardware as per **Section 14**.
- Provide heavy-duty roll-up doors or double doors where practical to allow room for equipment delivery and removal. All roll-up doors shall be electrically powered unless they are located in classified (explosion proof) areas where manual operation is acceptable. A personnel entry door shall be provided near each roll-up door.
- Exterior double doors with permanent wiring shall have quick wiring disconnects to facilitate equipment removal through the door.
- All doors shall be equipped with non-slam closures and dampeners.

- Ensure that doors are sized to allow for removal of the largest piece of equipment in each room unless other means of removal are provided (i.e., removable panels, slabs, or access hatches).

8. Below-Grade Structures

8.1. General

- Structures shall be designed to withstand hydrostatic and buoyancy uplift forces assuming groundwater elevations are to the surface or maximum flood elevation, whichever is greater.
- All structures shall be insulated, protected to below frost level, and waterproofed.
- All buried structures shall be designed as water retaining structures with zero leakage.
- Watertight maintenance hole lids are to be provided for any structures vulnerable to flooding or within overland flow route in accordance with **Region of Peel Wastewater Standard Drawings**.
- All pressure pipe penetrations through walls shall be cast-in-place and designed for thrust restraint.
- Maintenance hole structures shall comply with **Standard Drawings for New Construction Maintenance Holes**.
- All buried structures shall meet the intent of Standard Drawings for New Construction Maintenance Holes specifically for waterproofing membrane, frost straps and joint details.
- See **Section 11** for Emergency and Maintenance Storage structures.

8.2. Cast-in-Place Concrete

- Use ACI 350 as a reference for general requirements of water retaining structure design but exercise best engineering judgement based on experience for designing a non-leak susceptible structure throughout its service life.
- For all buried structures, high performance, low shrinkage concrete shall be used.
- Controlled permeability formwork liners shall be used for both interior and exterior walls on both wall surfaces.
- All form ties shall be equipped with waterstops.
- Use ribbed type PVC waterstop with centre bulb for movement joints and all construction joints.
- Cast-in-place conduits in the roof slab or in walls are not acceptable.

- For all buried structures, a leakage test shall be completed prior to backfilling and waterproofing installation. All leaking cracks and joints shall be repaired to achieve a fully watertight structure. Visual leakage tests are acceptable for all non-water retaining structures.

8.3. Pre-Fabricated Structures

8.3.1. FRP Wet Wells

- Pre-engineered fibreglass reinforced plastic wet wells can only be considered for Type I stations.
- The pre-engineered pump station package must include the submersible pumps, discharge elbows, Type 316 stainless steel guide rails, lifting system, fibreglass wet well, internal stainless steel piping, platforms, ladders, railings, ventilation pipes, machined inlet and outlet nozzles including conduit penetrations, lifting lugs/trunnion, access hatches, and anchor brackets for instruments all in accordance with Peel's SPS Standards contained herein.
- The wet well basin, cylinder, and roof shall be made of fibreglass reinforced plastic, UV-resistant, and suitable for corrosive wastewater environments. A safety factor of three in the minimum ultimate tensile strength of the laminate bottom shall be used in designing the basin and cylinder wall thicknesses for the station, taking into account all normally imposed loads arising from floatation, soil pressures, normal backfill, handling loads, operating loads and static loads imposed by equipment used in hoisting the pumps in and out of the station.
- All inside surfaces shall be smooth and free of cracks and crazing.
- The FRP wet well shall be designed with an anti-flotation system to resist buoyancy forces commensurate with the recommendations of the geotechnical and/or hydrogeological investigation(s).
- The pre-engineered pump station package must be stamped by a Professional Engineer registered in the Province of Ontario.

8.3.2. Pre-Cast Concrete Structures

- Pre-cast circular or rectangular buried structures shall comply with all applicable **Region of Peel Wastewater Standard Drawings**.
- Ensure all pre-cast joints are fully watertight with zero leakage.
- Pre-cast reinforced concrete wet wells and valve chambers are only acceptable for Type I and II stations.

8.4. Protective Concrete Coatings

- For all wet wells, inlet maintenance hole, inlet grinder chambers, and forcemain outlet structures, protective coating shall be applied to all interior concrete surfaces to enhance concrete durability and provide additional corrosion protection.
- Where HDPE protective liners are used, minimum thickness shall be 3mm.
- For new structures, minimum 32 mils DFT minimum epoxy protective coating system and minimum 40 mils DFT cementitious protective coating is required.
- For restoration projects, existing concrete wall surface must be clean and prepared to satisfy the selected protective coating requirements. Existing concrete substrate may need to be resurfaced to provide the profile to receive the selected protective coating system. The selected protective coating system can be an epoxy system with a minimum of 40 mils DFT, or cementitious coating with a minimum of 60 mils DFT.
- Ensure coating system has a smooth finish to allow for hose cleaning and washdown of accumulated grease and debris.
- Coating systems for emergency and maintenance storage structures shall be evaluated on a case-by-case basis.
- All coating systems shall have a minimum of extended five-year warranty for labour and materials.

8.5. Hatches

- Interior hatches shall be flush with the finished floor surface. Exterior hatches shall be cast flush within a raised concrete slab together 450mm above finished grade.
- The hinged cover shall be slip resistant checker plate lid designed to support a minimum live load of 14.4 KN/m^2 with a maximum deflection of 1/180 of the span. Single leaf hatches are preferred. Hatch cover to be equipped with sealing gasket and self-draining channel frame. Hatch covers to be insulated for exterior applications. Only exemption is that wet well hatch covers do not need to be insulated. All access hatches shall be aluminum with a minimum of type 316 stainless steel hardware. Provide hold-open arm, lifting assists and custom signage to indicate purpose (i.e. Pump 1, Personnel Access, etc.). Provide a stainless steel engraved tag with load rating affixed to the surface for all hatches. Lock ports shall be recessed, oversized to accommodate padlock, and provided with a drain. All hatches shall accommodate electronic key locks within the lock port with no protrusions above the hatch surface. Provide secondary locking mechanism for exterior hatches. Consult with Peel's Automation Data Solutions team on electronic lock requirements.

- All personnel access hatches shall be equipped with secondary fall protection grating, personnel davit base, fixed stainless steel grab bar, nearby travel restraint anchor and removable guardrail system.
- All equipment access hatches shall be equipped with secondary fall protection grating, nearby travel restraint anchor and removable guardrail system.
- All access hatches shall be equipped with secondary fall protection grating with minimum 75mm x 75mm mesh spacing, retractable lifting handle and entire system rated for a minimum live load of 14.4 KN/m^2.
- All davit sleeves to have a single user capacity of 205 kg with a minimum 4:1 safety factor. All davit sleeves to have a vertical load capacity of 22.2 kN.
- Stainless steel grab bars to be designed to OBC loading. Refer to Standard Drawing in **Appendix D**
- Travel restraint anchor points shall be mounted to a nearby wall when possible. If a wall anchorage is not possible, the anchor point shall be cast into and recessed within the concrete slab such that there is no trip hazard. As a last resort, the anchor point may be bolted onto the top of the concrete slab, with a hazard warning device provided to clearly indicate the trip hazard (i.e., flex bollard, highly visible warning flag). Travel restraint anchor points shall be capable of supporting a static force of at least 4.0 kN. Include a stainless steel tag with the words "*Travel Restraint Anchor, 4.0 kN Capacity*" indicated.
- Provide removable guardrail system, stored in the building, to be erected around open access hatches when required by operation staff. Guardrail to be sized to surround entire hatch opening complete with lockable swing gate.
- Refer to Access Hatch Standard Drawing in **Appendix D**.

8.6. Platforms, Ladders, Grating and Railings

- All platforms, ladders, grating, and railings exposed to open sewage environments (under normal operation) shall be constructed with fibreglass reinforced plastic (FRP) material complete with specialized resin to withstand continuous exposure to a corrosive sewage environment.
- All FRP shall be manufactured in accordance with CAN/CGSB 41.22-93 or ASTM 3647.
- Refer to **Peel Std. Dwg. 2-6-9** for FRP ladder details.
- Platform Load/Deflection: Designed to sustain the live load required for building egress, or minimum of 4.8 KN/m^2 uniformly distributed or a concentrated load of 13.5 kN, whichever is

greater. Maximum deflection of supporting beam or platform shall not to exceed 1/360 of the span or 6 mm.

- Railings, guardrails, and handrails shall be designed to resist the maximum loading conditions specified under the OBC. All anchors at railing post base plates must have a minimum of four anchors per base (regardless of whether it is a side-mounted or top-mounted railing). Top rail deflection for the railing shall not exceed 3 mm.
- Provide non-slip surfacing for stairs, ladders, and grating.
- All hardware shall be a minimum of 316 stainless steel.

9. Process

9.1. Inlet Sewer

- Design sewers, maintenance holes, and appurtenances as per the **Region of Peel Wastewater Standard Drawings**.
- All inlet sewer penetrations shall be perpendicular to the inlet maintenance hole and wet well structure.
- Do not place bar screens, obstructions on the inlet sewer to the wet well.
- Grit removal systems are to be evaluated on a case-by-case basis.

9.2. Grinders

- All Type II, III and IV pumping stations require an electrically driven influent grinder capable of handling the peak inlet flow to the pumping station without sewer surcharge. Grinders shall be capable of shredding rocks, wood, soft metals, plastic, rubber, and fibrous resilient material including but not limited to wipes, rags, textiles, and other debris into small pieces to prevent pumps and process piping from clogging.
- The need for grinders for Type I stations shall be evaluated on a case-by-case basis with input from Operation Staff.
- Electric motors shall be explosion proof and suitably classified for the installation environment in accordance with the NFPA 820 and the Electrical Code. Motors shall be rated for 575V /3 ph / 60 hz power with a 1.15 service factor. Motors shall be designed for full time in-air operation with periodic submergence up to 12m of head for a maximum period of 40 days. Motors shall be rated NEMA 6P (IP68) CSA certified.
- The grinder shall be equipped with a lifting bail made of Type 316L stainless steel, to allow for removal or installation of the grinder without entry from operations staff. The stainless

steel lifting bail shall be able to accommodate a stainless steel lift out chain of sufficient length to clear the grinder access hatch elevation by a minimum of 1.5 m. An access hatch shall be provided above the channel frame and guide rail system suitable for installation and removal of the grinder.

- The grinder's local control panel shall be fully PAIDS compliant and CSA approved. The grinder local control panel shall be located inside the building in a non-classified area. The panel enclosure shall be wall-mount with the proper NEMA rating to suit the operating environment. The control panel shall be a relay-logic type without a programmable logic controller (PLC) control. Include a main circuit breaker with disconnect handle, full voltage reversing type starters, current sensor, timer counters, a transformer rated for 600/120 VAC, 250VA, pilot lights, pushbuttons, selector switches, and an E-Stop for status indication and local control.
- Refer to Standard Drawings in **Appendix D** for grinder panel schematics.

9.3. Wet Well

- The Proponent shall address the following in the design:
  - Avoid excessive turbulence.
  - Avoid excessive pre-swirl into the pump.
  - Flow distribution at the pump intake shall be even and balanced.
  - Avoid conditions that favour development of flow vortices.
  - Reduce the potential for entrained air into the pump suction.
  - Avoid sedimentation of solids that may impact pump performance and increase wet well maintenance requirements.
- Provide benching to limit solids build-up in the wet-well and to achieve a self-cleaning system on manual pump down. Where possible, provide benching at 60 degrees or greater around the pump suctions.
- For submersible wet well pump installations, the flow path between the sump entrance and the pump inlets must be long enough for entrained air to rise to the surface and escape before reaching the pumps.
- Sufficiently dissipate the energy of falling water to keep high and irregular velocities from occurring within the sump.
- Minimize the release of odorous and corrosive compounds within the wet well.
- Sewage free fall within the wet well shall not exceed 1.05m from inlet sewer invert elevation to the Duty 1 Pump start elevation.

- Where required, utilize inlet sump baffle wall system and slots in the floor of the baffle to direct the flow evenly toward the pump inlets.
- Provide a permanent standpipe cleanout to facilitate vacuum cleaning for all wet wells deeper than 5.0 m. See Standard Drawings in **Appendix D**.
- Provide safe access to the floor of the wet well by ladder. The ladder shall be located to offer access directly to the base of the wet well. Provide steps in the benching as required.
- Refer to **Section 10.1** for wet well ventilation requirements.
- Type IV station wet wells designs shall be supported with computational fluid dynamics (CFD) analysis to confirm uniform flow and velocity toward the pump intakes in accordance with the ANSI/HI 9.8 design criteria.
- Provide active wet well mixing in the form of submersible propeller mixer (or mix flush valve for Type I and II stations) in each wet well. Mixers shall be equipped with a lifting bail to allow for removal or installation of the mixer without entry from operations staff. The stainless steel lifting bail shall be able to accommodate a stainless steel lift out chain of sufficient length to clear the mixer access hatch elevation by a minimum of 1.0 m. An access hatch shall be provided above the channel frame and guide rail system suitable for installation and removal of the mixer. Mixers shall be connected to SCADA.
- Type III and IV stations shall be equipped with both submersible propeller mixers and recirculation line mixers. See Standard Drawings in **Appendix D.**
- Ensure that recirculation lines are designed to prevent pump run-out conditions when opened as the static head will be zero.
- Wet well mixers are not intended to run continuously. Mixers are intended to resuspend solids and entrain floating grease, oils and debris within the wet well on each pump cycle to be conveyed through the forcemain.
- Trench style wet wells will be evaluated by the Region on a case-by-case basis.

9.4. Dry Well

- Dry wells, including their superstructure, should be completely separated from the wet well, generator and electrical room. Common walls shall be gas tight.
- Pumping functionality must be maintained under flooded dry well conditions. Emergency stops, local disconnects, junction boxes, start/stop push buttons, and other instruments or equipment that is not submergence rated shall be located above the maximum wet well surcharge elevation.

- A duplex sump pump shall be provided, complete with piping that discharges to a wet well inlet chamber. Refer to **Appendix D** for Standard Schematics.
- Provide stair access to the dry well and a second ladder exit as a minimum.
- Dry well shall be designed for continuous human occupancy and such shall not be classified as a confined space. Refer to **Section 10.1** for more information.

9.5. Pumps

9.5.1. General

- Pump selections and combinations shall be based on the following criteria:
  - The station shall be capable of delivering the peak influent flow rate under normal wet well operating levels (no surcharge), low forcemain friction factor of C=100 and without the use of standby pumps. Refer to **Table 2** for definition of rated capacity.
  - Optimized to achieve highest efficiencies at average flow rates.
  - Non-overloading under low static lift conditions (i.e., pumps operation under surcharge conditions at the overflow invert elevation) and high forcemain friction factor C=140.
  - Maintain adequate velocities through forcemains (see **Section –**).
  - Minimized life cycle costs (high efficiency, low risk of clogging, maintenance considerations, replacement costs).
- Selection of pump type and size shall take into consideration the full range of anticipated flows (including low flows) within the planning horizon. Evaluate the fill time during low flow periods (particularly the first few years of a new development area) and consider the potential for odour generation due to long residence times in the wet well and/or forcemain.
- The pump system shall be designed to operate within the pump's Preferred Operating Range (POR) under all anticipated design conditions (high and low static heads, and high and low C-factors).
- Pump selection shall consider forcemain friction factor. Pumping station design shall be based on system-head calculations and friction curves (C-factor values) as specified within **MECP Design Guidelines for Sewage Works**.
- Pumps should be designed to achieve maximum efficiency under normal average day flow conditions. Where more than one duty pump exists, avoid sizing the pumping system to achieve maximum efficiency under peak flow conditions, as this rarely occurs. However, pumps shall be capable of operation under both maximum (low wet well level) and minimum (overflow wet well surcharge level) system-head curve conditions without overloading the motor and must remain within the Allowable Operating Region (AOR) of the pump.

- Pump rates during normal average influent rate scenarios shall be balanced to:
  - promote energy efficiency.
  - prevent fouling within the forcemain.
  - minimize solid settlement within the wet well.
- All pumps shall be fully submersible, non-clog sewage design, with suction and discharge openings a minimum of 100mm and, pump body shall be protected by a factory applied sewage resistant coating.
- Only pump manufacturers with an approved repair facility within a 2.0-hour drive from the Region of Peel are acceptable.
- Suction lift, grinder pumps, and screw pumps are not permitted. Grinder pumps may be considered for Type I stations with approval from Operation Staff. Deviation request must be submitted and approved.
- All miscellaneous hardware shall be Type 316 stainless steel.
- Pump performance testing shall conform to ANSI/HI 11.6. Pump acceptance criteria shall be Grade 1B unless the Proponent believes that a stricter Grade 1U criterion is justified.
- Pump/motor assembly shall have CSA approval as one unit, per CSA standard C22.2-108.
- Refer to **Section 9.8.1** for required process piping velocities that must be achieved with selected pumps.
- Refer to **Section 9.8** for Equipment Lifting requirements.
- Motors shall be explosion proof (Class 1, Zone 1).
- Refer to **Section 14.9** regarding Starters.
- See **Section 14.10** for additional information regarding the motor specifications and protection.
- Ensure the pump cycle working volume is sufficient to accommodate a maximum of six pump starts per hour unless the motor size requires a fewer number of starts per hour.
- Regardless of the calculated pump cycle working volume, the minimum difference between normal pump start and stop setpoints shall be 0.5m.
- For pump wet well operating levels refer to **Appendix D** for Standard Drawings

9.5.2. Submersible Wet Well Pumps

- Pump discharge elbow shall be supplied by the pump manufacturer and protected with a high-performance epoxy coating. Secure discharge connection to base of wet well with minimum four stainless steel chemically bonded anchors with at least 100mm embedment.

- Mix flush valves are only acceptable for Type I and II stations.
- Provide pump guide bar system complete with intermediate guide bar supports at a maximum spacing of 3.0 m.
- Mount the pump cable support bracket/strain relief sheathing for easy access (i.e., within reach under the hatch).
- Size pump access hatches with a minimum of 100mm clearance all around the pump.
- Ensure pumps can be easily removed from the wet well without any obstructions or interferences. Do not install platforms above pumps.
- Evaluate the need for pump motor cooling jackets for wet well pumps on a case-by-case basis.

9.5.3. Dry Well Submersible Pumps

- Pump selection shall consider net positive suction head available by the application and required by the pump. Ensure net positive suction head (NPSH) margin (NPSH av > NPSH req) of at least 1.5 m under low wet well water levels, C factor of 100, maximum design flow rate, and a water temperature of 30°C.
- Dry well pumps shall be rated fully submersible under continuous operation.
- Motors shall be designed to be cooled with a glycol cooling jacket. The use of process fluid for motor cooling is not acceptable.
- Provide access ports to manually clean and unclog each pump without removing the pump.
- Provide an air valve on pump discharge prior to the check valve to facilitate priming. Extend the air valve vent line to the wet well above the emergency overflow level.
- Either horizontal or vertical installed pumps are permitted in the dry well. For horizontal applications, provide a service sled and winch for operation staff to separate pump rotating assembling from the pump volute for inspection and cleaning. Provide mechanical assist to slide service sled back and forth.
- Provide adequate pump supports to ensure vibrations are within pump manufacturer acceptable levels. Concrete base for the pump support shall be at least twice the mass of the pump and motor. Anchor the pump firmly to the base.
- Provide built-in vibration sensors for all dry well pumps. Final vibration sensor configuration to be determined with Peel during design. Pump manufacturers shall specify vibration limit specifications, tolerances and reference Standards to be followed. Field verify pump vibrations with independent vibration sensor (not built-in sensors) prior to commissioning. Submit inspection test plan and certificates of calibration for all equipment used during testing.

- Engineered witnessed Pump Factory Acceptance Testing is required for all Type IV stations.

9.6. Valves

- Stainless steel slide gate valves per AWWA C561 shall be used for influent maintenance hole and wet well isolation applications. Slide gates must be capable of withstanding hydrostatic forces at the maximum water level that may potentially be encountered (i.e. during overflow conditions) with 40% of the allowable leakage specified in AWWA C561. The slide gate gear must also be located above the normal water level as to not submerge the gear under normal conditions. Factory test all four-sided slide gate valves as per AWWA C651. Provide access above slide gates for removal and installation.
- Secondary stainless steel stop logs shall be provided next to each slide gate valve to facilitate isolation of slide gates for repair. Provide access above stop logs for removal and installation. Store stop logs in the control building when not in use.
- Air release, air vacuum, or combination air valves shall be AWWA C512 fusion bonded epoxy inside and out. For Type III and IV stations, all air valve selections shall be confirmed with a detailed transient analysis. Refer to **Appendix D** for Standard Drawings for more information.
- All check valves shall be AWWA C508 fusion bonded epoxy coated inside and out, swing flex type, non-slam with rubber flapper complete with stainless steel hardware and backflow actuator. Avoid check valve cavitation by making sure the check valve is placed at an elevation not greater than 8.0 m above the pump discharge.
- For valves under 450mm in size, plug valves are preferred over knife gate valves.
- Plug valves shall be AWWA C517 fusion bonded epoxy coated inside and out.
- Knife gate valves shall be AWWA C520 fully stainless steel.
- Review valve selections 450mm and larger with Peel operation staff.
- All forcemain valves should be installed within a chamber. Do not direct bury valves.
- Gate valves are not acceptable on wastewater piping.
- Provide a fully restrained flexible dismantling coupling and spool piece adjacent to all non-buried valves.
- All valves within chambers shall be flanged construction. Wafer and lug style valves are not permitted.
- For confined spaces, valve operators shall be combination hand wheel and extension stem such that they can be operated from the surface. The use of angled valve stems or valve stem with off-set swivel joints should be avoided. Watertight sealed valve boxes must be provided.

- All valves in maintenance holes, wet wells and exterior valve chambers must be accessible for operation with a truck mounted motorized valve turner.
- For non-confined spaces, ensure valves are accessible for operation staff for manual operation from floor level or platform access. Chain wheel operation is not permitted.
- All nuts, bolts, and miscellaneous hardware for valves shall be 316 stainless steel including any gear boxes or valve covers

9.7. Valve Actuators

- Motorized actuators shall be provided for valves in any of the following instances:
  - The valve requires automatic operation to support station processes.
  - For valves within confined spaces which cannot be accessed from the surface.
  - For valves that are used frequently (i.e., on a monthly basis).
  - For valves that are 450mm in size or larger.
  - If access to valves is difficult for manual operation.
- Sluice gates 450mm or larger do not need to have an electric actuator. Gates shall have an extension stem and valve box at the surface for remote operation with a truck mounted or handheld valve turner.
- Electric actuators shall be CSA approved and rated for the hazardous area classification.
- The use of motorized actuators shall be approved by the Region.
- Coordinate the electric actuator torque ratings to ensure they are matched to the torque requirements of the valve application, including a 25% safety margin at 1,034 kPa (150 psi) differential pressure.
- Electric actuators shall incorporate a motor, an integral reversing starter, local controls, and a control wiring interface for remote control and position indication housed within a self-contained, sealed enclosure.
- Designer must specify the opening and closing valve travel rate for all motorized actuators to minimize risk of excessive transient pressures.
- Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from minus 30°C to plus 50°C, up to 100% relative humidity.
- Actuator enclosures shall be rated NEMA 4 as a minimum requirement.
- Actuators shall be equipped with integral local status indication including Open Status, Closed Status, intermediate travel status, and control mode status. Include a digital numeric display that indicates the valve position status in increments of 1% (for a 0 to 100% valve travel).

- Include local controls integral to the actuator for Open/Close commands, Stop, and Mode Control. The local valve controls shall permit the valve to be set at any position from 0 to 100%, in increments of 1%.
- Provide a three-position mode control switch for Local, Off/Stop, and Remote. Provide an auxiliary output contact for monitoring of the Remote Mode Status. The Remote Mode status shall be configured such that no other status signals are combined with the signal contact. When the valve mode selector is in the Remote position, the contact shall remain closed during a power interruption. Actuator shall be equipped with an integral backup battery, as required to ensure that the remote mode auxiliary status contact does not change state during a power interruption.
- Provide a remote-control station at an elevation of 1200mm above the finished floor (AFF) where the actuator and valve are located within a confined space or at an elevation that is greater than 1500mm AFF. The local control station shall be equipped with the same control functions and status indication that are included with the actuator.
- Provide discrete input (DI) control and discrete output (DO) status indication based on contacts rated 120VAC/DC, 1A.

9.8. Process Piping

9.8.1. General

- Piping layout shall accommodate access to all critical components for operation and maintenance. Locate valves, equipment, and instruments in unhindered locations accessible from floors and platforms with sufficient clearance to complete maintenance.
- Ensure that the failure or maintenance of any single segment of pipe (between two valves) does not result in a total shutdown of the facility. Process piping and isolation valves should accommodate the maintenance and repairs of any pipe segment or valve while still maintaining partial operation of the station.
- Piping and isolation valve layout shall offer the flexibility during repair and maintenance work to isolate and replace valves and spools while still operating the station at partial capacity.
- All non-buried process piping and hardware shall be type 316L stainless steel.
- Minimum process pipe size shall be 100mm.
- All process piping shall be equipped with a flange connection at a maximum distance of 300mm prior to all wall or floor penetrations (interior locations only).
- All process piping wall penetrations shall be cast-in-place complete with embedded thrust flange.

- Design vertical pump discharge riser in wet well and dry pits for velocity between 1.5 and 2.5 m/s. Adequate scouring velocities should be selected to effectively mobilize heavy solids and grit.
- Design process piping and fittings for maximum transient pressures (minimum 1,034 kPa, 150 psi), full vacuum, thrust restraint, and thermal expansion/contraction. Pressure test piping to a minimum of 1,034 kPa (150 psi) for two hours with zero visible leakage.
- All pipe fittings shall have the same pressure ratings as the straight runs. Pump suction lines shall be pressure rated, restrained, and pressure tested with the same requirements as for station process piping.
- Submit proposed Process Piping labelling and colour coding for Peel to review.
- Provide a bypass connection to allow for the following:
  - Pumping from the wet well through the discharge header to a tanker truck (bypassing the forcemain).
  - Portable pumping from the inlet bypass maintenance hole to the forcemain (bypassing the wet well and pumps).
  - Forcemain access port to insert condition assessment tools for inspection of the forcemain (i.e., CCTV, leak inspection tools, etc.). Minimum 200mm in size.
- Refer to station piping arrangement identified within Standard Drawings in **Appendix D.**

9.8.2. Wet Well Piping

- All brackets, supports, anchors and hardware shall be type 316L stainless steel.
- Grooved restrained pipe couplings shall be stainless steel.
- Maximum length of piping in the wet well without a coupling shall be 5.0 m.
- No valves are permitted on the suction or discharge piping within the wet well.

9.8.3. Suction Piping for Dry Well Applications

- For Type IV stations, the inlet pipe should be equipped with an inlet bell mouth to minimize losses and disturbed flow into the pump.
- To achieve a uniform flow to the inlet of the pump, the suction pipe design should fulfill the following:
  - Ensure NPSH margin ($NPSH_{av} > NPSH_{req}$) of at least 1.5 m under low wet well water levels, C factor of 100, and water temperature of 30°C.
  - Minimize friction losses.
  - Minimize number of elbows.

  - Eliminate vapour from suction pipe.
  - Ensure correct pipe alignment.
  - Provide automatic air venting downstream of the pump before the check valve.
- To minimize the risk of cavitation, noise, and vibration, the suction isolation valve and the valve seat should be smooth to avoid flow disturbance and ideally be located more than five pipe diameters away from the pump.
- All elbows shall be smooth long radius.
- Provide hand access clean-out ports on the suction side of each pump.
- The submergence for the suction pipe should be 1.7 times the Froude number (Fr) times the inlet pipe diameter (D) (S=1.7*Fr*D), with the minimum condition that the submergence be not less than 1.75 times the inlet pipe diameter (1.75*D).
- Recommended velocities for suction pipes are:
  - Flows less than 300 L/s, 0.6 to 2.8 m/s velocity.
  - Flows 300 to 1200 L/s, 0.9 to 2.4 m/s velocity.
  - Flows greater than 1200 L/s, 1.2 to 2.1 m/s velocity.

9.8.4. Valve Chamber and Dry Well Discharge Piping

- Provide a minimum of 50mm taps and ball valves immediately before and after each pump (dry-well applications).
- Provide a minimum of 50mm tap and ball valves before check valves within the valve chamber (wet well applications).
- Provide drain valves such that each segment of process piping can be emptied prior to dismantling for repair/maintenance efforts.
- Provide drain valves and drain piping for each forcemain as shown in the Standard Drawings.
- Common header pipes (where flows from all pumps converge) should maintain minimum fluid velocity in the low end of 1.0 to 2.5 m/s (including discharge flow meters) to promote pipe scouring while maintaining hydraulic efficiency.

9.8.5. Pipe Supports

- Piping shall be independently supported (vertical and lateral supports). Pipe sections shall not be supported by adjacent process equipment such as pumps.
- Provide additional supports at key components such as valves.
- Provide supports within one pipe diameter on either side of all flexible joints.

- All parts of the system should be anchored so the primary disturbances have frequencies below the lowest natural frequency of the system, including pump, valves, supports, and pipes.
- In general, set the distance between pipe supports at 70% of the critical length.
- Near pumps, ensure pipes have a support located at a distance of 1/3 of the critical pipe length from the pump.

9.9. Equipment Lifting Devices

9.9.1. General

- Provide a means for lifting and removing all equipment from both the room and the entire building including but not limited to valves, secondary slide plates (i.e., stop logs), couplings, pumps, grinders, and flow meters.
- Pumps, grinders, and slide plates should be readily removable and replaceable without personnel entering the confined space.
- Provide equipment lifting device as follows (from most to least preferred):
  - Region's boom truck lifting through access hatch.
  - Permanent crane (I-beam, jib crane, or gantry system) with motorized hoist.
  - Permanent lifting davit and portable hoist.
  - Temporary mobile crane (i.e., for Type IV stations). Consider exterior access hatch above dry well for pump removal.
- Ensure all lifting devices can clear equipment at least 300mm above the floor.
- When permanent lifting equipment is used, provide a stainless steel engraved tag listing the rated capacity of the equipment.

9.9.2. Pump Removal

- For wet wells less than 10 m deep, submersible pumps shall be equipped with 1.0 m stainless steel chain (compatible with Peel's grip eye system) and stainless steel guide cable extending to an upper bracket hold (with custom carabiner connection) within arm's reach from the access hatch. Pumps shall slide within stainless steel guide bars (affixed at base bend and top of wet well) complete with intermediate supports at least every 3.0 m.
- For wet wells deeper than 10 m, provide custom deep pump lift system as recommended by the pump manufacturer.
- Design pump lifting components for full dynamic load plus 50% additional safety factor.

9.10. Transient Control

- Process piping, valves, equipment, and forcemain pressure class shall be selected to withstand potential worst-case transient surge pressures with all pumps (including standby) running. Only anti-slam check valves and redundant surge tanks can be used as a basis to lower the pressure class of process piping and the forcemain.
- Re-occurring or occasional transient pressures should be controlled to a maximum of 80% of the pipe pressure class.
- The following equipment can be used to control transient pressures (from most to least preferred):
  - Anti-slam check valves
  - Surge relief valves
  - Surge tanks
  - Air valves
- Re-occurring transient pressures during pump starts/stops should be minimized using soft starters with pump control feature or VFDs as deemed appropriate.
- Complete numerical modelling to algebraically solve continuity and momentum equations for detailed transient analysis for all stations.

9.11. Forcemains

All buried pressure pipe, pump laterals and forcemains shall comply with the **Region's Linear Infrastructure – Forcemain Design Criteria** as well as the following:

- Forcemains should be designed to maintain minimum fluid velocity near the low range of 1.0 to 2.5 m/s. Under VFD applications, forcemains could run as low as 0.8 m/s as long as flushing velocities above 1.0 m/s occur a few times per week (i.e., VFDs ramp up).
- Avoid local high points or low points and wherever practically feasible, continuously rise the forcemain toward the outlet.
- Forcemains shall be installed at sufficient depth to prevent freezing. Minimum burial depth for forcemains is 1.8 m.
- Adjust the forcemain profile such that no more than 6 m of pipe drains by gravity toward the outlet under non-pumping (static) conditions.
- The forcemain should enter the receiving maintenance hole with a smooth flow transition to the gravity sewer system at a point not more than 0.3 m above the flow line.

- Forcemain pressure class shall be selected to withstand potential worst-case transient surge pressures. See **Section 9.10**. Forcemains should also be designed to withstand full vacuum conditions.
- For forcemains subject to traffic loading, a loading factor in accordance with the regulations, codes, and by-laws of authorities having jurisdiction shall be considered for selecting depth of pipe cover. This includes but is not limited to: Highway Bridge Design Code (for vehicular traffic), Railway Safety Act, and Transport Canada Act. Appropriate structural support shall be provided to the pipes as required.
- Provide double flexible restrained couplings on buried pressure pipe at all wall penetrations.
- All process pipe penetrations to buildings and structures shall be watertight and structurally designed with appropriate thrust restraint as required.
- For a cement lined or metallic pipe, at a minimum, apply high-performance corrosion resistant coating to the pipe interior wherever air could accumulate such as at air valve locations and the forcemain outlet.
- Provide tracer wires on all buried non-metallic piping and concrete pressure piping. Tracer wires shall be 12-gauge TWU, 7-strand insulated copper wires suitable for buried installation. All spliced or repaired wire connections shall be made with water-tight wire connectors and enclosures. Tracer wires shall be installed along the crown of the entire pipe length and terminated on the inside of valve chambers or the outside wall of the pumping station.

10. Mechanical

10.1. HVAC

10.1.1. General

- As a minimum, all wet wells and emergency and maintenance wastewater storage structures shall be equipped with a passive ventilation system to permit rising and falling liquid levels.
- Portable mechanical ventilation equipment (fan and hose) is required for Type I and II stations. Store ventilation equipment in the Control Building.
- Permanent mechanical ventilation equipment is required for wet wells, dry wells, and valve chambers for Type III and Type IV (dry well) stations.
- All mechanical ventilation equipment used for confined spaces shall be sized to purge and ventilation the space for safe personnel entry.
- The ventilation system for process areas shall be designed in accordance with NFPA 820.

- Ventilation is not an acceptable means to de-rate hazardous electrical area classifications.
- Ventilation system intakes shall be located at a sufficient distance from ventilation exhaust, chemical tank vents, generator exhaust, and other nearby sources of emissions. Consider the prevailing wind direction when designing the air intake and exhaust locations.
- The ventilation system for occupiable spaces shall be designed in accordance with the requirements of the OBC and ANSI/ASHRAE 62.1.

10.1.2. Space Heating

- Areas periodically occupied by operations staff, including Type IV dry wells, Type III valve chambers, generator rooms, and all electrical and control rooms should be designed for an ambient temperature of 20°C.
- Life-Cycle-Cost should be strongly considered when selecting the heating energy source.
- Wet wells, Type I and II valve chambers, inlet maintenance holes, emergency and maintenance storage tanks do not need to be heated, however these structures shall be protected from freezing.

10.1.3. Air Conditioning

- Supply and exhaust fans should be considered as a primary means of cooling spaces whenever feasible. For process areas, design ventilation systems to achieve a maximum building temperature of 5°C above outdoor temperature.
- Provide air conditioning for Type III and IV electrical and control rooms to maintain a maximum internal summer temperature of 25°C. Account for the heat radiated from electrical equipment (VFD, filters, MCC, etc.).
- Assess the need for dehumidification systems for process areas to control condensation and control corrosion from a life-cycle-cost perspective.

10.1.4. Air Intake and Exhausts

- All air intake and exhaust dampers are to be insulated and equipped with stormproof vandal-resistant louvers complete with an aluminum insect screen.
- Refer to **Section 13.5**. for specific requirements for generator room louvers.

10.1.5. Wet Well Ventilation

- Passive (natural) ventilation shall be provided at a minimum.
- Provide permanent supply air mechanical ventilation for all Type III and IV wet wells.

- Fans, ductwork, and associated equipment shall be fabricated from non-sparking corrosion resistant material such as Type 316L SS or FRP.
- For Type I and II stations, make provisions for a portable ventilator fan and portable flexible ductwork that can adequately ventilate the wet well for confined space entry. Ensure the temporary installation of the portable duct work does not interfere with personnel access or equipment removals. The electrical supply outlet for the fan should be located nearby in a non-classified area.
- The wet well light switch shall activate the wet well fan and be accessible without entering the wet well.

10.1.6. Dry Wells and Valve Chamber Ventilation

- Type IV dry wells and Type III valve chambers shall be physically separated from all non-classified areas.
- Type IV dry wells and Type III valve chambers shall be designed for continuous human occupancy such that it is not classified as a confined space.
- Permanent ventilation fans and duct work shall be provided. An intermittent ventilation strategy should be considered when the space is unoccupied to save on energy.
- Provide a sign at all access locations indicating “Dry Well/Valve Chamber is Classified as a Confined Space if OK Status Light is OFF or Alarm Light is ON”.
- Control Philosophy
    - When the light switch or occupancy sensor is activated, the ventilation system should run continuously.
    - Status “OK” light should be ON if ventilation fan is running. If the ventilation system has failed or gas detectors are in alarm, turn OFF the “OK” light and turn ON the Alarm light.
    - Ventilation fans should automatically run if gas sensors are in a state of alarm.
    - Ventilation fans should stay running for at least 1 hour after occupancy sensors are deactivated.
    - Ventilation fans should turn OFF when the light switch is turned OFF (unless gas sensors or the occupancy sensor turn the fans back on).
- Refer to **Appendix D** Standard Drawings for more information.
- Refer to **Section 4.2** for electrical classification of spaces.
- Acceptable material for dry well fans and ductwork includes aluminum, FRP, and stainless steel.

10.1.7. Building Ventilation System Control

- The building ventilation system shall be controlled by a vendor-specific control panel or building automation system to interface with the SCADA system for alarm monitoring.

10.2. Plumbing

10.2.1. General

- All plumbing lines shall be labelled with the type of service, be colour coded, and indicate the flow direction in accordance with ANSI/ASME A13.1 Standards, unless otherwise indicated by the Region.
- The plumbing system shall be designed in accordance with the requirements of the OBC and CSA B64 standards.
- Refer to **Appendix D** for Building Service Water Schematic.

10.2.2. Water Service

- A potable water service line shall be provided to all facilities. The minimum water service size shall be 50mm.
- The potable water service shall be protected by a suitable backflow prevention device.
- The piping upstream of the water service backflow prevention device providing premise isolation shall be labelled “No Connection Permitted”.
- Provide either hot water tanks or inline water heaters suitable for the plumbing fixtures being serviced. Ensure the plumbing system is protected from thermal expansion.

10.2.3. Non-Potable Plumbing

- The non-potable water service shall be protected by a suitable backflow prevention device.
- All non-potable plumbing fixtures shall have signage posted above the fixture indicating “Non-Potable Water – Do Not Drink” in accordance with the OBC.
- Provide at least one hose reel and washdown line within the building that extends to the furthest point of the wet well for cleaning. Avoid using wall hydrants and yard hydrants.
- Comply with the Region’s Backflow Prevention By-Law 10-2017 (latest edition).

10.2.4. Washroom Facilities

- Where practical, provide washrooms at all facilities. As a minimum, washrooms are mandatory at all Type III and IV pumping stations.

- Washroom facilities shall be accessible from the exterior of the building and not necessarily from the interior unless specifically requested by Peel. It is the intent that other Peel groups (i.e. Transportation) can use the washroom facilities without entry into the station.
- Washroom design shall comply with the Region's Facility Accessibility Design Standards. At a minimum, provide a toilet, wash sink, soap dispenser, and paper towel dispenser.
- Provide a separate custodial room with a slop sink and/or service sink for Type IV stations.

10.2.5. Floor Drainage

- Floor drain traps are to be equipped with automatic primers.
- Gravity drainage to a wet well or inlet maintenance hole is acceptable provided the drainage line is equipped with a trap, the outlet is above the inlet sewer elevation and the outlet is equipped with a rubber check valve in the wet well.
- Floor drains are not permitted to be located within generator fuel containment areas.

10.2.6. Eyewash Stations

- All facilities shall be equipped with a permanent eye wash station supplied with tempered water in accordance with the latest editions of ANSI Z358.1.
- Locate eye wash near an easily accessible location near the main door.
- Provide a clearly marked sign above the eye wash station.
- Emergency showers shall be evaluated on a case-by-case basis.
- Eyewash and shower stations are to be equipped with a flow monitoring alarm connected to SCADA.

10.3. Sump Pumps

- Duplex sump pumps are required in all dry well stations with a discharge to the wet well inlet channel or inlet maintenance hole.
- For valve chambers, provide duplex sump pumps where gravity drainage back to the wet well is not feasible.

11. Emergency and Maintenance Storage

Provide emergency and maintenance storage capacity as follows:

Table 3: Emergency and Maintenance Storage Capacity

Station Type	Storage Capacity at Rated Capacity
Type I	2.0 hours
Type II	2.0 hours
Type III	Minimum 1.0 hour on-site (no less than 432 m^3 on-site) 2.0 hours total
Type IV	Minimum 1.0 hour on-site 2.0 hours total

Note: Storage capacity, in terms of volume storage over time, shall be calculated at peak wet weather flow (i.e. rated capacity).

- For Type III and IV stations, upstream pumping station storage and upstream trunk sewer storage can be used (if available) to fulfill the 2-hour total storage requirement. However, a minimum of 1-hour storage must still be provided on-site. Proponent must demonstrate that the additional upstream storage capacity is in sufficient proximity to the station such that the intent of emergency storage is satisfied.
- A maximum reduction of 1-hour from the total 2-hour emergency storage capacity may be considered through the use of a permanent self-priming engine driven backup pumping system. This option shall be evaluated on a case-by-case basis with approval by Peel. As a minimum, backup pumping system shall include the following:
    - Pump station standby pumping and power in one package.
    - Permanent suction and discharge piping and valving. All exposed piping shall be insulated.
    - Cold weather package for use in freezing conditions.
    - Automatic pump priming without operator assistance. Maximum suction lift of 8.0 m.

  - Automated control systems complete with wet well level control floats.
  - Sound attenuating enclosure reducing sound levels to as low as 69 dBa at 10 m.
  - SCADA interface.

- Emergency storage capacity is defined as the total volume of storage above the high-level wet well alarm to the overflow elevation (or 0.5 m below the maximum surcharge level where basement flooding occurs) and can include the wet well, upstream maintenance holes, available trunk sewer storage (where applicable), and the emergency and maintenance storage structure. System storage within the network of gravity sewer pipes shall not be included in the required capacity.
- Emergency overflow pipe connection to the environment is required provided it is approved by the local conservation authority and municipality. Size the overflow pipe for either the peak instantaneous influent flow plus 50% or the ultimate buildout capacity of the entire catchment area. The overflow elevation to the environment or stormwater system shall be selected to protect basement flooding under surcharge backwater conditions with the pumping station out of service. Overflow pipes shall not be submerged at the outlet.
- Emergency storage can be provided by one of the following means:
  - Large diameter concrete pressure pipe (pressure tested)
  - In-ground reinforced concrete chamber (leak tested)
  - Upstream trunk sewer (if available)
  - Upstream emergency and maintenance storage (if available)
- Large diameter pipe storage shall meet the requirements outlined in Peel Standard Drawings for new PCCP (CPCP) pressure-tested sanitary systems.
- In-ground reinforced concrete chambers shall meet the following requirements outlined in the South Peel Reservoir Design Guidelines:
  - Roof Drainage
  - Manway Access Hatches
  - Equipment Access Hatches
  - Architectural Requirements for Below-Grade Structures
  - Design of Water Retaining Structures
  - Quality Assurance During Construction
  - Except for the following: NSF61/600 is not required, and ladder access is preferred over stairway access.

- The emergency and maintenance storage system shall be designed to facilitate flushing, washdown, and cleaning of the entire structure.
- Include a fire hydrant (as per Peel Standard Drawings) within 10 m of the emergency and maintenance storage tank within the site limits. This will provide a water hook-up for operation staff to clean the tank following appropriate backflow prevention practices.
- Provide at least two points for access and egress for the storage tank.
- For pumping stations that will eventually be expanded to meet build-out conditions, ensure that the emergency and maintenance storage system can be expanded in the future to achieve full build-out capacity of the catchment and that its designed location will not interfere with any proposed physical expansion of the SPS.
- A simplex submersible sewage pump is required for all emergency and maintenance storage structures that cannot drain by gravity back to the wet well. The pump shall comply with requirements specified in **Section 9.5.2**.
- Refer to Standard Drawings in **Appendix D** for more information.

12. Odour Control

- Designs shall always endeavour to reduce the potential for odour generation.
- Consideration shall be given to providing a permanent odour control system on a case-by-case basis.
- An odour study shall be undertaken under any one of the following scenarios:
    - An existing sewage pumping station has received multiple nuisance odour complaints.
    - An existing sewage pumping station will be undergoing upgrades that are expected to increase the odour generated at the site.
    - A new sewage pumping station is being constructed that is within 50 m to sensitive receptors (i.e., residential or commercial areas, parks, schools etc.).
- An odour study conducted for existing stations shall be based on empirical odorant data collected from the wet well, and will include dispersion modelling to determine offsite impacts, at a minimum.
- An odour study conducted for new stations, not yet constructed, shall be based on typical odorant loadings observed at nearby sewage pumping stations, and will include dispersion modelling to determine offsite impacts, at a minimum.

- All stations shall be designed to accommodate future odour control equipment. At a minimum, provide pipe penetrations through structures, spare Motor Control Centre (MCC) units, and allocated building or outdoor area for future equipment.
- Acceptable odour control systems include: biofilter reactors, biotrickling filter reactors, and activated carbon systems, or a combination of these technologies, selected based on the expected or measured odorant loading and required ventilation rate. Activated carbon systems shall be equipped with a mist eliminator and grease filter. Biofilter and biotrickling filter reactors shall be provided with a service water connection and a drain connection back to the sanitary sewer or wet well.
- Wet well headspace shall be actively ventilated, treated continuously, and kept under marginal negative pressure to prevent fugitive emissions.

13. Standby Power

13.1. General

- Provide permanent standby power to meet the full load capacity of the facility.
- Portable generators are not acceptable.
- Provide a pre-engineered packaged stand-alone backup power system consisting of a closed loop liquid-cooled generator within a self-contained, lockable, sound-attenuating outdoor walk-in enclosure. Provide two sets of keys within the pumping station building hanging on the wall with a sign above indicating its purpose.
- Where outdoor generators are not acceptable due to neighbourhood aesthetic concerns, install standby power generator within a building.
- Only Type I facilities can have generators located within the electrical and control room. Otherwise, all other generators must be located in a dedicated room within a building.
- Generator fuel preference is diesel. However, natural gas or dual fuel systems may be acceptable on a case-by-case basis.
- In case of natural gas generators, additional instrumentation such as pressure transmitter and natural gas sensors must be provided as needed.
- Comply with CSA B139, CSA B149, CSA C282-09, NFPA 211, and TSSA requirements.

13.2. Noise and Emission Controls

- Provide site-specific noise and emission attenuation measures to minimize impact to neighbouring communities, comply with local noise by-laws, and meet the intent of NPC-300.

13.3. Installation Requirements

- Outdoor generators shall be installed on a dedicated concrete pad above the regional flood elevation and equipped with stair access to all enclosure openings.
- Provide safety guards around all hot surfaces, belts, shafts, gears, rotating equipment, and other moving parts.
- Do not insulate the turbochargers, flex pipes, or silencers as this prematurely stresses the components. Instead provide protective guarding and heat warning signs.
- All generator exhaust systems shall be installed in compliance with the OBC (latest adopted version).
- Gensets in excess of 1000 A output must be provided with ground fault protection.

13.4. Fuel Systems

- Where diesel generators are used, diesel storage tanks shall be sized based on 36 hours of operation at the facility's firm capacity plus ancillary loads starting from a 95% full tank.
- Fuel storage tanks shall be double walled.
- Include a fuel level-indicating transmitter, low fuel float switch, and an interstitial space alarm switch. All instruments shall be installed and monitored by SCADA. An approved sight gauge shall also be provided.
- Either an electronic overfill or a mechanical overfill prevention device shall be installed and a vent whistle shall be provided on each common vent pipe.
- All fuel tank, piping, and associated systems shall be designed to comply with the latest requirements of CSA B139 as adopted by the TSSA.
- Natural gas generators shall comply with the latest requirements of CSA B149 as adopted by the TSSA.
- Fuel lines should be placed in an accessible location where they can be visually inspected and maintained. If floor installations are necessary, provide a dedicated and sealed floor trench equipped with a flood switch connected to SCADA for monitoring fuel leaks.
- All fuel shall be stored indoors, where space permits. If outdoor tanks are necessary to meet the volume requirements, provide a day tank with at least four hours of fuel within the generator service room.
- Wherever possible, fuel containment berms shall be integrated into the generator service and fuel storage room designs to avoid tripping hazards. Secondary fuel containment areas should be sealed with a suitable epoxy floor coating.

13.5. Generator Ventilation

- The generator system shall be engineered complete with fans, dampers, and other ancillary systems to meet the required air intake volume and air velocities for engine combustion and ventilation requirements. The engine ventilation system shall be designed to operate with or without local utility power. Inlet air dampers shall open on loss of power in a fail-safe manner.
- Installed damper actuators shall open in less than 30 seconds upon receiving a generator start command and be equipped with a limit switch to prove open status. Monitoring of the damper actuator status is to be completed by a separate control panel with output signals monitored by SCADA.
- Generator exhaust system components are to be constructed of stainless steel and installed with the most direct path to the exterior of the building/enclosure.
- Generators cooled by an external water supply are not acceptable.

13.6. Generator Starting System

- Engine shall be started by an electrical cranking motor with power provided from storage batteries, which may either be a 12 or 24 V system.
- The system shall include a fully automated battery charger to maintain the battery in a fully charged state, with an alarm to SCADA in the event of malfunction or low battery voltage.
- Provide sufficient amperage for at least three cold cranking cycles each of 15 second duration.
- The generator and day tank shall be kept warm as required by the manufacturer in preparation for starting in all weather conditions.

13.7. Generator SCADA Communications

- The generator shall be provided with an onboard control system compatible with the automatic transfer switch (ATS) described in **Section 14**, and designed to provide automatic starting, monitoring, protection and control functions.
- Provide ethernet communication between the generator control panel and onsite SCADA to collection additional information such as temperature, oil pressure, engine speed and others as required. Refer to standard drawings for list of signals that are required for remote monitoring through SCADA system, refer to **Appendix D**.

13.8. Generator Load Bank Testing

- The generator shall be provided with a dedicated circuit breaker for load bank testing. Generators with an output current of 100 A or greater (80 kW and above for 600 VAC) shall

be wired to a load bank connection box with cam-lock style plugs to allow for easy connection of a load bank.

13.9. Generator Testing

- All generators shall be factory tested. The requirement for the Proponent to witness factory testing shall be determined between the Proponent and the Region on a project specific basis. Only when a generator has passed the factory test can it be shipped to site. Following installation and pre-commissioning checks, the generator system must be tested continuously for a minimum period of four hours at full load. Complete acoustical field testing of the generator equipment to confirm compliance with the specified noise limits. Alarm and shutdown conditions are to be demonstrated during commissioning and all signals to SCADA verified.

14. Electrical

14.1. Safety Requirements

- 600 V MCC and motor starter panels should be separated from low voltage control panels (120 VAC or less).
- Emergency stop buttons shall be provided for all moving/rotating process equipment (pumps and grinders) in the field. Location to be as close as practical to equipment. Provide an additional emergency stop button at the MCC.
- Generators should be provided with local emergency stops located on the generator controller, on the generator enclosure for outdoor generators, and a remote e-stop wall mounted for indoor generators.

14.2. Arc Flash Risk Mitigation

- The electrical system design should eliminate or reduce the risk of arc flash by reducing the likelihood of exposure, reducing the magnitude of severity of exposure, and providing an electrically safe work environment. Complete an arc flash risk assessment according to CSA Z462 - Workplace Electrical Safety for new installations.
- All retrofitted electrical systems must include the arc flash risk assessments and proper labelling.
- Remote on/off switches shall be provided for MCC’s and starter panels that are located outside of the MCC/starter Arc flash boundary to allow starting and stopping of equipment

manually. Designer shall confirm this requirement with Peel during design on a per project basis.

14.3. Investigations and Studies

- When variable frequency drives (VFDs) are being used, the completion of a harmonics study by a qualified specialist firm shall be provided.
- A Short Circuit, Arc Flash Hazard, and Protective Device Evaluation and Coordination Study must be completed for every project when a modification to the electrical system is proposed, unless otherwise indicated by the Region. The study must be completed and implemented in accordance with all applicable codes.
- Power studies and harmonic studies are to be performed by a contractor as per requirements outlined by the Proponent; all the test results must be stamped by a Professional Engineer licensed to practice in the province of Ontario as per requirement; the Proponent is responsible for reviewing all the test results and providing corrective design approaches when needed.

14.4. Temporary Power During Construction

- The Proponent shall evaluate the need for temporary power for bypass pumping during construction (when required). The Proponent's design shall incorporate the supply of temporary power from the existing electrical service where possible. Where use of the existing service is not possible, the Proponent shall include in their design sufficient information and direction for the contractor to supply temporary power to the site.

14.5. Utility Power

- The preferred electrical service entrance power supply shall be 600 volt, three phases. Service transformers shall have a solidly grounded wye secondary. A neutral conductor shall be brought into the main service entrance breaker/disconnect or switchboard and grounded even if it is not used in the distribution system.
- Ungrounded delta or wye secondaries are not acceptable. Service transformers shall be designed to meet the estimated demand load requirements of the station and be sized to allow for 25% future load growth and contingencies.
- Transformation requirements shall be coordinated with the local Hydro Authority (i.e., Utility) that has jurisdiction over the service area.
- The requirements for transformer vaults and easements shall be coordinated with the local Hydro Authority.

- Hydro metering shall be provided to meet the requirements of the Hydro Authority having jurisdiction. Hydro meter is to be located outside the building (pending hydro authority approval). Consult with the Local Hydro authorities on the preferred location of the hydro meter and confirm the location.
- The Proponent shall coordinate requirements for metering current transformers (CT) & potential transformers (PT) versus feed through metering. The installation of metering CTs & PTs shall be in a dedicated metering cabinet or incorporated into an MCC service entrance arrangement.
- A separate power monitor shall be provided for monitoring of power quality on the client side. The power monitor shall be provided with network connectivity to the SCADA system as per PAIDS requirement. The unit must be set to capture and log voltage sag and swells more that 5%.
- When a new utility power service or an existing utility service is being modified or upgraded, a surge protective device and lightning arrester system shall be provided.
- A microprocessor-based auto-switching power factor correction system shall be installed at the main electrical service entrance to the station. The system shall be capable of automatically switching capacitor modules in and out of service to maintain power factor as needed and minimize voltage sags and swells in the station. The system shall be provided in a single enclosure and shall be either wall-mounted or free-standing to suit the specific application. The system shall be preferably installed indoors in a NEMA 12 enclosure when possible.
- Where the main station transformer is not supplied by the local utility, and thus owned by the Region, the following items are to be incorporated into the design:
    - Three-phase, oil-filled, pad-mounted, dead-front transformer.
    - Tamper-proof design.
    - Transformer to meet the energy efficiency requirements of CAN/CSA C802.1.
    - Separate compartment/panel for low-voltage (120V and below) connections and alarms.
    - Oil sample port shall be accessible without opening the low-voltage/high-voltage bushing compartment on the transformer. Sample port to be extended outside of compartment if needed.
    - Transformer shall include liquid temperature, liquid level, and vacuum gauges.
    - Pressure relief device.

- Hard-wired signals to SCADA for monitoring winding temperature, sudden pressure, liquid level (low and high), liquid temperature (high).

14.6. Automatic Transfer Switch

- An ATS shall be provided for all facilities with standby power generators.
- The requirement for a maintenance bypass on the ATS scheme is mandatory for Type IV stations. For all other station types, a maintenance bypass may be required. The Proponent must include for an evaluation study to be used by the design team during the design stage to determine whether an ATS maintenance bypass is required for non-Type IV stations.

14.7. Motor Control Centres

- All MCC equipment is to be installed on house concrete keeping pads which are a minimum of 75mm high.
- MCCs and all components shall be designed, manufactured, and tested in accordance with NEMA Standards. All compartmentalized vertical sections shall be provided with common power bus bars. Each vertical section of the MCC shall be designed to permit the removal or addition of motor starters and control units as required.
- MCCs shall be floor-mounted, freestanding, dead front, completely enclosed control assembly and should accommodate front mounting combination starters and circuit breakers. Cubicles housing the service entrance main breaker shall be compartmentalized and provided with a full-width front door complete with locking handle.
- Breakers shall operate with “OPEN” in the clockwise direction and “CLOSED” in the counterclockwise direction.
- Digital metering shall be incorporated into the MCC for the purpose of plant metering.
- Incorporate infrared (IR) ports on to new MCCs for infrared testing to allow for viewing/testing of connection points where possible.
- All new MCCs shall incorporate arc flash resistant design features such as heavier gauge steel, reinforced latches, and isolated buses, and features to better contain and/or redirect energy away from the operator. MCC main breakers shall include an arc flash maintenance mode switch.
- MCCs shall have adequate ventilation to limit internal temperature rise. Provide a continuous ground bus with accessible external connection for bonding to the ground. All indicating light lamps shall be LED type. All lights shall be push-to-test type.

- All major components in the MCC shall have the ethernet communication option included. Smart overload relays with ethernet capability are to be included in the MCC design.
- Conduit entries to and from MCCs are to be bottom or side entry only.
- Wire identification – MCC to have oil resistant markers at ends of each conductor.
- All devices inclusive of digital metering, indicator lights, elapsed time meters, switches, etc. to be located with consideration for operator ergonomics with respect to height and eye level accessibility.

14.8. Motor Starters

- The process designer should review the benefits of VFDs, soft starters and across-the-line starters with Region staff and document the decision (in a project memo) on whether these are required.
- Soft starter pump control is preferred in situations where forcemain fluid velocity can be maintained within acceptable limits regardless of the number of pumps in operation.
- Evaluate the need for a soft starter pump control ramp feature in consideration of efficacy with regards to actual motor loads on normal pump starts/stops and effectiveness to minimize transient pressures.
- Variable frequency drives (VFD) are generally discouraged, however can be considered for stations based on the following:
    - High friction systems under peak flow where VFDs could be used to reduce speed under normal operating conditions to maximize energy efficiency while maintaining minimum forcemain velocity.
    - Large pump applications where additional transient controls under normal pumps starts/stops are required.
    - Do not use VFDs for flow matching as it can results in excessive single pump run times and possibly low forcemain velocities.
    - Provide a bypass starter and manual switch with every VFD.
- VFDs should be configured such that the minimum speed at the drive is established to overcome the static lift of the station when flow starts to move within the forcemain and not less than 30 hz. However, the minimum pump speed to be programmed in the PLC shall be set such that the minimum acceptable velocity of the forcemain is maintained.
- VFD maximum speed setpoints are to be 60 hz (100%) unless otherwise specifically required by the process designer.

- VFD speed feedback (sent to the PLC) must be set to the full signal range (0 to 60 hz and 0 to 100%).
- All VFDs and soft starters must be provided with network connectivity as per PAIDS requirement for additional monitoring through the SCADA system.
- The VFD shall not cause line side voltage spikes, which exceed the envelope of the line voltage waveform by 10% under continuous steady state conditions.
- Input DC line reactors to be utilized on all VFD installations to minimize the input current harmonics.
- Harmonic filters to be utilized on all VFD installations 50HP and above to minimize the input current harmonics.
- For across-the-line starters, smart electronic overload relays are to be provided with network connectivity as per PAIDS requirement for additional monitoring through the SCADA system.

14.9. Motor Specifications and Protection

- Unless otherwise specifically noted, all electric motors shall be high efficiency, explosion-proof motors.
- All electric motors including and over 1.0 HP must be 575 V, three phases, 60 hz.
- The design, construction, testing and performance of all supplied motors shall conform to the latest requirements of EEMAC and bear the CSA approval label.
- All motors used for VFD application to be inverter duty rated.
- Where power factor correction is to be applied using capacitors, the selection of capacitor rating shall be motor specific. Consider power factor improving capacities for motors rated for 40 hp and greater.
- A motor protection relay system must be provided for all motors equal to or greater than 22.4 kW (30 hp) in size.
- All motors greater than 22.4 kW (30 hp) shall be equipped with the following resistance temperature detectors (RTDs):
    - RTD connections for windings, one per phase
    - RTD for motor inboard and outboard bearings (where applicable)
    - RTD for pump inboard and outboard bearings (where applicable)
    - Vibration monitoring (where applicable)
- RTD modules and vibration sensors are to be connected to a protective relay installed in the starter panel and are to be used to provide alarms and warnings to SCADA.

- All motor protection relays must be provided network connectivity as per PAIDS requirement for additional monitoring through the SCADA system.
- All motors less than 22.4 kW (30 hp) shall be provided with thermistors tied to the motor starter for protection.
- All submersible motors, regardless of size, shall be equipped with built-in thermal and moisture/leakage sensors tied to trip the circuit and alarm.
- All dry pit pump motors shall be equipped with built-in vibration sensors.
- All motors shall be factory-tested in accordance with NEMA MG-1 and applicable Institute of Electrical and Electronics Engineers (IEEE) Standards.
- All motors shall be rated for continuous operation.
- Provide adequate cooling for all motors.

14.10. Electrical Panel

- All electrical control equipment must be located outside of process, chemical, or other hazardous areas whenever possible. The electrical design should reduce the operator risk of arc flash hazards by reducing or eliminating the need to be near high voltage electrical equipment during normal operations. Cabinets and panels can be sized to permit safe maintenance work.
- Mount all electrical panels outside confined spaces and classified area.
- Any valve actuators located in confined space should be provided with local control panel (LCP) integrated to MCC or located in electrical room.
- All free-standing electrical panels installed indoors or outdoors shall be mounted on designated concrete equipment pads.
- Panels are to be installed indoors where possible. Where outdoor panels cannot be avoided, the following design features are to be included:
    - NEMA 4X Stainless Steel Enclosure. Enclosures to be lockable and incorporate a continuous piano hinge.
    - NEMA 4X rated breather drain appropriate to the size of the enclosure. Breather drain is to be located at a location where water ingress and condensate can be drained.
    - Enclosure heater for freeze protection. Heaters shall maintain an inside temperature above 4^{o}C based on a outside ambient temperature of -30^{o}C.
    - Where panels contain sensitive equipment (PLC's, electronics, microprocessor-based equipment) and heat generating equipment (Variable Frequency Drives) air conditioning units shall be incorporated into the design. Air conditioning units shall

be sized to ensure inside temperature does not exceed 25°C based on an outdoor ambient temperature of 35°C.

- LED lighting within panel activated by door switch.

- Each electrical panel is to have a typed directory listing loads on respective circuits.
- Panel boards are to be provided with transient voltage surge suppression.

14.11. Equipment and Wiring Requirements

- TECK cables are to be used in lieu of rigid steel conduit in hazardous locations.
- The design of lightning protection is to be reviewed and considered based on the site location.
- Lightning arresters are to be provided at the 600-volt terminals at the service entrance transformation.
- A secondary surge protection device (SPD) is to be provided at the point of service entrance to the facility.
- All electrical equipment must be identified with clear lamacoid nameplates that are adequately fastened to the exterior of the panels regardless of the voltage level. Equipment or equipment panel lamacoid must clearly identify the name, tag ID, description, as well as voltage and power source.
- All electrical wiring must be clearly identified with permanent identifying markings at both ends. All work shall comply with the Ontario Electrical Safety Code (OESC).
- Equipment control wiring must follow PAIDS requirements; refer to **PAIDS Section E – Instrumentation & Control Design** for addition details.
- Provide clear guidelines within the design package for power wires/cable labels.
- Provide labels for all power and TECK cables; labels must identify the source and destination of cables.
- Low-voltage indoor distribution transformers shall be located outside of process areas where possible. Where transformers must be located in process areas, they shall have a NEMA rating suitable for the environment in which they are installed Transformers shall be of drip-proof design regardless of the location. Mount transformers up to 75kVA on wall where possible.
- Provide expansion joints in conduits entering buildings and at building expansion joints.
- Duct banks to enter buildings above grade where possible to avoid water infiltration into buildings. To minimize the potential water infiltration when below grade penetrations are necessary, ducts should be sloped away from the building and sealing provided at both ends. Where possible, a continuous run of duct with no joints should be used. Design should

consider the use of an open-bottomed manhole or hand hole with gravel bedding for water filtration.

- Receptacles installed outdoors shall have switches installed within the station to control power to the outlet.

14.12. Grounding

- Grounding design to consist of 3m long copper ground electrodes installed exterior to the station. Quantity of ground electrodes is to be determined by designer on a per project basis. Where soil conditions may not permit the use of copper ground rods, grounding plates may be considered.
- Include ground electrode inspection boxes at select locations to allow for inspection and testing of grounding. Exact quantity and location of inspection boses to be determined by the designer.
- Ground conductors shall be of stranded-copper construction.
- Ground conductors in corrosive environments are to be insulated or bare tinned copper where in contact with aluminum or corrosive material, soil or atmosphere.
- Conduit sleeves are to be used where ground conductors penetrate masonry walls, floors, foundations and similar locations. Seal sleeves installed in walls or floors below grade are to be watertight after installation of ground conductor.
- Provide a dedicated (separately derived) grounding system for outdoor generators where possible.
- Coordinate “customer” grounding requirements for Utility supplied transformers with the local hydro utility and incorporate into the station design.
- Provide an isolated ground system for instrumentation and PLC control panels.

14.13. Lighting

- Conduct a photometric assessment to confirm the necessary number of light fixtures and optimum locations for design.
- All lighting for indoor and outdoor applications shall be LED. Avoid locating light fixtures on high ceilings or in areas that may be difficult to access for maintenance purposes. Consider wall-mounted LED lights in these locations.
- Emergency lighting shall also be provided for all buildings.

- Provide exterior photocell control lighting for illuminating entrance doors. There shall be zero spill of light beyond the property line. A manual light switch, bypassing automatic operation to offer manual ON and OFF control, is to be provided within the control building.
- Provide lighting in all wet wells. Lighting in each wet well is to be controlled via a dedicated switch located inside the station. Wet well light shall also turn on the corresponding wet well fan.
- Provide flood lighting at wet wells and valve chambers controlled by a manual switch; the status of these flood lights is to be monitored by SCADA.
- Provide permanent interior lighting for all Type II, III, and IV valve chambers.
- Ensure all lighting is easily accessible for maintenance without needing ladder access.

14.14. Installations at Valve Chambers and Wet Wells

- Junction boxes equipped with terminal strips are to be installed on the exterior of the wet well to facilitate changes of the electrical equipment in hazardous locations. See Standard drawings in **Appendix D** for the location of electrical EYS Seals.
- Wet well entry fans are to be controlled by the lighting switch.
- Provide a GFIC weatherproof receptacle adjacent to the wet well and valve chamber; each receptacle must be fed from dedicated 20A circuits.
- Welding receptacles are to be included based on project requirements and needs. Provide locks on receptables and junction boxes in the field as required.
- All electrical equipment installed in area’s subject to be submergence are to be properly rated; electrical actuators installed in valve chambers are to be IP68 rated.

14.15. Access Control System

- Site security/access in each station must be managed by a dedicated Access Control System which is connected to a server offsite for monitoring and administration. The system consists of card readers, electric strikes, and door position contacts. These components are connected to local door controllers. The door controllers are housed in small control panels labelled SPS-SEC-4XX, where XX is the site number. All exterior doors and hatch position contacts are connected to this system. The SCADA system monitors an intrusion alarm state from each access control panel.
- Security system design is to be done per the Region’s Access Control System Design Guidelines.

- The security system is to be provided with network connectivity to the SCADA system network.
- The security system panel must be powered by a UPS located in the PLC panel.
- Wiring from any door or hatch switches located in the classified area must go through an ISR panel dedicated to the security system and labelled as SPS-ISR-XXX prior to entering the security panel. Use one common ISR panel for all items related to the security system.

14.16. Closed-Circuit Television Cameras

- Type III and IV stations should be equipped with exterior closed-circuit television (CCTV) cameras mounted at strategic locations and connected to the Region's CCTV network.
- All cameras should be IP cameras and power over ethernet (POE) powered.
- On site CCTV servers with proper storage capacity, POE switches, and data storage are to be designed as needed.
- CCTV cameras should be equipped with day/night vision and resolution as needed to capture faces or licence plates.

14.17. Fire Alarm System

- When required by the OBC (see **OBC Section 3.2.4.1. Determination of Requirement for a Fire Alarm System**), provide addressable heat and smoke detectors monitored by a vendor-specific fire alarm system.
- The fire alarm system should provide fire alarm, system trouble, and supervisory alarm relays wired to SCADA. The fire alarm system must also be monitored by an authorized monitoring facility.
- When the fire alarms are installed, provide a dedicated phone line and 3G cellular modem for remote monitoring of the fire alarm system.

15. Instrumentation and Control

15.1. Instruments and Devices

- Review process operating conditions to determine the most suitable instrument technology. All instruments should be installed in locations that are safe for workers and easily accessible. Instruments shall be suitable for their intended service, easily serviceable, and calibrated.
- Field instrument enclosures/transmitters shall be rated in accordance with the area classification. Locate instrument displays and transmitters in accessible locations and away

from confined spaces or other hazardous locations. Avoid installing instruments in hazardous areas when non-hazardous alternative locations are available.

- Instrument transmitters are preferably mounted indoors and within proximity of the sensing elements when possible. When required, any instruments mounted outdoors shall be in NEMA 4X enclosures and should be suitable for operating temperatures of minus 40°C to plus 50°C. Provide a heater complete with thermostat and sunshields where required.
- Factory made sensor cables must be used between the sensor and the transmitter. Sensor cables are to run continuously from the sensor to the transmitter without any splice unless the sensor provides 4-20 mA with HART directly to SCADA (with no transmitter). In this case, splicing is allowed through a junction box mounted close to the sensor. DIN rail-mounted terminal blocks must be used for splicing the cables.
- For all instruments installed in classified areas, provide intrinsically safe relays (ISR) or intrinsically safe barriers, unless it is included as part of the transmitter. ISRs are to be mounted in a dedicated enclosure.
- All instruments and equipment installed in valve chamber are to be IP68 rated.
- All instruments are to be grounded properly using an isolated ground system.
- For any outdoor mounted device such as a receptacle, junction box, or equipment, consider using lockable enclosures based on station location.
- Refer to **PAIDS Section E – Instrumentation & Control Design** for additional details on instrumentation design, mounting, installations, and connections to process lines and the instrumentation lamacoid label.
- Refer to **PAIDs Section A - Design Reference and Tagging** for the instrumentation and device tagging requirement.
- Typical instruments in the sewage pumping stations area are as follows:

Table 4: Typical Instruments in Sewage Pumping Stations

Instrument Type	Application	Detail
Level Transmitter	• Only ultrasonic and radar are acceptable • Wet well level • Emergency and maintenance storage level monitoring • Diesel fuel tank level monitoring	Refer to Wet Well Level Schematic Refer to Typical SPS P&IDs (**see Appendix D**)
Float	• Flood/high level monitoring • Pump backup control • Overflow monitoring (to emergency storage or environment)	Refer to Typical SPS P&IDs (**see Appendix D**)
Smoke and CO/Heat Detectors	• Building condition monitoring	All buildings must have combination smoke/CO detector in applicable areas
Temperature Transmitter	• Building and PLC panel temperature monitoring	Refer to Typical SPS P&IDs (**see Appendix D**)
Flow	• Forcemain flow monitoring • Station inlet flow monitoring • Overflow monitoring	Refer to Typical SPS P&IDs (**see Appendix D**)
Pressure Transmitter	• Forcemain pressure monitoring • Pump discharge pressure for Type II and III stations • Pump discharge and suction pressure monitoring for Type IV stations • Incoming natural gas line pressure	Refer to Typical SPS P&IDs (**see Appendix C**)

Instrument Type	Application	Detail
Hazardous Gas Detection Sensors	• Dry wells, Type III valve chambers, and building rooms that are connected atmospherically to a classified space.	Refer to Standard Drawings (**see Appendix D**)

15.2. Gas Detection System

- Permanent gas detection systems shall be provided for all dry wells, Type III valve chambers, and building rooms that are connected atmospherically to a classified space (i.e., not adequately sealed gas tight).
- Do not install permanent gas detection systems in wet wells, maintenance holes, emergency and maintenance storage structures, Type I and II valve chambers or forcemain chambers. Portable gas detection systems will be used by operation staff when entering these spaces.
- Permanently installed combustible gas detection systems shall be considered when there is a risk of exposure to biological and chemical agent gases within normal buildings and working areas.
- Install combustible gas and H_2S gas sensors when open liquid surface connects to a building interior.
- The design of combustible gas detection systems is to follow the requirements stipulated in OESC and NFPA 820.
- Install carbon monoxide sensors when fuel burning devices (diesel generators) are installed indoors.
- Methane gas sensors should be installed in the case of a natural gas generator.
- Other chemical gas detectors should be considered based on chemical handling and storage in each facility.
- Quantity and location of sensors shall be designed to properly detect the presence of any hazardous gas in the building and adhere to the manufacturer installation instructions.
- Install horn and strobe system for visual and audible warning inside and outside of area exposed to gas rated for the area. For stations located in residential area consider using dual light warning instead of a horn outside the station building.
- A dedicated gas detection panel with a horn and silence button shall be provided.
- All gas sensors are to be wired to the gas detection panel; gas alarm and general fault of gas detection panel are to be wired to the SCADA system.

- The gas detection panel should provide a gas alarm and general fault to the PLC control panel for monitoring purposes; gas detection panel must also provide additional relays to be wired to the HVAC controller.
- Gas detection panels must be powered from the UPS and should power all the sensors.
- Combination carbon monoxide/smoke detectors separate from the gas detection system are required for buildings to alert operations personnel of hazardous conditions.
- When gas detection systems are installed, provide audible and visual warning as required; avoid installation of audible horns in outdoor areas. Alternatively use dual light warning for entrance to areas that are not constantly occupied.

15.3. Control System

15.3.1. General

- Refer to **PAIDS** for detailed information on control system requirements on device and wire tagging, software and instrumentation and control design and commissioning procedures, and contract submission requirements.
- Each station is to be provided with a PLC control panel equipped with a panel mounted HMI computer as a centralized control point to monitor and control all process and non-process parameters for the facility. Under normal operating conditions, all PLC controlled devices shall be operated in “remote-computer” mode using the control logic of the SCADA system.
- PLC controlled devices are to be equipped with LCPs to allow control of the operation locally by operators. Incorporate hardwired and software interlocks as required by the process to ensure redundancy of operation and safety of personnel and equipment.
- Any personnel or equipment safety interlocks must be protected by means of hardwired interlocks, which will interrupt the operation of the equipment until the condition is reset in the field.
- All equipment and control system wiring are to be done in the fail-safe mode to protect equipment and personnel in case of wire breaks.
- Each control panel shall be provided with two separate grounds, one would be the isolated ground for instrument grounding (i.e. 4-20 mA cable shields etc.) and one for control circuit grounding (i.e. case grounds, control circuits, etc.). Keep two grounds isolated (separate).
- For details of PLC panel requirements, refer to **PAIDS Section E – Instrumentation & Control Design**.

15.3.2. Local Control Panels

- All PLC controlled devices are to be provided with Local/Off/Remote selector switches unless a bump-less mode transfer is required. Where the ability to switch the devices between local and remote in a bump-less fashion is required, Start/Stop Pushbuttons with a separate Local/Remote Selector (make before break type) shall be provided.
- LCP shall be in a dedicated electrical room for new construction whenever feasible. Local controls for pumps and major equipment are preferably part of the MCC lineup. Each LCP should be connected to the SCADA system for monitoring and remote control. Develop detailed loop drawings for all signals to and from each LCP to the central PLC as part of the tender package.
- Using any kind of PLC, microprocessor or smart relay in local control panels is prohibited. Local control of devices should not rely on any PLC or programmable device.
- For valve actuators, see **Section 9.7**.
- Vendor equipment local control panels are to comply with PAIDS requirements; using smart replays or PLCs is not allowed.
- All LCP are to be provided with a PAIDS compliant label.
- Refer to **PAIDS Section E – Instrumentation & Control Design** for additional requirements of LCP, including but not limited to various pilot lights and selector switch requirements as well as colour scheme.

15.4. Network and Communications

15.4.1. General

- The Region Water/Wastewater SCADA system utilizes WAN fibre ring (PSN) as the main network media; stations are to be connected to the overall network through fibre when possible; when running fibre is not feasible, cellular network connection is to be used to provide connectivity to the overall network. To provide redundancy on the cellular network, two different carriers, Rogers and Bell, are to be utilized in each location.
- In case of using WAN fibre for network connectivity, a dedicated WAN enclosure equipped with a UPS is to be designed for housing WAN network hardware. A connection from the WAN switch will be provided to the SCADA network switch.
- Install communication control panel(s) (CCP) to house SCADA network components based on the facility size, number of SCADA network connections and the physical distribution of

various nodes. In small-sized facilities with a limited number of network connections, SCADA network equipment can be mounted inside the PLC control panel.

- When more than one CCP is installed in a facility, the interconnection between CCPs is to be based on fibre. Refer to **PAIDS Section D – IT** for details of network system requirements such as standard CCP details, cable and equipment labelling, and the various tests and certification required.
- Provide internal cell phone boosting to support working alone devices such that all areas of the facility have adequate cellular connection. Particular attention should be given to dry well and valve chambers.

15.4.2. Equipment Network Connectivity

- The following table provides a list of equipment in a typical sewage pumping station that would require network connectivity:

Table 5: Equipment List in Typical SPS Requiring Network Connectivity

Device	Network Connection	Protocol
Power Monitor	Ethernet to SCADA network	Refer to **PAIDS** for details
VFD	Ethernet to SCADA network	
Soft Starter	Ethernet to SCADA network	
Overload Relay	Ethernet to SCADA network	
Motor Protection Relay	Ethernet to SCADA network	Refer to **PAIDS** for details
Security System	Ethernet to SCADA network	
UPS	Ethernet to SCADA network	Refer to **PAIDS** for details
PLC	Ethernet to SCADA network	
Local HMI	Ethernet to SCADA network	
Generator Control Panel	Ethernet to SCADA network	

16. Requirements for Stormwater Pumping Stations

16.1. General

- Stormwater pumping stations maybe required for grade separations, multi-use pathways or flood prevention where no gravity drainage outlet can be provided.
- The requirements outlined in the the Region of Peel Public Works Stormwater Design Criteria and Procedural Manual (latest version) shall be followed.
- Refer to MECP - Stormwater Management Planning and Design Manual.
- Stormwater pumping stations shall generally follow the Design Standards for Sewage Pumping Stations except as specified in this section.

16.2. Design Criteria

- A public notification and road closure system is required to alert pedestrians/vehicles that the pathway is closed during high storm events.
- Provide a depth gauge along roadway in both directions.
- Ponding diagrams should be prepared to show the depth and area for the full range of storm events (2, 5, 10, 25, 50 and 100 year). This is required to establish and quantify the adverse impacts when the pumping station is inoperative, which may occur during a power outage or mechanical equipment failure.
- Overland flow route must be clearly identified including the ultimate outlet of the overland flow route (i.e. watercourse or roadway).
- A suitable factor of safety should be built into the design of the stormwater pumping station and associated storage facility, depending on the risk and the criticality of the surrounding infrastructure and services (for example, hospitals, fire stations, emergency vehicle route, schools and so on).
- Private property shall not be flooded under the 100-year storm.

16.3. Location

- Driveway access must be 300mm above 100-year flood elevation to control building, generator and wet well.
- The siting of the stormwater pumping station should ensure the structure and equipment is protected from damage caused by the 100-year flood event, with the station remaining fully operational and accessible during the 100-year storm event.
- The location of the station should consider future maintenance.

- Access hatches should be large enough to permit equipment entry and located away from any overpass structure.
- The station itself should not be located on the travelled portion of the municipal right-of-way.
- The station shall be accessible to maintenance vehicles that may need to be parked next to the wet well, MHs and valve chambers and provide enough room for setting up mechanical hoists.

16.4. Stormwater Quality

- Provide bar screens on the wet well inlet to protect pumps from large debris. Allow for overflowing of the bar screen in the event the bar screen is clogged while maintain peak flow capacity into the wet well.
- For large stormwater facilities, a grit chamber suitable for the collection of debris and sediments may be incorporated in the design. The tank must include a flushing system to remove accumulated sediments on the floor of the tank after a tank dewatering event. A tipping bucket assembly which utilizes recycled stormwater is preferred. Other flushing system options, including those which require a potable water supply line to fill the tipping buckets, complete with remote control, can also be considered as approved by Peel.
- For pumping stations servicing a public right-of-way, a pre-treatment Manufactured Treatment Device (MTD) unit shall be installed for the removal of TSS from stormwater runoff upstream of the facility (e.g., oil grit separator or filter device).

16.5. Capacity

16.5.1. Rated Capacity

- Design to the greater of the following:
- 10-year storm with no barrier curb overtopping and at least one lane free of water in each direction.
- If downstream sewer has sufficient capacity, design to 100-year storm with maximum road flooding of 0.3m.
- The designer shall determine the station capacity by optimizing the number and capacity of the duty pumps together with the sizing of the storage/detention tank volume.

16.5.2. Pumps

- Pumps shall be self-priming wet well submersible unless otherwise approved by Peel.

- Jockey Pump – at least one sized for typical wet weather flows.
- Duty Pumps – one or more pumps together meeting the rated capacity without use of small jockey pump or standby pump.
- Single Large Standby Pump (i.e. equivalent size to the largest Duty pump).
- Minimum hard solid throughlet for duty/standby pumps shall be 50mm. This requirement, however, does not need to apply to the jockey pump.

16.5.3. Storage and Detection

- Storage/detection can be used to reduce the size of the pumping station while maintaining the required level service.
- Minimum storage/detection tank size shall be 1.0 hr at rated capacity which includes the wet well, storm sewers, inlet MHs and catch basins up to 0.3m freeboard below the lowest roadway inlet.

16.6. Additional Requirements

- Pumps remain idle for extended periods of time. How to test and cycle pumps?
- Pumping station inlets shall be designed assuming the capacity has been reduced by 50 per cent as a result of blockage associated with debris.
- Passive ventilation is preferred over mechanical ventilation.
- Wet well classification: Class I, Zone 2.
- Dry well classification: Class I, Zone 2.
- Odour control equipment is not required.
- Wet well mixing is not required.
- Inlet flow metering is not required.
- If practically feasible, provide gravity overflow.
- Structures shall be design watertight.
- Valves in separate valve chamber (not wet well).
- Forcemain bypass shall only be provided on long forcemains at the discretion of Peel.
- For short forcemains, provide a dedicated forcemain per pump at the discretion of Peel.

Appendix A: Definitions and Abbreviations

The following are definitions for terms and abbreviations used throughout this document.

Term	Definition
ACI	American Concrete Institute
ANSI	American National Standards Institute
AODA	Accessibility for Ontarians with Disabilities Act
AOR	Allowable Operation Range
APL	Approved Products List
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATS	Automatic Transfer Switch
AWWA	American Water Works Association
BAS	Building Automation System
BEP	Best Efficiency Point
BOM	Bill of Material
CCP	Communication Control Panel
CCTV	Closed-circuit Television
CFD	Computational Fluid Dynamics
CGSB	Canadian General Standards Board
CSA	Canadian Standards Association
CSI	Construction Specifications Institute
CT	Current Transformer
Controlled Space	A fully or partially enclosed space, that is not both designed and constructed for continuous human occupancy and does not have atmospheric hazard potential based on its construction, location, or contents. A controlled space could become a confined space if an

Term	Definition
	atmospheric hazard is introduced because of the nature of the work being performed or other changes to the space.
DC	Direct-current
Designed and Constructed for Continuous Human Occupancy	A space that was designed and constructed in accordance with recognized codes and standards that contain provisions to make the space suitable for humans to occupy, such as provisions for structural adequacy, accessibility, entry and exit, adequate lighting and most importantly fresh air ventilation such that a human could continually occupy that space.
ECA	Environmental Compliance Approval
EEMAC	Electrical and Electronic Manufacturers Association of Canada
ESA	Electrical Safety Authority
EYS	Electrical Y Seal
FRP	Fibreglass Reinforced Plastic
HI	Hydraulic Institute
HMI	Human Machine Interface
HVAC	Heating, Ventilation, and Air Conditioning
I&I	Inflow & Infiltration
ICP	Instrument Control Panel
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IR	Incorporate Infrared
ISEA	International Safety Equipment Association
ISO	International Organization for Standardization
ISR	Intrinsically Safe Relays
LCC	Life Cycle Cost/Costing
LCP	Local Control Panel
LED	Light-emitting Diode
LID	Low Impact Development

Term	Definition
MCC	Motor Control Centre
MECP	Ministry of the Environment, Conservation and Parks
NBC	National Building Code
NEMA	National Electrical Manufacturers Association
NPSH	Net Positive Suction Head
NFPA	National Fire Protection Association
NSF	National Sanitation Foundation
OBC	Ontario Building Code
OESC	Ontario Electrical Safety Code
OHSA	Ontario Occupational Health and Safety Act
OPSS	Ontario Provincial Standards Specifications
OPSD	Ontario Provincial Standards Drawings
P&ID	Piping and Instrument Diagram
PAIDS	Process Automation and Instrumentation Design Standards
PCN	Process Control Narrative
PEO	Professional Engineers of Ontario
PLC	Programmable Logic Controller
POE	Power Over Ethernet
POR	Preferred Operating Range
Proponent	User of these design standards i.e., consulting engineer, contractor, developer
PT	Potential Transformer
Region	The Regional Municipality of Peel
RPZ	Reduced Pressure Zone
RTD	Resistance Temperature Detectors
SCADA	Supervisory Control and Data Acquisition
SOPs	Standard Operating Procedures

Term	Definition
SPD	Surge Protection Device
TSSA	Technical Standards and Safety Authority
UPS	Uninterruptible Power Supply
VFD	Variable Frequency Drive
SPS	Sewage Pumping Station
WAN	Wide Area Network
WWTP	Wastewater Treatment Plant

Appendix B: Design Checklist, Conformance Acknowledgement Form and Truck Lifting Chart

1. Design Standards Checklist
2. Conformance Acknowledgement Form
3. Region of Peel Boom Truck Lifting Chart

Region of Peel
Sewage Pumping Station Design Standards - Checklist

Facility Name: _____
Project Title: _____
Project Number: _____
Prime Consultant: _____
Design Milestone: _____

Does the design comply with the Region's Sewage Pumping Station Standards within each of the following design disciplines?		Yes/No	Deviation Requested (submit PIPM forms)	Not Applicable
5.0	**Sewage Pumping Station Design Summary**			
5.01	The rated capacity of the station shall be equal to or greater than the anticipated peak instantaneous flow to the station including the response of a five-year storm without the use of standby pumps			
5.02	Station is equipped with permanent on-site standby power generator			
5.03	Number of pumps meet station type			
5.04	Number of wet well cells meet station type			
5.05	Valve chamber configuration meets station type			
5.06	Number of forcemains meet station type			
6.0	**Site Considerations**			
6.1.1.	Permanent structures are all located on Peel owned lands			
6.1.1.	Required setback distances are met			
6.1.2.	Security fencing around site with lockable gates			
6.1.3.	Asphalt access laneway accommodates necessary maintenance vehicles, parking and is above the 100 year flood elevation			
6.1.3.	Adequate snow storage and snow clearing areas are provided			
6.1.3.	Protective bollards are provided where required			
6.1.4.	Yard lighting meets electrical requirements			
6.1.5.	Enough space is available for future expansion needs			
6.2.	All pressure pipe 100mm and larger outside of structures can accommodate potential differential settlement			
6.2.	All buried pressure pipe joints are designed for thrust restraint without use of concrete			
6.2.	Yard piping has adequate earth cover			
6.2.	Tracer wires are provided			
6.2.	Type 316 stainless steel bolts and nuts for all fittings and joint restraints for direct buried installations			
6.2.	All ferrous materials associated with buried infrastructure including pipe fittings, valves and couplings shall be protected with three-part corrosion protection primer/paste, mastic, and petroleum tape			
6.2.	Yard piping design complies with Peel Linear Standards			
6.3.	Pumping station entrance floor level and all access hatches are at least 300mm above Regional flood line and 100-year flood elevation, whichever is higher			
6.3.	The design of grading and stormwater management allows full site access by vehicular traffic during the 25-year flood event			
6.3.	Positive drainage away from all structures with a minimum slope of 2%			
6.3.	TRCA or CVC low impact development guidelines are followed			
6.4.	Landscaping complements the surrounding environment and require minimum maintenance and watering			
6.4.	Trees, and their maximum growth canopy, are not located above buried infrastructure, chambers, buildings, or driveways			
6.4.	Maximum slope for grass areas is 3:1			
7.0	**Buildings**			
7.1.	Building classified as OBC Group F, Division 3, except for fuel storage which is Group F, Division 1.			
7.1.	Buildings designed as Post Disaster			
7.1.	All buildings designed in compliance with OBC, National Building Code (NBC) and Canadian Standards Association (CSA) design standards for concrete, masonry blocks and steel			
7.1.	All wet wells, maintenance holes, emergency and maintenance storage structures, and forcemain outlet structures are electrically classified at Class 1, Zone 1 (Division 1) environments			
7.1.	Dry wells and valve chambers are electrically classified as Class 1, Zone 2 (Division 2) environments			

Region of Peel
Sewage Pumping Station Design Standards - Checklist

Facility Name: _____
Project Title: _____
Project Number: _____
Prime Consultant: _____
Design Milestone: _____

Does the design comply with the Region's Sewage Pumping Station Standards within each of the following design disciplines?		Yes/No	Deviation Requested (submit PIPM forms)	Not Applicable
7.1.	Type IV dry wells and Type III valve chambers are designed for continuous human occupancy. At least two means of access/egress to these spaces are provided. Main access is by stairs and secondary access/egress via ladder.			
7.2.	Building exterior materials and finishes are designed maintenance free			
7.2.	Building is insulated and complete with vapour barriers			
7.2.	Buidlings use steel reinforced concrete masonry block wall systems or combined with face brick systems or pre-cast insulated concrete wall panels. Exposed wood or gypsum boards are not permitted on any interior walls or ceiling finishes.			
7.2.	Interior walls have waterproof antimicrobial painted finish			
7.2.	All exterior wall surfaces including entrance doors and louvers have anti-graffiti clear coat			
7.2.	All floors have slip-resistant surface			
7.3.	Facility sign near the front door and main gate is provided			
7.3.	"No Trespassing" warning signs are posted every 15 meters along the fence line			
7.3.	Surveillance monitoring warning signage is posted			
7.3.	Laminated full-size drawing depicting the overall process flow diagram of the facility installed near desk. A second laminated full-size drawing showing electrical single line layout of the facility is also provided.			
7.3.	Fire plan mounted to interior walls at all doors			
7.3.	Building exit signage provided			
7.3.	All appropriate signs are provided identifying anticipated hazards including, but not limited to, chemicals, noise, arc flash, confined spaces, non-potable water, pinch points, rotating equipment, heat, fall hazards, fire extinguisher location, and test label. Safety signage shall follow ANSI/NEMA Z535 and WHMIS requirements			
7.4.	Sufficient separation is provided between water service plumbing fixtures and appurtenances and electrical equipment such as MCC and control panels			
7.4.	For Type II, III, and IV stations, interior generators are located in a separate room from electrical and control equipment			
7.4.	A desk, chair, and storage unit for documents are provided within the building for use by operation staff			
7.5.	Metal shingle roofing systems for minimum 50-year life span			
7.5.	All roofs are pitched design and designed to drain rainwater away from the entrance, flat roofs are not permitted			
7.5.	Roof equipped with snow guards			
7.5.	Roof trusses are either open web steel joists or wooden roof truss with a metal deck or pre-cast hollow core concrete to finish the ceiling			
7.5.	Personnel access and passive ventilation for building attic space			
7.5.	Eavestroughs and downspouts discharge to a vegetated surface complete with concrete splash guard. Discharges prevent icing of commonly utilized walking or driving areas			
7.6.	All doors are hollow metal with stainless steel hardware and equipped with a touch-bar panic exit device, three sets of heavy-duty hinges, heavy-duty closer mechanism, non-slam closures, dampeners, head and jamb seals, and a kick plate			
7.6.	All doors meet minimum width of 914mm			
7.6.	Exterior doors insulated and equipped with a door sweep and threshold			
7.6.	Exterior double doors with permanent wiring have quick wiring disconnects			
7.6.	Roll-up doors electrically powered with personnel entry door provided nearby			
7.6.	Interior doors equipped with a window panel			
7.6.	Interior doors leading to generator room insulated for noise attenuation			
7.6.	Doors are large enough to remove the largest piece of equipment in each room			
8.0	**Structures**			
8.1.	Structures can withstand full hydrostatic and buoyancy uplift forces			
8.1.	Structures are insulated and protected to below frost level complete with waterproofing			

Region of Peel
Sewage Pumping Station Design Standards - Checklist

Facility Name: _____
Project Title: _____
Project Number: _____
Prime Consultant: _____
Design Milestone: _____

Does the design comply with the Region's Sewage Pumping Station Standards within each of the following design disciplines?		Yes/No	Deviation Requested (submit PIPM forms)	Not Applicable
8.1.	Buried structures are designed as water retaining structures with zero leakage and meet the intent of Standard Drawings for New Construction Maintenance Holes			
8.1.	Structures vulnerable to flooding or within overland flow route have watertight maintenance hole lids			
8.1.	Pressure pipe penetrations through walls cast-in-place and designed for full thrust restraint			
8.2.	Cast-in-place walls have controlled permeability formwork liners on inside and outside wall surfaces			
8.2.	All form ties equipped with waterstops			
8.2.	All cast-in-place movement joints and construction joints have ribbed type PVC waterstop with centre bulb			
8.2.	No cast-in-place conduits in roof slab or walls			
8.3.1.	Pre-engineered pump station package includes the submersible pumps, discharge elbows, Type 316 stainless steel guide rails, lifting system, fiberglass wet well, internal stainless steel piping, platforms, ladders, railings, ventilation pipes, machined inlet and outlet nozzles including conduit penetrations, lifting lugs/trunnion, access hatches, and anchor brackets for instruments.			
8.3.1.	FRP wet well basins, cylinder, and roof are UV and corrosion resistant			
8.3.1.	FRP wet wells only used for Type I stations			
8.3.2.	Pre-cast concrete wet wells and valve chambers only used for Type I and II stations			
8.3.2.	Pre-cast joints fully watertight with zero leakage			
8.4.	Wet wells, inlet maintenance holes, inlet grinder chambers, and forcemain outlet structures have a corrosion protective coating applied to all interior concrete surfaces			
8.5.	Hatches' hinged covers are slip resistant checker plate lid designed to support a minimum live load of 14.4 KN/m2 with a maximum deflection of 1/180 of the span			
8.5.	Hatches are aluminium equipped with sealing gasket, self-draining channel frame, a stainless steel engraved tag with load rating, removable guardrail system, hold-open arm, lifting assists, custom signage indicating purpose, and a minimum of Type 316 stainless steel hardware			
8.5.	Hatches equipped with secondary fall protection grating with minimum 75mm x 75mm mesh spacing, retractable lifting handle and rated for minimum live load of 14.4 KN/m2			
8.5.	Hatches equipped with nearby travel restraint anchor capable of supporting a static force of at least 4.0 kN and include a stainless steel tag with the words “Travel Restraint Anchor, 4.0 kN Capacity”			
8.5.	Hatch lock ports recessed, have drain and oversized to accommodate padlock or electronic key locks with no protrusions above the hatch surface			
8.5.	Interior hatches flush with the finished floor surface			
8.5.	Exterior hatches flush within a concrete slab that's raised 450mm above finished grade			
8.5.	Exterior hatch covers insulated with secondary locking mechanism			
8.5.	Personnel access hatches equipped with personnel davit base and fixed stainless steel grab bar designed to OBC loading			
8.5.	Davit sleeves have a vertical load capacity of 22.2 kN and a single user capacity of 205 kg with a minimum 4:1 safety factor			
8.5.	Removable guardrail system large enough to surround entire hatch opening complete with lockable swing gate is provided in the building			
8.6.	All platforms, ladders, grating, and railings exposed to open sewage environments constructed with FRP material complete with specialized corrosion resin			
8.6.	Platforms can sustain the live load required for building egress, or minimum of 4.8 KN/m2 uniformly distributed or a concentrated load of 13.5 kN, whichever is greater.			
8.6.	Platforms or supporting beams have maximum deflection of 1/360 of span or 6 mm			
8.6.	Railings, guardrails, and handrails designed to resist the OBC maximum loading conditions with a minimum of four anchors per railing post base plate and a top rail deflection not exceeding 3 mm			
8.6.	Stairs, ladders, and grating have non-slip surfacing			
9.0	**Process**			
9.1.	All inlet sewer penetrations are perpendicular to the inlet maintenance hole and wet well			

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9.1.	Inlet sewer to the wet well is free of bar screens and obstructions			
9.2.	Type II, III and IV pumping stations have electrically driven influent grinders capable of handling the peak inlet flow			
9.2.	Grinders include an access hatch above and guide rail system			
9.2.	Grinders equipped with a Type 316L stainless steel lifting bail with a stainless steel lift out chain of sufficient length to clear the access hatch elevation by a minimum of 1.5 m			
9.2.	Grinder electric motors rated for 575V /3 ph / 60 hz power with a 1.15 service factor and explosion proof in accordance with the NFPA 820 and the Electrical Code			
9.2.	Grinder electric motors designed for full time in-air operation with periodic submergence up to 12m of head and rated NEMA 6P (IP68) CSA certified			
9.2.	Grinder local control panel located inside the building in a non-classified area is a relay-logic type, fully PAIDS compliant and CSA approved			
9.2.	Grinder local control panel includes a main circuit breaker with disconnect handle, full voltage reversing type starters, current sensor, timer counters, a transformer rated for 600/120 VAC, 250VA, pilot lights, pushbuttons, selector switches, and an E-Stop			
9.2.	Grinder local control panel enclosure is wall-mount with the proper NEMA rating			
9.3.	Wet well design addresses turbulence, pre-swirl into the pump, flow distribution at the pump intake, flow vortices, entrained air into pump suction, and sedimentation of solids			
9.3.	Wet well benching to limit solids build-up and be self-cleaning on manual pump down			
9.3.	Submersible wet well pumps have a long enough flow path between the sump entrance and the pump inlets for entrained air to escape to surface before reaching the pumps			
9.3.	Wet well design dissipates the energy of falling water to keep high and irregular velocities from occurring within the sump			
9.3.	Wet well sewage free fall does not exceed 1.05m from inlet sewer invert elevation to the Duty 1 Pump start elevation			
9.3.	Wet wells deeper than 5.0 m have permanent standpipe cleanout for vacuum cleaning			
9.3.	Wet wells have a ladder that offers safe access directly to the wet well base			
9.3.	Wet wells have submersible propeller mixer connected to SCADA equipped with a stainless steel lifting bail able to accommodate a stainless steel lift out chain of sufficient length to clear the mixer access hatch elevation by a minimum of 1.0 m			
9.3.	Wet well access hatch above the channel frame and guide rail system suitable for installation and removal of the mixer			
9.3.	Wet wells in Type III and IV stations also equipped with recirculation line mixing. Wet well recirculation lines are designed to prevent pump run-out conditions when opened			
9.4.	Dry wells, including superstructures, are completely separated from wet wells, generator, and electrical rooms with common walls gas tight			
9.4.	Dry well emergency stops, local disconnects, junction boxes and start/stop push buttons are located above the maximum wet well surcharge elevation			
9.4.	Dry wells equipped with a duplex sump pump that discharges to a wet well inlet chamber, stair access and a ladder exit			
9.4.	Dry well designed for continuous human occupancy not classified as a confined space			
9.5.1.	Station capable of delivering the peak influent flow rate without use of standby pumps			
9.5.1.	Pump selection minimizes life cycle cost through high energy efficiency, low risk of clogging, maintenance considerations and replacement costs			
9.5.1.	Pump types and sizes accommodate the full range of anticipated flows including avoiding long fill times with potential for odour generation during low flow periods			
9.5.1.	Pump system operates within the pump's POR and are non-overloading under high and low static heads, and high and low C factors and meet MECP Design Guidelines			
9.5.1.	Pumps designed to achieve maximum efficiency under average day flow conditions but are capable of operation under maximum and minimum system-head curve conditions without overloading the motor or exiting the AOR of the pump			
9.5.1.	Pumps are fully submersible, non-clog sewage design, with suction and discharge openings a minimum of 100mm, stainless steel hardware, factory applied sewage resistant coating on body and CSA C22.2-108 approval as pump/motor assembly			

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9.5.1.	Pump manufacturer has an approved repair facility within a 2.0-hour drive			
9.5.1.	No suction lift, grinder or screw pumps			
9.5.1.	Pumping rates during average influent scenarios are balanced to promote energy efficiency, prevent forcemain fouling and minimize solid settlement in the wet well			
9.5.1.	Pump cycle working volume accommodates a maximum of six pump starts per hour			
9.5.1.	Pump start and stop setpoints are at minimum 0.5m apart			
9.5.1.	Pumps have NPSH margin (NPSH av > NPSH req) of at least 1.5 m under low wet well water levels, 100 C factor, maximum design flow rate, and 30°C water temperature			
9.5.2.	Wet well pump discharge elbow supplied by the pump manufacturer, protected with a high-performance epoxy coating and has a secure connection to base of wet well with minimum four stainless steel chemically bonded anchors with 100mm embedment			
9.5.2.	Wet well pump guide bar system has intermediate support at least every 3.0 m			
9.5.2.	Wet well pump cable support bracket/strain relief sheathing within reach of the hatch			
9.5.2.	Wet well pump access hatches have a minimum of 100mm clearance around the pump and have no obstructions, platforms or interferences between them and the pump			
9.5.3.	Dry well pumps rated fully submersible under continuous operation with an access port to manually clean and unclog without removing			
9.5.3.	Dry well pump motors cooled with a glycol cooling jacket			
9.5.3.	Dry well pump discharge has an air valve prior to the check valve with a vent line extending to the wet well above the emergency overflow level			
9.5.3.	Horizontal dry well pumps have a service sled with mechanical assist and winch to separate pump rotating assembling from the pump volute			
9.5.3.	Dry well pump supports have a concrete base, at least twice the mass of the pump and motor, that the pump is firmly anchored to			
9.5.3.	Dry well pumps have built-in vibration sensors			
9.5.3.	Dry well pump supports keep vibrations within pump manufacturer specified levels			
9.6.	Valves have adjacent fully restrained flexible dismantling coupling and spool piece			
9.6.	Valves have 316 stainless steel hardware including nuts, bolts, gear boxes and covers			
9.6.	Valve selections 450mm and larger reviewed with Peel operation staff			
9.6.	Slide gate valves used for influent maintenance hole and wet well isolation applications are capable of withstanding hydrostatic forces at the maximum water level with 40% of the allowable leakage specified in AWWA C561			
9.6.	Slide gate valves are stainless steel with the gear located above the normal water level, adjacent secondary stainless steel stop logs to facilitate isolation, and access above the valve and stop logs for removal and installation			
9.6.	Air release, air vacuum, or combination air valves are AWWA C512 fusion bonded epoxy inside and out			
9.6.	Air valve selection for Type III and IV stations confirmed by detailed transient analysis			
9.6.	Check valves are AWWA C508 fusion bonded epoxy coated inside and out, swing flex type, non-slam with rubber flapper and placed at an elevation no greater than 8.0 m above the discharge pump with stainless steel hardware and backflow actuator			
9.6.	Plug valves are AWWA C517 fusion bonded epoxy coated inside and out			
9.6.	Knife gate valves are AWWA C520 fully stainless steel			
9.6.	All forcemain valves installed within a chamber not direct buried			
9.6.	Chamber valves are flanged construction (not wafer or lug style)			
9.6.	Valves in maintenance holes, wet wells and exterior valve chambers are accessible for operation with a truck mounted motorized valve turner			
9.6.	Valves in confined spaces have watertight sealed valve boxes and can be operated from surface by combination hand wheel and extension stem			
9.6.	Valves in non-confined spaces are accessible for operation staff for manual operation from floor level or platform access without the use of chain wheel			
9.7.	Valves have motorized actuators if require automatic operation, require confined space entry to access, used on monthly basis or more frequently, 450mm or larger, or difficult to manually operate			
9.7.	Actuators equipped with integral local status indication including Open Status, Closed Status, intermediate travel status, and control mode status with feedback to SCADA			

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9.7.	Actuators within a confined space or at an elevation greater than 1500mm AFF have a remote-control station at an elevation of 1200mm AFF equipped with the same control functions and status indication as the actuator			
9.7.	Motorized actuators have specified opening and closing travel rate to minimize the risk of excessive transient pressures			
9.8.1.	Piping layout places valves, equipment, and instruments in locations accessible from floors or platforms with sufficient clearance to complete operation and maintenance			
9.8.1.	Process piping and isolation valves offer flexibility during failure or maintenance of any pipe segment or valve to replace while maintaining partial operation of the station			
9.8.1.	Process piping is minimum 100mm in size and pressure tested to a minimum of 1,034 kPa for two hours with zero visible leakage			
9.8.1.	Process piping and fittings designed and rated for the same maximum transient pressures, full vacuum, thrust restraint, and thermal expansion/contraction			
9.8.1.	Process piping equipped with a flange connection at a maximum distance of 300mm prior to all wall or floor penetrations			
9.8.1.	Process piping wall penetrations are cast-in-place with embedded thrust flange			
9.8.1.	Non-buried process piping and hardware are Type 316L stainless steel			
9.8.1.	Vertical pump discharge riser in wet well and dry pits designed for velocity between 1.5 and 2.5 m/s with adequate scouring to effectively mobilize heavy solids and grit			
9.8.1.	Pump suction lines are pressure rated, restrained, and pressure tested with the same			
9.8.1.	Bypass connections, minimum 200mm, allow for: pumping from the wet well through discharge header to a tanker truck, portable pumping from inlet bypass maintenance hole to the forcemain and forcemain access by condition assessment tools			
9.8.2.	Wet well piping brackets, supports, anchors and hardware are Type 316L stainless steel			
9.8.2.	Wet well piping grooved restrained pipe couplings are stainless steel			
9.8.2.	Wet well piping is no longer than 5.0 m without a coupling			
9.8.2.	Wet well piping, both suction and discharge, has no valves within the wet well			
9.8.3.	Dry well suction piping for Type IV stations equipped with inlet bell mouth			
9.8.3.	Dry well suction piping minimize friction losses, minimizes number of elbows, eliminates vapour from suction pipe and has automatic air venting after pump before check valve			
9.8.3.	Dry well suction elbows are smooth and long radius			
9.8.3.	Dry well suction piping has hand access clean-out ports			
9.8.3.	Suction pipe velocities meet Standards			
9.8.4.	Dry well piping has minimum of 50mm taps and ball valves before and after each pump			
9.8.4.	Wet well stations have minimum of 50mm tap and ball valves before check valves within the valve chamber			
9.8.4.	Dry wells and wet well valve chambers have drain valves to empty each segment of process piping			
9.8.4.	Forcemains have drain valves and drain piping			
9.8.5.	Piping independently supported by vertical and lateral supports			
9.8.5.	Valves are fully supported			
9.8.5.	Piping supports provided within one pipe diameter on either side of flexible joints			
9.9.1.	Equipment lifting devices clear equipment at least 300mm above the floor to allow for removal of all equipment from room and building			
9.9.1.	Pumps, grinders, and slide plates are removable and replaceable without personnel entering a confined space			
9.9.1.	Equipment lifting devices used are limited to boom truck, permanent crane with motorized hoist, permanent lifting davit with portable hoist, or temporary mobile crane			
9.9.1.	Permanent lifting equipment has stainless steel engraved tag listing rating capacity			
9.9.2.	Wet wells less than 10 m deep have stainless steel guide bars supported every 3.0 m, 1.0 m chain and guide cable from submersible pumps to upper bracket hold			
9.9.2.	Wet wells deeper than 10 m deep have custom lift systems			
9.10.	Process piping, valves, equipment, and forcemain pressure class selected to withstand worst-case transient surge pressures with all pumps (including standby) running			
9.10.	Transient control equipment used is limited to anti-slam check valves, surge relief valves, surge tanks and air valves			

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9.11.	Buried pressure pipe, pump laterals and forcemains comply with the Region's Linear Infrastructure – Forcemain Design Criteria			
9.11.	Forcemains designed to maintain minimum fluid velocity of 1.0 m/s			
9.11.	Forcemains installed at minimum burial depth of 1.8 m			
9.11.	Forcemain enters the receiving maintenance hole with a smooth flow transition to the gravity sewer system at a point not more than 0.3 m above the flow line			
9.11.	Forcemains designed to withstand full vacuum conditions			
9.11.	Buried pressure pipe has double flexible restrained couplings at all wall penetrations			
9.11.	Process pipe penetrations to buildings and structures is watertight with thrust restraint			
9.11.	Cement lined or metallic pipe has interior high-performance corrosion resistant coating wherever air could accumulate			
9.11.	Buried non-metallic piping tracer wires are 12-gauge TWU, 7-strand insulated copper wires with all spliced wire connections made with water-tight wire connectors			
9.11.	Tracer wires installed along the crown of the entire pipe length and terminated on the inside of valve chambers or the outside wall of the pumping station			
10.0	**Mechanical**			
10.1.1.	Passive ventilation systems present as minimum in all wet wells and wastewater storage structures that permits rising and falling liquid levels			
10.1.1.	Portable mechanical ventilation equipment is stored in the control building for Type I and II stations			
10.1.1.	Permanent mechanical ventilation equipment included for wet wells, dry wells, and valve chambers for Type III and Type IV stations			
10.1.1.	Ventilation system for process areas is designed in accordance with NFPA 820			
10.1.1.	Ventilation is not used to de-rate hazardous electrical area classifications			
10.1.1.	Ventilation system intakes located a sufficient distance from ventilation exhaust, chemical tank vents, generator exhaust, and other nearby sources of emissions considering the			
10.1.1.	Ventilation for occupiable spaces in accordance with the OBC and ANSI/ASHRAE 62.1			
10.1.2.	Space heating for an ambient temperature of 20°C provided for areas periodically occupied by operations staff, including Type IV dry wells, Type III valve chambers, generator rooms, and electrical/control rooms			
10.1.2.	Wet wells, Type I and II valve chambers, inlet maintenance holes, emergency and maintenance storage tanks are protected from freezing			
10.1.3.	Ventilation systems for process areas achieve a maximum building temperature of 5°C above outdoor temperature			
10.1.3.	Air conditioning for Type III and IV electrical and control rooms maintains a maximum temperature of 25°C accounting for the heat radiated from electrical equipment			
10.1.3.	Dehumidification of process areas was assessed for life-cycle-cost of controlling condensation and corrosion			
10.1.4	Air intake and exhaust dampers are insulated and equipped with stormproof vandal-resistant louvers and aluminium insect screens			
10.1.5.	Permanent supply air mechanical ventilation included for Type III and IV wet wells			
10.1.5.	Fans, ductwork and associated equipment is a non-sparking corrosion resistant material			
10.1.5.	Portable ventilator fan, flexible ductwork and electrical supply outlet in a non-classified area provided for Type I and II stations that can adequately ventilate the wet well for confined space entry without interfering with personnel access or equipment removals			
10.1.5.	Wet well fan activated by wet well light switch accessible without entering the wet well			
10.1.6.	Type IV dry well and Type III valve chamber ventilation is physically separated from non-classified areas			
10.1.6.	Type IV dry well and Type III valve chamber ventilation designed for continuous human occupancy with permanent ventilation fans and duct work			
10.1.7.	Building ventilation system is controlled by a vendor-specific control panel or building automation system to interface with the SCADA system for alarm monitoring			
10.2.1.	Plumbing lines labelled with the type of service, colour coded, and indicate the flow direction in accordance with ANSI/ASME A13.1 Standards			
10.2.1.	Plumbing system designed in accordance with the OBC and CSA B64 standards			
10.2.1.	Potable and non-potable water service line protected by a backflow prevention device			

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10.2.2.	Potable water service at least 50mm at all facilities with piping upstream of backflow prevention device providing premise isolation labelled "No Connection Permitted"			
10.2.2.	Plumbing system protected from thermal expansion with hot water tanks or inline water heaters suitable for the plumbing fixtures being serviced			
10.2.3.	Non-potable plumbing has signage posted above each fixture indicating "Non-Potable Water – Do Not Drink" in accordance with the OBC			
10.2.3.	One hose reel and washdown line within the building extends to the furthest point of the wet well for cleaning			
10.2.4.	Washroom provided			
10.2.4.	Washrooms include a toilet, wash sink, soap dispenser, and paper towel dispenser			
10.2.4.	Washroom facilities are accessible from the exterior of the building			
10.2.4.	Washroom design complies with the Region's Facility Accessibility Design Standards			
10.2.4.	Separate custodial room provided for Type IV stations including slop/service sink			
10.2.5.	Floor drain traps are equipped with automatic primers			
10.2.5.	Floor drainage lines that gravity drain to a wet well or inlet maintenance hole are equipped with a trap, have the outlet above the inlet sewer elevation and equipped with a rubber check valve			
10.2.5.	No floor drains are located within generator fuel containment areas			
10.2.6.	Permanent eye wash station supplies tempered water in accordance with ANSI Z358.1			
10.2.6.	Eye wash easily accessible, located near the main door and clearly marked			
10.2.6.	Eye wash and shower stations have flow monitoring alarm connected to SCADA			
10.3.	Duplex sump pumps provided in all dry well stations with discharge to the wet well inlet channel or inlet maintenance hole			
10.3.	Duplex sump pumps provided in valve chambers where gravity drainage back to the wet well is not feasible			
11.0	**Emergency and Maintenance Storage**			
11.0.	Emergency and Maintenance Storage capacity of 2.0 hours at peak flow			
11.0.	Type III and IV stations have a minimum of 1-hour storage on-site and upstream storage capacity is in sufficient proximity to satisfy the intent of emergency storage			
11.0.	Emergency overflow pipe connection to the environment sized for the peak instantaneous influent flow plus 50% or the ultimate buildout capacity of the entire catchment area is approved by the local conservation authority and municipality			
11.0.	Emergency overflow pipe connection to the environment is not submerged at the outlet and at an elevation that protects basement flooding under surcharge backwater conditions with the pumping station out of service			
11.0.	Emergency storage is provided by either overflow pond, large diameter concrete pressure pipe, in-ground reinforced concrete chamber, upstream trunk sewer or upstream emergency and maintenance storage			
11.0.	Large diameter pipe storage meets requirements in Peel Standard Drawings for PCCP			
11.0.	In-ground reinforced concrete chambers follow the South Peel Reservoir Design Guidelines (except NSF61/600 and stairways not required) with roof drainage, manway access hatches, and equipment access hatches.			
11.0.	Storage system designed for flushing, washdown, and cleaning of the entire structure			
11.0.	Storage tank is minimum 10 m from of a fire hydrant located within the site limits			
11.0.	Storage tank has at least two points for access and egress			
11.0.	Storage system can be expanded to achieve full build-out capacity of the catchment and its location will not interfere with any proposed physical expansion of the SPS			
11.0.	Storage structures that cannot drain by gravity back to the wet well contain submersible sewage pump system for transfer			
12.0	**Odour Control**			
12.0.	Station accommodates future odour control equipment by providing pipe penetrations through structures, spare MCC units, and allocated area			
12.0.	When needed, odour control is provided by biofilter reactors, biotrickling filter reactors, and/or activated carbon systems, selected based on odorant loading and ventilation rate			
12.0.	Wet well headspace treated continuously and kept under marginal negative pressure			
13.0	**Standby Power**			
13.1.	Permanent standby power meets the full load capacity of the facility			

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13.1.	Pre-engineered packaged stand-alone backup power system consists of a closed loop liquid-cooled generator within a self-contained, sound-attenuating walk-in enclosure			
13.1.	Generator enclosure has two sets of keys hanging in the SPS building compelte with sign			
13.1.	Generator within a building where there are neighbourhood aesthetic concerns, with a dedicated room for Type II, III and IV stations			
13.1.	Natural gas generators have pressure transmitter and natural gas sensors			
13.1.	Standby power complies with CSA B139, CSA B149, CSA C282-09, NFPA 211, and TSSA			
13.2.	Noise and emission attenuation measures minimize impact to neighbouring communities, comply with local noise by-laws, and meet the intent of NPC-300			
13.3.	Outdoor generators installed on dedicated concrete pad above the regional flood elevation and equipped with stair access to all enclosure openings			
13.3.	Safety guards around all hot surfaces, shafts, rotating equipment, and moving parts			
13.3.	Turbochargers, flex pipes, and silencers are not insulated withe heat warning signs			
13.3.	Generator exhaust systems installed in compliance with the OBC			
13.3.	Gensets in excess of 1000 A output provided with ground fault protection			
13.4.	Fuel storage tanks are double walled with a fuel level-indicating transmitter, low fuel float switch, an interstitial space alarm switch, and approved sight gauge			
13.4.	Diesel storage tanks sized for 36 hours of operation at the facility's firm capacity plus ancillary loads starting from a 95% full tank			
13.4.	Fuel system instruments are monitored by SCADA			
13.4.	Fuel systems have electronic or mechanical overfill prevention device and a vent whistle on each common vent pipe			
13.4.	Fuel lines placed in an accessible location for visual inspection and maintenance			
13.4.	Fuel storage of at least four hours provided within the generator service room			
13.4.	Secondary fuel containment areas sealed with a suitable epoxy floor coating			
13.5.	Generator ventilation system meets air intake volume and velocities for engine combustion requirements with or without local utility power			
13.5.	Generator ventilation inlet air dampers open on loss of power in a fail-safe manner			
13.5.	Generator damper actuators open in less than 30 seconds upon receiving a generator start command and have a limit switch to prove open status with separate control panel with output signals monitored by SCADA			
13.5.	Generator exhaust system components are stainless steel and installed with the most direct path to the exterior of the building/enclosure			
13.6.	Engine started by electrical cranking motor with power from 12 or 24 V storage batteries			
13.6.	Generator starting system includes a fully automated battery charger, with an alarm to SCADA in the event of malfunction or low battery voltage			
13.6.	Generator starting system provides at least three 15-second cold cranking cycles			
13.6.	Generator and day tank kept warm in preparation for starting in all weather conditions			
13.7.	Generator onboard control system compatible with the ATS and designed to provide automatic starting, monitoring, protection and control functions			
13.7.	Ethernet communication between the generator control panel and onsite SCADA collects additional information including temperature, oil pressure and engine speed			
13.8.	All generators provided with a dedicated circuit breaker for load bank testing			
13.8.	Generators with an output current of 100 A or greater are wired to a load bank connection box with cam-lock style plugs to allow for easy connection of a load bank			
14.0	**Electrical**			
14.1.	600 V MCC and motor starter panels are separated from low voltage control panels			
14.1.	Emergency stop buttons provided near all moving/rotating equipment and at the MCC			
14.1.	Generator local emergency stops located on the generator controller, on the generator enclosure for outdoor generators, and remotely wall mounted for indoor generators			
14.2.	Arc flash risk assessment completed according to CSA Z462			
14.2.	Remote on/off switches for MCC and starter panels are located outside of the MCC/starter arc flash boundary to allow for manual starting and stopping of equipment			
14.3.	Harmonics study by a qualified specialist provided for any VFDs			
14.3.	Short Circuit, and Protective Device Evaluation and Coordination Study completed			
14.4.	Temporary power is provided from existing electrical service where possible.			
14.5.	Electrical service entrance power supply shall be 600 volt, three phases			

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Design Milestone: _____

Does the design comply with the Region's Sewage Pumping Station Standards within each of the following design disciplines?		Yes/No	Deviation Requested (submit PIPM forms)	Not Applicable
14.5.	A neutral conductor is brought into the main service entrance breaker/disconnect or switchboard and grounded even if it is not used in the distribution system			
14.5.	Service transformers are designed to meet the estimated demand load requirements of the station and sized to allow for 25% future load growth and contingencies			
14.5.	Metering CTs and PTs installed in a dedicated metering cabinet or incorporated into an MCC service entrance arrangement			
14.5.	Separate power monitor captures and logs voltage sag and swells of more that 5% on the client side with network connectivity to the SCADA system as per PAIDS requirement			
14.5.	Lightning arrester system provided			
14.5.	Microprocessor-based auto-switching power factor correction system installed in single enclosure at the main electrical service entrance to the station capable of automatically switching capacitor modules in and out of service and minimize voltage sags and swells			
14.5.	Region-owned main station transformers are three-phase, oil-filled, pad-mounted, dead-front with tamper-proof design, energy efficiency according to CAN/CSA C802.1, separate compartment/panel for low-voltage connections, oil sample port, liquid temperature/level gauges, pressure relief devices, and hard-wired signals to SCADA			
14.6.	Automatic transfer switch (ATS) provided if facility has standby power generation			
14.6.	ATS scheme has maintenance bypass for Type IV stations			
14.7.	MCC equipment installed on house concrete keeping pads minimum of 75mm high			
14.7.	MCC and components designed, manufactured and tested according to NEMA Standards			
14.7.	MCC compartmentalized vertical sections have with common power bus bars and are designed to permit the removal or addition of motor starters and control units			
14.7.	MCC is floor-mounted, freestanding, dead front, completely enclosed control assembly and accommodates front mounting combination starters and circuit breakers			
14.7.	MCC cubicles housing the service entrance main breaker are compartmentalized with a full-width front door complete with locking handle			
14.7.	MCC breakers “OPEN” clockwise and are “CLOSED” in the counterclockwise direction			
14.7.	MCC incorporates digital metering for the purpose of plant metering			
14.7.	New MCCs incorporate arc flash resistant design features including heavier gauge steel, arc flash maintenance mode switch, reinforced latches, isolated buses, and features to better contain/redirect energy away from the operator			
14.7.	MCC has a continuous ground bus with accessible external connection, adequate ventilation to limit internal temperature rise, and LED push-to-test indicating light lamps			
14.7.	MCC has smart overload relays with ethernet capability and all major components have ethernet communication option			
14.7.	MCC conduit entries are bottom or side entry only			
14.7.	MCC has oil resistant markers at ends of each conductor			
14.7.	MCC devices located with at height that considers operator ergonomics and accessibility			
14.8.	Motor starter types reviewed with Region staff and requirement decision documented			
14.8.	Soft starter pump control ramp feature efficacy evaluated with regards to motor loads on normal pump starts/stops and effectiveness to minimize transient pressures			
14.8.	VFD minimum speeds are set to overcome the static lift of the station and meet the minimum acceptable velocity of the forcemain			
14.8.	VFDs and soft starters provided with network connectivity as per PAIDS requirement			
14.8.	VFD instillations utilize input DC line reactors to minimize the input current harmonics			
14.8.	VFD installations 50 HP and above utilize harmonic filters			
14.8.	Across-the-line starters have smart electronic overload relays with network connectivity			
14.9.	Electric motors are high efficiency and explosion-proof			
14.9.	Electric motors including and over 1.0 HP are 575 V, three phases and 60 hz			
14.9.	Motor design, construction, testing and performance conforms to the latest requirements of EEMAC and bears the CSA approval label			
14.9.	Motors used for VFD application to be inverter duty rated			
14.9.	Where motor power factor correction is applied using capacitors, capacitor rating is selected based on the specific motor			
14.9.	Motor protection relay system provided for all motors equal to or greater than 22.4 kW			

Region of Peel
Sewage Pumping Station Design Standards - Checklist

Facility Name: _____
Project Title: _____
Project Number: _____
Prime Consultant: _____
Design Milestone: _____

Does the design comply with the Region's Sewage Pumping Station Standards within each of the following design disciplines?		Yes/No	Deviation Requested (submit PIPM forms)	Not Applicable
14.9.	Motors greater than 22.4 kW are equipped with one RTD connections per phase for windings, RTD for motor inboard/outboard bearings, RTD for pump inboard/outboard bearings, and vibration monitoring			
14.9.	Motor RTD modules and vibration sensors used to provide alarms and warnings to SCADA are connected to a protective relay installed in the starter panel			
14.9.	Motor protection relays provide network connectivity as per PAIDS requirements			
14.9.	Motors less than 22.4 kW provided with thermistors tied to the motor starter			
14.9.	Submersible motors equipped with built-in thermal and moisture sensors tied to trip the circuit and alarm			
14.9.	Dry pit pump motors equipped with built-in vibration sensors			
14.10.	Electrical panels are mounted outside of confined spaces and classified areas			
14.10.	Valve actuators in confined spaces have LCP integrated to MCC or in electrical room			
14.10.	Free-standing electrical panels are mounted on designated concrete equipment pads			
14.10.	Outdoor panels have NEMA 4X stainless steel lockable enclosure with continuous piano hinge, NEMA 4X rated breather drain, enclosure heater to maintain an inside temperature above 4°C, and LED lighting activated by door switch			
14.10.	Electrical panel has a typed directory listing loads on respective circuits			
14.10.	Panel boards provided with transient voltage surge suppression			
14.11.	TECK cables used in lieu of rigid steel conduit in hazardous locations			
14.11.	Lightning arresters provided at the 600-volt terminals of service entrance transformation			
14.11.	Secondary surge protection device is provided at point of service entrance to the facility			
14.11.	Electrical equipment identified with lamacoid nameplates fastened to the panel exterior that clearly identify the name, tag ID, description, voltage and power source			
14.11.	Electrical wiring clearly identified with permanent markings at both ends			
14.11.	Equipment control wiring follows OESC and PAIDS requirements			
14.11.	Power and TECK cable labels identify the source and destination of cables			
14.11.	Transformers are of drip-proof design			
14.11.	Transformers located in process areas, have a NEMA rating suitable for the environment			
14.11.	Conduit expansion joint provided when entering building and at building expansion joints			
14.11.	Duct banks with below grade penetrations are sloped away from the building and sealed at both ends			
14.11.	Outdoor receptacles have switches within the station to control power to the outlet			
14.12.	Grounding design consists of 3m long copper ground electrodes exterior to the station			
14.12.	Ground electrode inspection boxes at locations that allow for testing of grounding			
14.12.	Ground conductors constructed of stranded-copper and if in contact with aluminium, corrosive material, soil or atmosphere insulated or bare tinned copper			
14.12.	Isolated ground system provided for instrumentation and PLC control panels			
14.12.	Lighting is LED and avoids areas that are difficult to access for maintenance purposes			
14.12.	Emergency lighting provided for all buildings			
14.12.	Exterior photocell control lighting illuminates entrance doors with zero spill of light beyond the property line			
14.12.	Lighting in each wet well controlled via a dedicated switch located inside the station			
14.12.	Flood lighting at wet wells and valve chambers has manual switch monitored by SCADA			
14.13.	Permanent interior lighting provided for all Type II, III, and IV valve chambers			
14.14.	Junction boxes equipped with terminal strips are installed on the exterior of the wet well to facilitate changes of the electrical equipment			
14.14.	GFIC weatherproof receptacle fed from dedicated 20A circuit placed adjacent to any wet wells or valve chambers			
14.14.	All electrical equipment installed in area's subject to be submergence are properly rated; electrical actuators installed in valve chambers are to be IP68 rated			
14.15.	Dedicated Access Control System, monitored for intrusion alarm state by SCADA system, consists of card readers, electric strikes, and door position contacts			
14.15.	Local door controllers housed in small control panels labelled SPS-SEC-4XX connect to all exterior doors and hatch position contacts as well the Access Control System			
14.15.	Security system design follows the Region's Access Control System Design Guidelines			

Region of Peel
Sewage Pumping Station Design Standards - Checklist

Facility Name: _____
Project Title: _____
Project Number: _____
Prime Consultant: _____
Design Milestone: _____

Does the design comply with the Region's Sewage Pumping Station Standards within each of the following design disciplines?		Yes/No	Deviation Requested (submit PIPM forms)	Not Applicable
14.15.	Security system panel powered by a UPS located in the PLC panel			
14.15.	Wiring from all door/hatch switches located in a classified area must go through one ISR panel dedicated to security and labelled as SPS-ISR-XXX prior to entering security panel			
14.16.	Type III and IV station's exterior CCTV cameras connect to the Region's CCTV network			
14.16.	IP cameras are POE powered with proper storage capacity and POE switches			
14.16.	CCTV cameras equipped with day/night vision to capture faces and licence plates			
14.17.	Addressable heat and smoke detectors monitored by a vendor-specific fire alarm system provided if required by the OBC Section 3.2.4.1.			
14.17.	Fire alarm system has fire alarm, system trouble, supervisory alarm relays wired to SCADA, and dedicated 3G cellular modem for remote monitoring by an authorized facility			
15.0	**Instrumentation and Control**			
15.1.	All instruments installed in locations that are safe for workers and easily accessible			
15.1.	Field instrument enclosures/transmitters rated in accordance with the area classification			
15.1.	Any instruments mounted outdoors are in NEMA 4X enclosures and suitable for operating temperatures of minus 40°C to plus 50°C			
15.1.	Factory made sensor cables run continuously from the sensor to the transmitter without any splice unless the sensor provides 4-20 mA with HART directly to SCADA			
15.1.	Splicing cables is done through a junction box mounted close to the sensor using DIN rail-mounted terminal blocks			
15.1.	Instruments installed in classified areas, ISRs mounted in a dedicated enclosure or intrinsically safe barriers, unless it is included as part of the transmitter			
15.1.	Instruments and equipment installed in valve chamber are IP68 rated			
15.1.	Instruments grounded properly using an isolated ground system			
15.1.	Level transmitters are ultrasonic or radar			
15.2.	Permanent gas detection systems provided for dry wells, Type III valve chambers, and building rooms connected atmospherically to a classified space			
15.2.	Combustible gas and H2S gas sensors installed when open liquid surface connects to a building interior as stipulated in OESC and NFPA 820			
15.2.	Carbon monoxide sensors installed when fuel burning devices are installed indoors			
15.2.	Methane gas sensors installed in the case of a natural gas generator			
15.2.	Horn and strobe system connected to dedicated gas detection panel has visual and audible warning inside and outside of area exposed to gas			
15.2.	Gas detection panel provides a gas alarm, general fault to the PLC control panel, relays wired to the HVAC controller, wiring to all gas sensors, and UPS power			
15.2.	Combination carbon monoxide/smoke detectors provided for buildings			
15.3.	PLC control panel at each station is equipped with a panel mounted HMI computer as a centralized control point to monitor and control all parameters for the facility			
15.3.	PLC controlled devices operated in "remote-computer" mode using the SCADA system under normal conditions but are equipped with LCPs to allow local control by operators			
15.3.	PLC controlled devices incorporate hardwired and software interlocks			
15.3.	Safety interlocks protected by hardwired interlocks, which interrupt the operation of the equipment until the condition is reset in the field			
15.3.	Equipment and control system wiring in fail-safe mode for safety in case of wire breaks			
15.3.	Control panel provided with two separate grounds, one isolated ground for instruments and one for control circuit grounding			
15.3.	PLC controlled devices provided with Local/Off/Remote selector switches unless a bump-less mode transfer is required			
15.3.	Bump-less mode transfers have Start/Stop Pushbuttons with a separate Local/Remote Selector			
15.3.	LCP connected to SCADA system for monitoring and remote control with detailed loop drawings for all signals to and from each LCP to central PLC part of the tender package			
15.3.	LCPs do not use any kind of PLC, microprocessor, smart relay or programmable device			
15.3.	Vendor equipment LCPs comply with PAIDS requirements and have a lamacoid label			
15.3.	WAN fibre connection from the WAN switch to the SCADA network switch has a dedicated WAN enclosure equipped with a UPS			
15.3.	Cellular network connections to the overall network have redundancy of two different carriers, Rogers and Bell, at each location			

Region of Peel
Sewage Pumping Station Design Standards - Checklist

Facility Name: _____
Project Title: _____
Project Number: _____
Prime Consultant: _____
Design Milestone: _____

	Does the design comply with the Region's Sewage Pumping Station Standards within each of the following design disciplines?	Yes/No	Deviation Requested (submit PIPM forms)	Not Applicable
15.3.	CCP installed to house SCADA network components with interconnection between CCPs based on fibre according to PAIDS Section D - IT			
15.3.	Internal cell phone boosting supports working alone devices so all areas of the facility, even dry well and valve chambers, have adequate cellular connection			
15.3.	Ethernet to SCADA network connection provided for all power monitors, VFDs, soft starters, overload relays, motor protection relays, security systems, UPSs, PLCs, local HMIs and generator control panels			
16.0	**Requirements for Stormwater Pumping Stations**			
16.1.	Region's Public Works Stormwater Design Criteria and Procedural Manual is followed			
16.2.	Road closure system alerts pedestrians/vehicles that the pathway is closed during high storm events			
16.2.	Depth gauge provided along roadway in both directions			
16.2.	Design ensures private property will not be flooded under the 100-year storm			
16.3.	Driveway access to control building, generator and wet well at minimum 300mm above 100-year flood elevation			
16.3.	Station structure/equipment is protected from damage, remains fully operational, and is accessible during the 100-year flood event			
16.3.	Access hatches are large enough to permit equipment entry and located away from any overpass structure			
16.3.	Station is not located on the travelled portion of the municipal right-of-way			
16.3.	Station accessible for maintenance vehicles parking next to the wet well, MHs and valve chambers with enough room for setting up mechanical hoists			
16.4.	Wet well inlet has bar screen with overflow to protect pumps from large debris but maintain peak flow capacity into the wet well if clogged			
16.4.	Stations servicing a public right-of-way have a pre-treatment unit installed for the removal of TSS from stormwater runoff upstream of the facility			
16.5.	Station capacity rated for the greater of 10-year storm with no barrier curb overtopping and at least one lane free of water in each direction or 100-year storm with maximum road flooding of 0.3m (if downstream sewer has sufficient capacity)			
16.5.	Pumps are self-priming wet well submersible			
16.5.	At least one jockey pump provided that is sized for typical wet weather flows			
16.5.	Duty pump/pumps meet the rated capacity without use of jockey pump or standby pump			
16.5.	Single Large Standby Pump provided that is equivalent size to the largest Duty pump			
16.5.	Hard solid throughlet for duty/standby pumps is minimum 50mm			
16.5.	Storage/detection tank sized for a minimum of 1.0 hr at rated capacity which includes the wet well, storm sewers, inlet MHs and catch basins up to 0.3m freeboard below the lowest roadway inlet			
16.6.	Pumping station inlets designed assuming the capacity has been reduced by 50 per cent as a result of debris blockage			
16.6.	Structures are watertight			
16.6.	Valves located in separate valve chamber (not wet well)			

Region of Peel
Sewage Pumping Station Design Standards - Conformance Acknowledgement Form

Facility Name: _____
Project Title: _____
Project Number: _____
Prime Consultant: _____
Design Milestone: _____

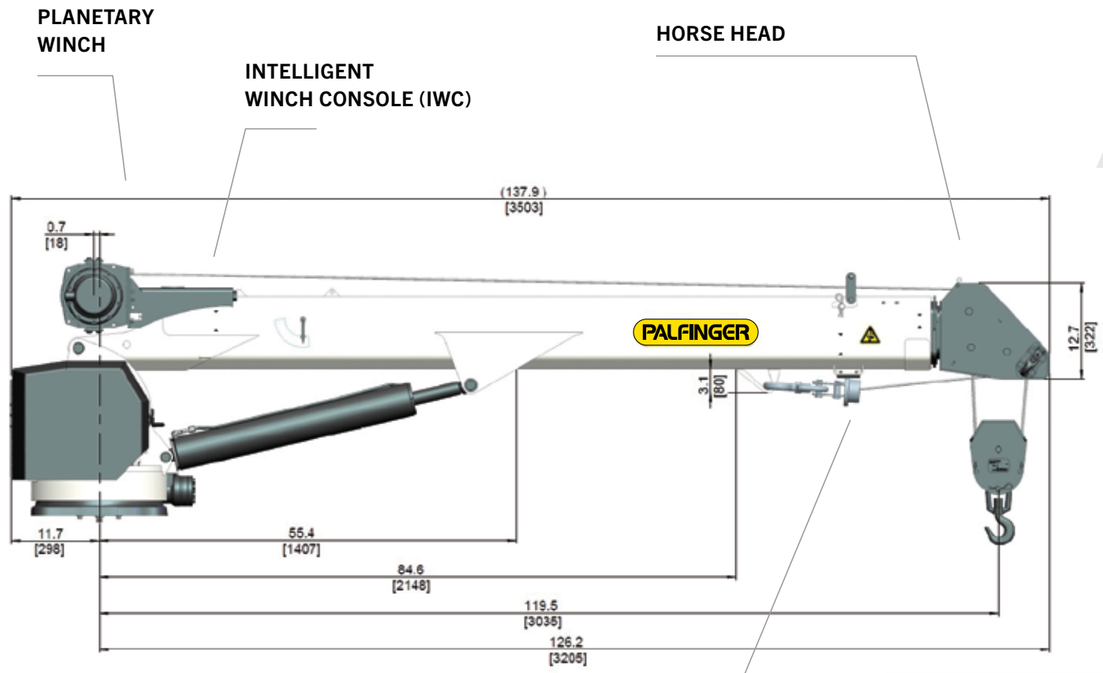
We, the undersigned, confirm that the proposed design for this project complies with the latest edition of the Region of Peel Sewage Pumping Station Design Standards.
*Where deviations from the standards are proposed, the Region's written approval has been received and the approved PIPM "*Request for Deviation from Design Standard* " documentation is attached.

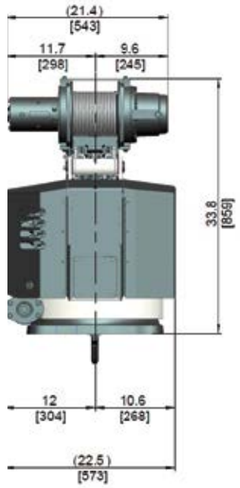
Discipline	Discipline Lead Name and Company	Signature	Date	Design Deviation (Yes/No)*
Civil				
Buildings				
Structures				
Process				
Mechanical				
Emergency and Maintenance Storage				
Odour Control				
Standby Power				
Electrical				
Instrumentation and Control				
PAIDS Compliance				

The deliverable has been reviewed for overall completeness and conformance with the project scope and the Region's Sewage Pumping Station Design Standards (latest version) and is deemed ready for submission to the Region.

Consultant Project Manager Name _____ Signature _____ Date _____

TECHNICAL SPECIFICATIONS





TECHNICAL SPECIFICATIONS

CRANE RATING

Rated lifting moment	38,500 ft*lbs. (52.2 kNm (5.3 mt))
Maximum lifting moment	42,800 ft*lbs. (58 kNm (5.9 mt))
Boom extensions 2 hydraulic	25 ft. (7.6 m)
Crane weight **Electric**	1,280 lbs. (580 kg)
Crane weight **Hydraulic**	1,230 lbs. (560 kg)
Hydraulically powered extensions	

CONTROL SYSTEM

Wireless remote control unit
Integrated E-stop button
Manual emergency valve activation capability
Integrated warning horn
12V DC power supply

ROTATION SYSTEM

Slewing torque	5,545 ft*lbs (7.5 kNm (0.8 mt))
Slewing angle **Electric**	Continuous rotation
Slewing angle **Hydraulic**	410 ° rotation

STANDARDS (meets or exceeds)

Crane design	ASME B30.5	OSHA 1910.28
Calculation	EN 12999 H1,B6	

PLANETARY GEAR WINCH

Max. winch force single line	3,000 lbs. (1,375 kg)
Max. winch force double line	6,000 lbs. (2,750 kg)
Max. line speed **Electric**	43.3 ft./min (13.20 m/min)
Max. line speed **Hydraulic**	51 ft./min (15.54 m/min)
Cable size and length	5/16" x 95' (7.9 mm x 28.9 m)
Two-block damage prevention system	
3rd wrap end stop system option	

HYDRAULIC SYSTEM

Operating pressure	2,800 psi (19.3 Mpa (193 bar))
Required oil flow **Hydraulic**	5.2 GPM (20 l/min)
Electronic overload protection system	
Five stage marine-grade seals on all cylinders	
Non integrated load-holding valves on all cylinders	

CRANE | CHASSIS INTERFACE

Base plate dimension	17.75" x 17.75" (450 mm x 450 mm)
Hole pattern	14.75" x 14.75" (375 mm x 375 mm)
Mounting bolts	4 x 1" -8 UNC

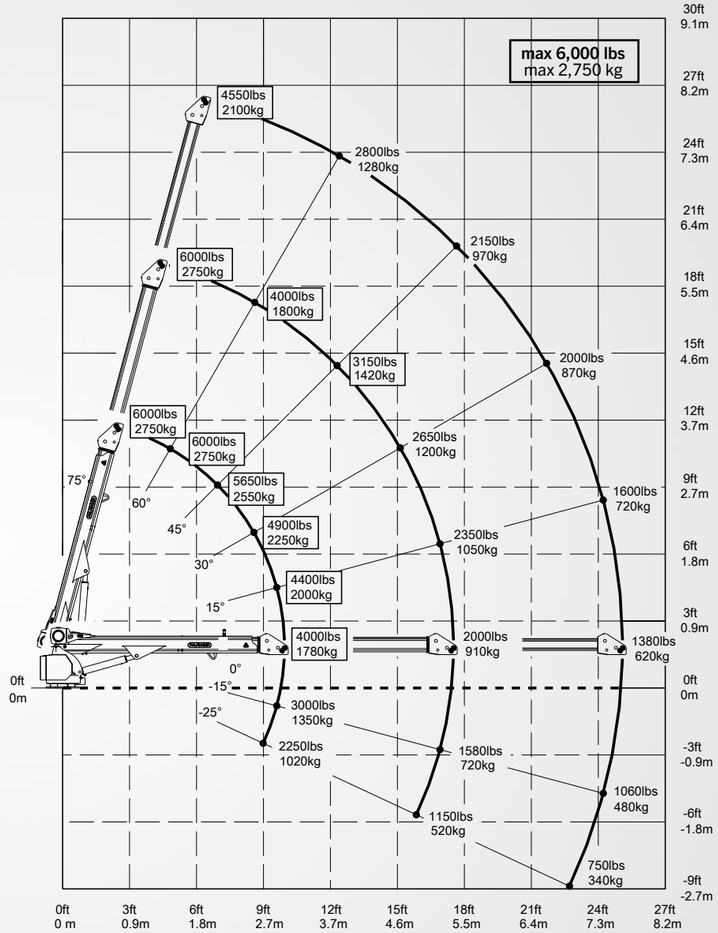
CHASSIS RECOMMENDATION

Chassis style	Conventional
Minimum GVWR	Class 4 (14,001 lbs. (6,350 kg))

Weights of load-handling devices are part of the load lifted and must be deducted from the capacity.

....lbs
....kg

Boxes denote two-part line required.



Appendix C: Sewage Pumping Station Process Control Narrative

PROCESS CONTROL NARRATIVE

Facility Name Sewage Pumping Station

Type I/II/III/IV *(select one)*

Physical Address, City

NOTE TO DESIGNER:

- YELLOW highlights identify the fields that need to be updated.
- RED text in this document provides guidelines to designer on adjustment and updates required based on specific project design decisions.
- Facility Name and Type are the fields that are referenced through in various section, once updated on cover page all references are to be updated.
- When updating an existing facility PCN use following color codes:

BLUE Identifying additions and changes made under the scope of the project
~~**BLUE**~~ Removals proposed under the scope of the project

Version 1.1

REVISION HISTORY

Version	Date	Description of Revision
1.0	July 2021	For Region Review
1.1	May 2022	Revised backup float controls and added VFD min. flow setpoint

TABLE OF CONTENTS

Page

LIST OF TABLES

APPENDIXES

1. INTRODUCTION

This document describes the process control narrative for the Facility Name Sewage Pumping Station that is used as the basis of the automatic process control system. The Facility Name Sewage Pumping Station is a Type I/II/III/IV (select one) pumping station, according to the Region of Peel Sewage Pumping Station Design Standards.

1.1 BACKGROUND

The Facility Name Sewage Pumping Station is part of the Region of Peel's municipal sanitary sewage collection system that operates under the following Environmental Compliance Approval (ECA):

- ECA Number: 2960-ALCLTM
- Issue Date: June 22, 2017

1.2 GENERAL SYSTEM DESCRIPTION

Table 1 describes the general specifications of the Facility Name Sewage Pumping Station.

Table 1 Sewage Pumping Station General Specifications

Parameter	Specifications
Station Type:	Type I/II/III/IV (select one)
Rated (Firm) Capacity:	XXX L/s
Number of Pumps:	*Number (n)* Pumps; *Number (n -x)* Duty and *Number (x)* Standby
Number of Wet Well Cells:	*Number (1 or 2)*
Forcemains:	*Number, size, and length of forcemain(s), including discharge location(s)*
Total Volume of Emergency Storage:	*Volume (m^3)*, providing XXX minutes of emergency storage at the firm capacity of XXX L/s.
Overflow	*Size, length, and discharge point of overflow point (if available)*
Standby Power	*Number and rated capacity(ies) of standby power generators (in kW)*

2. EQUIPMENT

2.1 CONTROL EQUIPMENT

2.1.1 PLC/SCADA Architecture

The PLC/SCADA architecture is based on an Ethernet Local Area Network (LAN). Programmable Logic Controller (PLC) controls all automation of the swage pumping station equipment.

The communications link to the Region of Peel's Wide Area Network (WAN) is a (3G/4G/5G wireless/dedicated Fibre Optic Link.) *(Select applicable network arrangement)*

The SCADA system architecture is identified within the Instrumentation (I) drawing set. The architecture identifies automation systems and building services equipment that are connected to the Sewage Pumping Station Local Area Network (LAN).

The following automation and building service systems are connected to the pumping station LAN:

- SPS-ICP-4XX – Main Process Automation Control Panel
- SPS-CCP-4XX – Data Communication Panel *(if installed)*
- SPS-WAN-4XX – WAN Telecom Panel *(if installed)*
- Station Power Monitor
- Sewage Pumps VFD/SS *(Select appropriate starter types)*

The pumping station has been designated the following facility code in accordance with PAIDS:

- Facility Type: SPS
- Facility Code: P4XX
- Facility Name: Facility Name Sewage Pumping Station
- Main PLC processor Tag: P4XX-SPS-PLC-001

2.1.2 Motor Starters

Soft motor starters (SS's) and Variable Frequency Drives (VFDs) *(select appropriate starters)* are required to be connected to the pumping station communications network for status monitoring via the SCADA system.

The starters and VFDs are configured such that the specific data that is intended for remote monitoring is in a contiguous address block to facilitate communications polling. The following table of status information (as a minimum) is provided for remote monitoring via the pumping station PLC automation system via communications:

Table 2 Motor Starter Status Information

Electrical	Power	VFD (Not required for Soft Starters)	Alarms
- Phase Currents (A) - Line Voltage (V) - Frequency (Hz)	- Motor Load (%) - Real Power (kW) - Apparent Power (kVA) - kW Demand - Power Factor	- Speed (Hz) - Speed (%) - Speed (RPM) - Torque (Nm or other acceptable units)	- Fault Status - Alarm Status

{Designer is to update this table as required}

2.1.3 Motor Protection Relays

{Designer is to update this section to suit the facility's design arrangement}

A motor protection relay system is provided for all pump motors equal to or greater than 22.4kW (30hp) in size.

The motor protection relays are connected to the pumping station communications network to facilitate remote status monitoring of discrete and analog signals via the SCADA system.

The protection relays are configured such that specific data that is intended for remote monitoring is made available for communications polling. The following table of status information (as a minimum) is provided for remote monitoring via the pumping station PLC automation system:

Table 3 Motor Protection Relays Status Information

Electrical	Power	Protection	Alarms
- Phase Currents (A) (While Running) - Line Voltage (V) - Frequency (Hz)	- Motor Load (%) - Real Power (kW) (While Running) - Apparent Power (kVA) (While Running) - kW Demand - Power Factor (While Running)	- Delay on Restart Timer Value (Start Inhibit Timer) - RTD 1 Temperature (Stator A) - RTD 2 Temperature (Stator B) - RTD 3 Temperature (Stator C) - RTD 6 Temperature (Motor Out Bearing) - RTD 7 Temperature (Motor In Bearing) - RTD 8 Temperature (Pump Out Bearing) - RTD 9 Temperature (Pump In Bearing) - Vibration - Leakage (when applicable and connected to MPR) - Cause of Last Trip - Starts per Hour Lockout Timer	- Trip Status - Alarm Status - Motor Overload - Drive Fault - Drive Warning - SMC Alarm (For Solid State Drives Only) - SMC Fault (For Solid State Drives Only) - Access Switch - Speed Switch - Spare Switch - Vibration Switch - Leakage Alarm - Emergency Switch - Reset Switch (DRS Reset) - Trip Relay - Alarm Relay - Aux Relay 1 - Aux Relay 2

2.1.4 Overload Relays

{Designer is to update this section to suit the facility's design arrangement; this section is applicable to FVNR starters only}

A smart motor overload relay protection is required for all pumps equipped with Full-Voltage Non-Reversing (FVNR) motor starters.

The smart overload relays are connected to the pumping station communications network to facilitate remote status monitoring of discrete and analog signals via the SCADA system.

The smart overload relays are configured such that specific data that is intended for remote monitoring is made available for communications polling. The following table of status information (as a minimum) is provided for remote monitoring via the pumping station PLC automation system:

Table 4 Smart Motor Overload Relays Status Information

Electrical	Power	Alarms
- Phase Currents (A) - Average Current (A) - Frequency (Hz) - Unbalanced Voltage (V) - Unbalanced Current (A) - Line Voltages (V) - Line Average Voltage (V) - Line-Line Voltages (V) - Line-Line Average Voltages (V)	- Real Power (kW) - Apparent Power (kVA) - Reactive Power (kVAr) - Power Factor - Maximum Total Dynamic Distortion Line Voltages - Maximum Total Dynamic Distortion Phase Currents	- Relay Fault Code - Relay Warning Code

2.2 MOTOR CONTROL CENTERS (MCC)

The Facility Name Sewage Pumping Station MCCs provide power distribution to process and building services equipment. There is qty (#) 600VAC Motor Control Centre(s) (MCC(s)) at the pumping station that include pump motor starters, auxiliary process loads and building services. The MCC process loads are grouped as shown in Table 5.

Table 5 MCC Process Loads

MCC No.	Switch/ MCC Loads	Equipment Tag Number(s)

2.3 PUMPS

Table 6 presents the pumps specification details:

Table 6 Pump Specifications

Pump Tag No.	Equipment Description		Equipment Specifications			
	Design Flow	TDH (m)	Motor Size (kW/ HP)		VFD/SS	Additional Protection (Protection Relay/Smart Overload/Temp and Leak)
SP4XX10						
SP4XX20						
SP4XX30						
SP4XX40						
Sump Pumps						
SUP4XX80					No	No

{Designer is to make adjustment in the table based on station type}

2.4 MOTORIZED VALVES

Table 7 presents the motorized valves specifications details

Table 7 Motorized Valves

Tag Name	Size (mm)	Type	Operation	Position	Location
FV4XX01			Motorized	Normally Open	Forcemain A
FV4XX02			Motorized	Normally Open	Forcemain B
FV4XX03			Motorized	Normally Open	Forcemain A Recirculation
FV4XX04			Motorized	Normally Open	Forcemain B Recirculation
FV4XX11			Motorized	Normally Open	Pump 1 Suction Line
FV4XX12			Motorized	Normally Open	Pump 1 Discharge Line

{Designer is to make adjustment based on station type. Note: Station Types I and II do not have motorized valves per the Standard.}

2.5 INSTRUMENTS

The instrument specifications are presented in Table 8.

Table 8 Instrument Specifications

Tag Name	Equipment Description				Details/Spec
	Instrument	Location	Range		
LIT4XX05	Level Indicating Transmitter	Emergency and Maintenance Storage	0 – TBD/ 0 - 100%	m/%	100% Level @ XXm 0% Level @ XXm Sensor Location @ XXm
LSH4XX85	Level Switch, High	Emergency and Maintenance Storage	-	-	Elevation @ XXm
LSH4XX84	Level Switch, High	Inlet Maintenance Hole	-	-	Elevation @ XXm
LIT4XX01	Radar/ Ultrasonic Level Indicating Transmitter	Wet Well A	0 – TBD/ 0 - 100%	m/%	100% Level @ XXm 0% Level @ XXm Sensor Location @ XXm
LIT4XX02	Hydrostatic Level Indicating Transmitter	Wet Well A	0 – TBD/ 0 - 100%	m/%	100% level @ XXm 0% level @ XXm
LSHH4XX81	Level Switch, High	Wet Well A	-	-	Elevation @ XXm
LSH4XX01	Level Switch, High	Wet Well A	-	-	Elevation @ XXm
LIT4XX03	Radar/Ultrasonic Level Indicating Transmitter	Wet Well B	0 – TBD/ 0 - 100%	m/%	100% Level @ XXm 0% Level @ XXm Sensor Location @ XXm
LIT4XX04	Hydrostatic Level Indicating Transmitter	Wet Well B	0 – TBD/ 0 - 100%	m/%	100% level @ XXm 0% level @ XXm
LSHH4XX82	Level Switch, High	Wet Well B	-	-	Elevation @ XXm
LSH4XX02	Level Switch, High	Wet Well B	-	-	Elevation @ XXm
LIT4XX0X	Level Indicating Transmitter (Virtual)	Master Level	TBD	m	
PIT4XX11	Pressure Indicating Transmitter	Raw Sewage Pump 1 Suction	TBD	kPa	
PIT4XX12	Pressure Indicating Transmitter	Raw Sewage Pump 1 Discharge	TBD	kPa	
PIT4XX21	Pressure Indicating Transmitter	Raw Sewage Pump 2 Suction	TBD	kPa	
PIT4XX22	Pressure Indicating Transmitter	Raw Sewage Pump 2 Discharge	TBD	kPa	
PIT4XX31	Pressure Indicating Transmitter	Raw Sewage Pump 3 Suction	TBD	kPa	
PIT4XX32	Pressure Indicating Transmitter	Raw Sewage Pump 3 Discharge	TBD	kPa	
PIT4XX41	Pressure Indicating Transmitter	Raw Sewage Pump 4 Suction	TBD	kPa	
PIT4XX42	Pressure Indicating Transmitter	Raw Sewage Pump 4 Discharge	TBD	kPa	
PIT4XX01	Pressure Indicating Transmitter	Forcemain A	TBD	kPa	
PIT4XX02	Pressure Indicating Transmitter	Forcemain B	TBD	kPa	

Tag Name	Equipment Description				Details/Spec
	Instrument	Location	Range		
LSH4XX83	Level Switch, High	Valve Chamber	-	-	Elevation @ XXm
LSH4XX8X	Level Switch, High	TBD	-	-	Elevation @ XXm
TT4XX01	Temperature Transmitter	SPS-ICP-4XX Control Panel	TBD	°C	
TT4XX91	Temperature Transmitter	Electrical Room	TBD	°C	
XSH4XX90	Smoke/ Carbon Monoxide Detector	TBD	-	-	
GIT4XX10	Generator Frequency Indicating Transmitter	Generator	TBD	Hz	
JIT4XX10	Generator Load Indicating Transmitter	Generator	TBD	W	
VRSL4XX91	Vacuum Switch, Low	Indoor Diesel Tank	-	-	
LSL4XX91	Level Switch, Low	Indoor Diesel Tank	-	-	Elevation @ XXm
LSH4XX91	Level Switch, High	Indoor Diesel Tank	-	-	Elevation @ XXm
LSHH4XX91	Level Switch, High	Indoor Diesel Tank Containment	-	-	Elevation @ XXm
LIT4XX91	Level Indicating Transmitter	Indoor Diesel Tank	TBD	m/%	100% Level @ XXm 0% Level @ XXm Sensor Location @ XXm
LSL4XX92	Level Switch, Low	Outdoor Diesel Tank	-	-	Elevation @ XXm
LSH4XX92	Level Switch, High	Outdoor Diesel Tank	-	-	Elevation @ XXm
LIT4XX92	Level Indicating Transmitter	Outdoor Diesel Tank	TBD	m/%	100% Level @ XXm 0% Level @ XXm Sensor Location @ XXm

{Designer is to make adjustment in instrument listed in this table based on station type and requirements}

The flow meter specifications are presented in Table 9.

Table 9 Flow Meter Specifications

Tag Name	Equipment Description			
	Location	Pipe Dia. (mm)	Max. Flow (L/s)	Flow Meter Type
FIT4XX03	Inlet Maintenance Hole			
FIT4XX04	Overflow to Environment Channel			
FIT4XX01	Forcemain A			
FIT4XX02	Forcemain B			

{Designer is to make adjustment based on station type}

2.6 SURGE RELIEF VALVES

The surge relief valves specifications are presented in Table 10.

Table 10 Surge Valves Specifications

Tag Name	Equipment Description	Size (mm)	Location
PSV4XX01	Forcemain A Surge Valve		
PSV4XX02	Forcemain B Surge Valve		

{Designer is to make adjustment based on station type}

2.7 MISCELLANEOUS

Miscellaneous equipment and instrumentation for the station is presented in Table 11.

Table 11 Miscellaneous Equipment Specifications

Tag Name	Equipment Description	Location	Equipment Specifications
GRD4XX10	Inlet Grinder 1	Inlet Grinder Channel	
GRD4XX20	Inlet Grinder 2	Inlet Grinder Channel	
MX4XX10	Mixer 1	Wet Well A	
MX4XX20	Mixer 2	Wet Well B	
EEW4XX90	Emergency Eyewash Station		
JSL4XX01	Control Panel Power Relay	SPS-ICP-4XX Control Panel	
PSU4XX01	24VDC Power Supply 1	SPS-ICP-4XX Control Panel	
PSU4XX02	24VDC Power Supply 2	SPS-ICP-4XX Control Panel	
UPS4XX01	UPS	SPS-ICP-4XX Control Panel	
JU4XX01	Power Monitor Unit		
ATS4XX10	ATS		
GEN4XX10	Genset		
DM4XX91	Combustion Damper		
GDP4XX90	Gas Detection System		
HCP4XX90	HVAC System (Use BAS4XX9X when applicable)		
FAP4XX90	Fire Alarm System		
SEC4XX90	Security System		

Tag Name	Equipment Description	Location	Equipment Specifications
FCP4XX01	Float Control Panel		
FAN4XX91	Wet Well Ventilation Fan	Wet Well	

{Designer is to make adjustment based on station type and requirements}

3. CONTROL MODES

3.1 OVERVIEW

The Facility Name Sewage Pumping Station operates on three different modes. The modes are applicable to the PLC and HMI systems with similar designations.

The Local/Remote Mode of operation is typically made by an operator at the device, MCC or a Local Control Panel by using a selector switch. The different modes are summarized in Table 12.

Table 12 Control Modes for Sewage Pumping Station Equipment

Mode	SCADA
Remote	Remote-Manual
	Remote-Auto
Local	Local

The different control modes apply to all major pieces of equipment associated with the operation of the pumping station. The control mode of operation is determined by a selector-switch on the respective control panel starter.

The positions on the pump starter have the following selections: Local and Remote. The PLC registers the position of the selector switch via dedicated auxiliary input contacts.

The control modes are described in more detail in the following subsections.

3.2 CONTROL MODES DESCRIPTION

3.2.1 Local

When the selector switch is in the Local position, Start/Stop control functions can be initiated manually at the respective device via local start/stop push buttons. All PLC automatic control is disabled when the selector switch is in the Local position. Operation via the PLC is available only when the selector switch is in the Remote position.

The equipment is started and stopped separate from the controller through one of the switches described in Section 3.2.3: Switches and Push Buttons.

3.2.2 Remote

The Remote mode is active when the respective selector switch is in the Remote position. Once the selector switch is in the Remote position, PLC control functions or modes are enabled. The PLC monitors the device mode via auxiliary position contacts on the Local/Remote selector switch. The following subsections describe the three Remote modes in more detail.

3.2.2.1 Remote-Manual

REMOTE-MANUAL is the software-generated manual mode of operation. REMOTE-MANUAL mode represents remote SCADA manual control of equipment through the HMI. This mode is selected via the SCADA system or via the local HMI. When a pump or a piece of equipment is in REMOTE-MANUAL mode, automatic process logic is disabled and Start/Stop functions are initiated manually by Operations Staff via the SCADA system or Local HMI. No software interlocks are present in REMOTE-MANUAL mode.

3.2.2.2 Remote-Auto

REMOTE-AUTO is the software generated, standard process pumping automatic mode of operation. REMOTE-AUTO mode operation is selected via the SCADA system or via the local HMI. REMOTE-AUTO initiates a setting change in the respective PLC such that automatic control logic for equipment operation is enabled. When a pump is in the REMOTE-AUTO mode it will operate in response to the typical process pumping auto logic located within the respective local PLC. This mode is typically used for parallel pump applications.

3.2.3 Switches and Push Buttons

Switches and push buttons located on control panels, MCCs and devices are defined below:

LOCAL – Mode selector switch is in the Local position. The device is in local mode and is controlled independently from the equipment control panel. START/OPEN and STOP/CLOSE push buttons are typically separated.

When sewage pumps are controlled in local all safety interlocks such as overload protection, starter failure, thermal and leak protection are bypassed; it is operator's responsibility to assure that pumps are stopped as needed.

REMOTE – Mode selector switch is in the Remote position. The device is controlled via a separate PLC. When in REMOTE, the local START/OPEN and STOP/CLOSE push buttons are disabled.

AUTO – Mode selector switch is in the Auto position. The device is automatically controlled by the equipment's own control panel, and not via the local START/OPEN and STOP/CLOSE push buttons. In this mode of operation, the START/OPEN and STOP/CLOSE functions are initiated by a proprietary interlock or automation logic in the equipment's control panel.

3.2.4 Emergency Stop

An emergency stop (also known as an E-stop) is typically a red push button with a mushroom head located on a control panel or MCC to stop the operation of a specific device. The E-stop button is different from a regular stop button via the following characteristics:

- It is larger in diameter than a regular STOP push button and projects further from the panel/MCC surface thus allowing easier access to the E-stop.
- It stops the operation of a specific device whether it is in LOCAL or REMOTE modes, while a regular stop button will only work if the device is in LOCAL mode.
- It is typically supplied with a lock reset. Until the E-stop button is reset (pulled out), the specific device will remain locked out, i.e., it will not be permitted to operate.

Table 13 summarizes the Sewage Pumping Station's equipment and the different control modes in which they can operate.

Table 13 Control Modes

Equipment Tag	Equipment Description	Local ☑	Remote-Manual ☑	Remote Auto ☑
GRD4XX10	Inlet Grinder 1	✓	✓	✓
GRD4XX20	Inlet Grinder 2	✓	✓	✓
MX4XX10	Wet Well A Mixer	✓	✓	✓
MX4XX20	Wet Well B Mixer	✓	✓	✓
SP4XX10	Raw Sewage Pump 1	✓	✓	✓
SP4XX20	Raw Sewage Pump 2	✓	✓	✓
SP4XX30	Raw Sewage Pump 3	✓	✓	✓
SP4XX40	Raw Sewage Pump 4	✓	✓	✓
SUP4XX80	Emergency & Maintenance Storage Sump Pump	✓	✓	✓
FV4XX01	Forcemain A Discharge Valve	✓	✓	✓
FV4XX02	Forcemain B Discharge Valve	✓	✓	✓
FV4XX03	Forcemain A Recirculation Valve	✓	✓	✓
FV4XX04	Forcemain B Recirculation Valve	✓	✓	✓
FV4XX11	Raw Sewage Pump 1 Suction Valve	✓	✓	✓
FV4XX12	Raw Sewage Pump 1 Discharge Valve	✓	✓	✓

{Designer is to make adjustment based on station type and requirements}

4. EQUIPMENT I/O

Refer to Appendix 1 for the detailed list of SCADA related I/O signals.

5. CONTROL LOGIC

5.1 STANDARD PROCESS CONDITIONS

5.1.1 Inlet Maintenance Hole Flowmeter

The Facility Name Sewage Pumping Station's Inlet Maintenance Hole is equipped with an area velocity flowmeter that provides the following analog signals to SCADA for monitoring:

- Inlet Maintenance Hole Sewage Level (m)
- Inlet Maintenance Hole Sewage Flow Velocity (m/s)
- Inlet Maintenance Hole Sewage Flow Rate (L/s)

Inlet Maintenance Hole Flowmeter data is used to trend influent flow rates into the pumping station.

5.1.1.1 Calculated/Virtual Inlet Flow Rate

In addition to the Inlet Maintenance Hole Flowmeter, inlet flows into the Facility Name Sewage Pumping Station are calculated as a back-up calculation to the measured inlet flowmeter reading. The calculation uses variations in the Wet Well Master Level during the pump off cycle. The variations are measured only within a range that has a known and consistent cross-sectional area, known as the control volume, to eliminate errors due to irregularly shaped wet well components such as benching and sewers. The inlet flow rate is calculated using the following equation during the pump off cycle only:

$$\mathrm{Q}_{IRC} = \frac{\{\mathrm{H}_2 - \mathrm{H}_1\}}{\mathrm{t}} \times A_W \times 1000$$

Where:

- Q_{IRC} = Calculated Inlet flow Rate (L/s)
- H_2 = Wet Well Master Level at the top of the control volume (m)
- H_1 = Wet Well Master Level at the bottom of the control volume (m)
- t = Time for Wet Well Master Level to increase from H_1 to H_2 (s)
- A_W = fixed cross-sectional area of the control volume (m^2)

{Designer to update the above equation as required to suit the facility requirements.}

5.1.2 Inlet Grinder

The Facility Name Sewage Pumping Station is equipped with {one or two} grinder{s} located in the {Designer to indicate location based on Station Type}.

Under normal operating conditions (i.e. REMOTE-AUTO), the grinder always runs. Failure of the grinder does not interlock sewage pumps or any other equipment in the station. {All Station Types except Type IV include one grinder – Designer to update text accordingly}

Detail of operation and various control modes are as follows:

5.1.2.1 Normal Operating Conditions

The grinder control mode can be selected using the LOCAL/AUTO/ PLC selector switch at the Starter/Local Control Panel, GRD-LCP-4XX.

When the selector switch is in LOCAL position, the grinder will be controlled via a REV/STOP/FWD (Reverse / Stop / Forward) selector switch at the Local Control Panel. While running in forward direction, the forward running indicator lamp will illuminate. While running in reverse direction, the reverse running indicator lamp will illuminate. The station's PLC monitors a common run status signal.

When the selector switch is in AUTO position, the grinder runs continuously in the forward direction without manual operator intervention or PLC control.

In PLC Mode, the grinder is controlled (started/stopped) by the station's PLC in SPS-ICP-4XX control panel. In REMOTE-MANUAL: Mode, the grinder is commanded to run in the forward direction as requested by operations.

In normal operating (REMOTE-AUTO) conditions, the grinder runs continuously in the forward direction. There is no automatic stop signal unless the grinder jams and/or fails to clear a jam. The grinder only runs in reverse direction in case a jam condition is detected. Clearing a jam is triggered and controlled by the Local Control Panel and not by the PLC.

5.1.2.2 Grinder Jam Clearing Sequence

The sequence to clear a grinder jam is as follows: When the current sensor detects a jam, the motor forward contactor is momentarily de-energized. The motor reverse contactor then energizes for a predetermined period (4 seconds), then is de-energized. After the reverse contactor is de-energized, the motor forward contactor is re-energized for a predetermined period (2 seconds). This sequence is repeated for a total of 3 reversals to clear the jam condition in a 30-second period.

During the jam clearing sequence, the inrush current is ignored when the motor is energized to avoid an accidental fault condition. This sequence of de-energizing and re-energizing is to push material back and forth inside the grinder until either the jam is cleared, or 30 seconds have passed.

If the jam is not cleared in accordance with this sequence (3 reversals in a 30-second period), a "Grinder Jammed" alarm condition is issued, and the grinder is stopped. Jam condition is reset through the control devices on the grinder starter/control panel. A grinder jammed alarm is displayed on SCADA.

5.1.3 Wet Well Master Level

{This writeup suites Type I and II – Designer to update as required}

The Facility Name Sewage Pumping Station has a single wet well cell that is equipped with two (2) level transmitters for level monitoring, one hydrostatic level transducer and one {radar/laser/ultrasonic} transmitter.

{This writeup suites Type III and IV – Designer to update as required}

The Facility Name Sewage Pumping Station is equipped with two (2) wet well cells. During normal operating conditions (i.e., REMOTE-AUTO), the two (2) wet wells cells are hydraulically connected since the two (2) wet well interconnecting sluice gates are normally open.

Each wet well cell is equipped with two (2) level transmitters for level monitoring, one hydrostatic level transducer and one {radar/laser/ultrasonic} transmitter.

All level transmitters in the wet well are utilized in a Master Level logic that receives all various LIT readings and selects one common reading referred to as the "Master Level" that is used for pump control as well as alarming. In case of a duty Level transmitter failure or loss of signal, the Master Level automatically updates to use other available transmitters.

The Master Level can be obtained from either the selected duty transmitter or from an average value. Through the HMI screen, operators can choose the desired duty level transmitter, enable/disable each transmitter, and assign duty levels to various LITs that are available. HMI screens also allow the operator to select the average mode, which calculates the average value of the enabled level transmitters.

Level readings from various transmitters are compared against the duty level transmitter when the wet well cells are hydraulically connected. The deviation set point is indicated in the Alarm Setpoints Table. If the difference is above a predetermined deviation set point, an alarm is displayed on SCADA, prompting operator intervention.

5.1.4 Raw Sewage Pumps

5.1.4.1 PLC Mode (Master LIT)

{The following is a typical PLC mode control logic for a constant speed pumping system – Designer to update as required to suit the specific facility type and number of pumps}

The Facility Name Sewage Pumping Station is equipped with *number (#)* sewage pumps. The pumps operate in a Duty / Standby fashion. Under normal operating conditions, the pumps are placed in REMOTE-AUTO mode, where the pumps operate based on the Master Level reading and Duty Start/Stop setpoints that are operator-adjustable through HMI screens.

In PLC Mode, the start and stop of pumps is controlled by the PLC according to the following logic:

<u>On rising wet well level:</u>

- If the Master Level is equal to or greater than the Duty *(pump #)* Start Level Setpoint, Duty *(pump #)* Pump is requested to start.

On dropping wet well level:

- As the pump operates and wet well level drops, Duty *(pump #)* Pump stops once the Master Level is equal to or less than the Duty *(pump #)* Stop Level Setpoint.

In the event that a duty pump is called to start, and it fails to start or is unavailable, the standby pump becomes the duty pump and is called to start instead. Duty rotation can be configured by the operator; see Section 5.1.4.5

Following table provides a list of the control setpoints.

Table 14 Raw Sewage Pumps Level Control Setpoints

SCADA Tag Name	Description	Data Type	Unit	Sig. Digit	Input Range		Default Value	Operator Adjust.	Security Level
					Min.	Max.			

Note: Refer to Standard Drawings for more information regarding wet well level setpoints.
{Designer is to add additional pumps to this table as needed}

{Following section applies when pumps are equipped with VFD; designer is to make adjustments as required}

Speed control:

Table 15 shows minimum and maximum speed of the variable speed pump while operating. While the pump is running, the speed is primarily controlled and adjusted based on the level; however a dedicated PID control loop is used to override the level based speed setpoint as needed to ensure the station min-flow requirement are met.

This PID control loop utilizes station's discharge flow(actual value) and minimum flow setpoint(target value) to provide a min.flow-based speed setpoint for pumps. When min flow -based speed setpoint is greater than level-based setpoint, it will override the level speed setpoint.

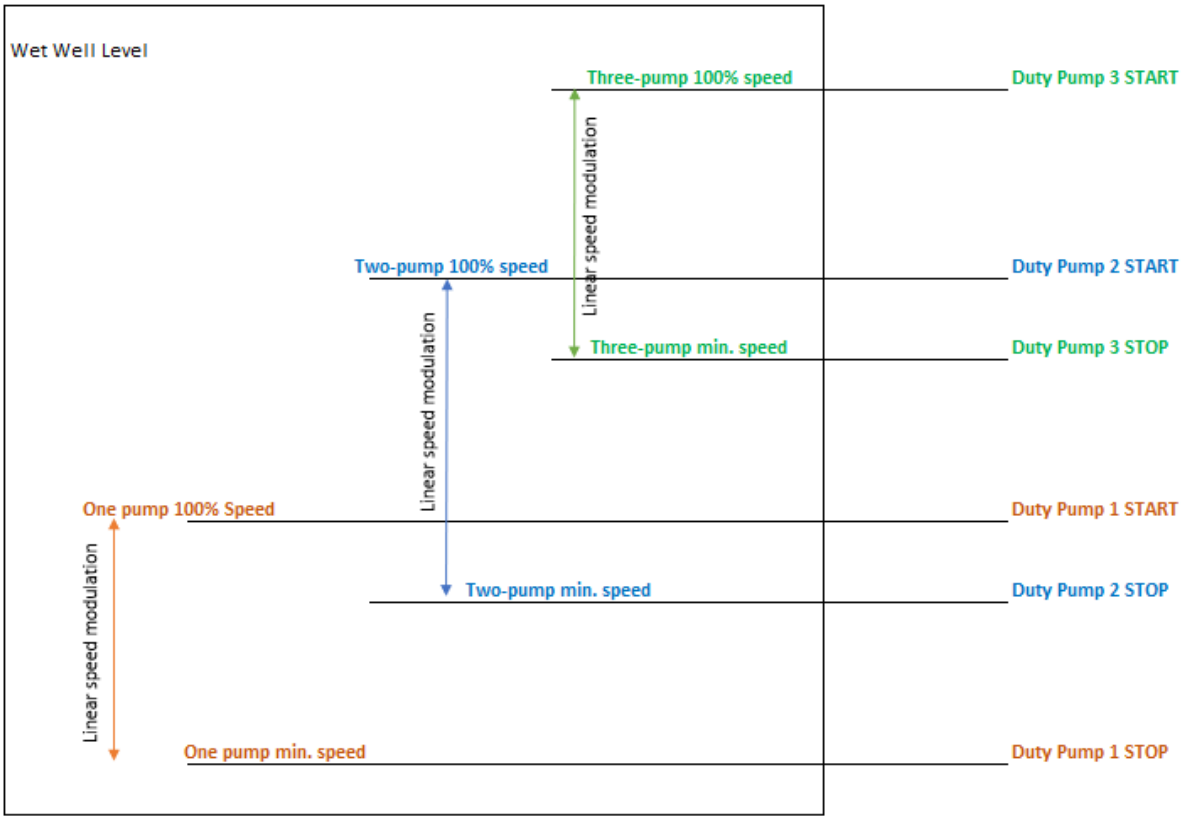
Level-Based Speed control of the VFD Pump is as follows:

- *As the duty pump is requested to start, the VFD pump will start up at minimum speed and will modulate to maximum speed. As the pump runs, the level in the wet well decreases,*

the pump speed will modulate in linear relation with the difference in wet well level between the upper/pump start level setpoint and the lower/pump stop level setpoint.

- *Pumps will run at maximum speed when the wet well level is at or above the pump start level setpoint and will modulate to minimum speed as the level drops to the pump stop level setpoint. Pumps will run in linear relation when in between start and stop level.*
- *Refer to Figure 1 for the overlapping speed operating band between duty pumps.*
- *Two or more duty pumps of the same size running in parallel shall have matching operating speeds according to Table 15.*

Figure 1: Pump Speed modulation between various control bands



1. *This schematic shows control band for variable speed pumping under PLC Auto Control only. Refer to the Region of Peel Standard Drawing SPS-107 for a detailed list of control levels and alarms.*
2. *The schematic is based on Type IV stations with up to 3 duty pumps. Schematic to be adjusted to suit the specific number of duty pumps (excludes standby).*

Table 15 Maximum and Minimum Speed Setpoints of Raw Sewage Pumps

Description	***VFD Pump Speed (%)***		
	Range	***Minimum** Speed*	***Maximum** Speed*
Duty 1 Raw Sewage Pump	*TBD*	*TBD*	*TBD*
Two Duty Raw Sewage Pumps	*TBD*	*TBD*	*TBD*

Description	***VFD Pump Speed (%)***		
	Range	***Minimum** Speed*	***Maximum** Speed*
Three Duty Raw Sewage Pump)	*TBD*	*TBD*	*TBD*

{include only if VFDs are used, designer is to add duty 3 and 4 to table as needed}

The VFDs are configured as shown in Table 16. The pump speed feedback (VFD to PLC analog signal) monitors the full signal range (0-60Hz/ 0-100%); while the speed setpoint (PLC to VFD) is configured in the PLC to prevent pump from operating below the Pump Manufacturer's Minimum Recommended Speed.

Table 16 Speed Configuration of Raw Sewage Pumps VFDs

Description	***VFD Pump** Speed Configuration*		
	***Current** (mA)*	***Speed** (%)*	***Speed (Hz)***
Speed Feedback (from VFD to PLC)	*4 mA*	*0 %*	*0 Hz*
	20 mA	*100 %*	*60 Hz*
Speed Setpoint (from PLC to VFD)	*4 mA*	*Y %*	*X Hz*
	20 mA	*100 %*	*60 Hz*

Where:

X Hz = Minimum VFD Speed
Min VFD speed is determined during commissioning based on the speed of pump when sewage starts flowing in the pipe; all pumps of the same size must have the same min speed; pump max speeds to be always set at 60 Hz(100%).

Y % = Percent value in relation to the X Hz within the 0-60Hz range

i.e: if VFD minimum speed is 30 Hz (X Hz), then Y % would be 50 %.

5.1.4.2 Pump Performance Monitoring

{Note to Designer – Pump Performance Monitoring is only applicable to Pumps with motor sizes equal to or greater than 30 hp which are equipped with Motor Protection Relays and/or a vendor-supplied motor protection system that measures real power}

Individual pump performance is calculated and monitored when the pump is running solo in REMOTE-AUTO to monitor wire-to-water efficiencies over time. The following conditions must be satisfied to calculate the pump specific energy:

- Pump is in REMOTE-AUTO control mode.
- Pump is running as single duty.

- Discharge flowmeter is not faulted.

The following formula is used to calculate the pump specific energy:

$$E = P \div (3.6 \times \mu \times Q)$$

Where:

- E = specific energy of the pump, (kWh/m^3)
- P = measured real power delivered to the pump by the motor protection relay (kW)
- μ = motor efficiency, constant, to be confirmed by the Designer, (fraction)
- Q = discharge flow rate in the forcemain(s) when a single pump runs (L/s)

Specific energy data is calculated during a pump run time and the value is displayed on the HMI and is logged and trended for each pump.

5.1.4.3 Float Back up Control

The Float Control Panel (SPS-FCP-4XX) provides a secondary (back-up) control of the raw sewage pumps in the event of failure of the LITs and/or the PLC.

{The following write up suites Type I and II Stations – Designer to update as required}

The wet well is equipped with the following two (2) level floats:

- Pump Start Float
- Wet Well High-Level Float

{The following write up suites Type III and IV Stations – Designer to update as required}

Each wet well cell is equipped with the following two(2) level floats:

- Pump Start Float
- Wet Well High-Level Float

The level floats are intended to act only in the event of a failure of the electronic equipment (typically the PLC or level transmitters), or under unusually high station flow conditions.

The Pump Start Float in Wet Well A, control Raw Sewage Pumps 1 and 2. The Pump Start Float in Wet Well B, control Raw Sewage Pumps 3 and 4. These floats are wired to the backup float control panel (SPS-FCP-4XX) which will generate hardwired start/ stop commands based on timers to each pump starter circuit. The float signals are also wired to the PLC in SPS-ICP-4XX panel for monitoring purposes.

Should the level in the wet well increase to tip the Pump Start Float (LSH) for the first pre-set period (determined by a hardwired adjustable delay timer located in the FCP), Pump 1 in wet well A or Pump 3 in wet well B is commanded to start through the hardwired circuitry in the Float Control Panel (SPS-FCP-4XX) and direct wiring between float control panel and MCC. Should the level in the wet well remain above the LSH float for a second pre-set period (determined by a hardwired adjustable delay timer located in the FCP), Pump 2 in wet well A or Pump 4 in wet well B starts through the hardwired circuitry between the Float Control Panel and MCC.

Once the pumps are running in Float Backup Control mode (meaning the Start Float tipped to start the pump), the pumps continue to run until the float system stop condition is reached. Backup float stop request in each cell will be generated once the start float is back to normal(hanging) state, one the start float remains hanging for a pre-set period (determined by a hardwired adjustable on-delay timer located in the FCP) Pump 2 in wet well A or Pump 4 in wet well B are commanded to stop through the hardwired circuitry between the Float Control Panel and MCC. As the level remains below the LSH float for an extended period of time Pump 1 in wet well A or Pump 3 in wet well B are commanded to stop through the hardwired circuitry between the Float Control Panel and MCC.

A Bypass/ Backup Active Selector Switch is provided on the float backup control panel; the selector switch must be at “Backup Active” position for the float backup control circuitry to engage. If the selector switch is at “Bypass” position, a signal will be sent to the PLC to alert operators that the float backup control is bypassed; a critical alarm “Backup Float Control Enabled/ Bypassed” will be displayed on SCADA.

Operation of the backup float system can be unlatched/deactivated by manually pushing the reset push button located on the SPS-FCP-4XX.

While the pumps are running on Float Backup Control, the PLC does not control the pumps. The pumps Uncommanded Start/Stop alarms are disabled in the PLC to avoid nuisance alarms and ensure that PLC control can resume automatically given the LIT and PLC are functional.

During the time that backup float system is active/engaged, the pump(s) remain in REMOTE-AUTO mode but are controlled by the Float Backup System circuit. An indicator, “FLOAT” is shown beside the pump on the HMI to indicate which pump is in “FLOAT MODE”. A critical alarm for backup float control mode is displayed on SCADA to notify operators that the wet well is in Float Backup System control.

When the backup float is disengaged, the “FLOAT” indicator on the HMI remains on until the duty pump is started by the PLC in REMOTE-AUTO. When PLC control of the pumps resumes, the critical alarm for “Float control mode active” is cleared

When the Pump Start Float tips to engage “FLOAT MODE”, the PLC starts a timer. If the Pump Stop Request (through the back up float circuit) does not activate within 60 minutes, a critical alarm “Float Mode Failure – LSH4XX0x – Wetwell Cell x Stop Float Condition Did Not Reach (Backup

Mode Running too Long)" is displayed on SCADA. Note that pump performance will deteriorate over time and thus there is a reasonable buffer in the alarm timer. Consequently, this alarm can inform operations of a pumping issue before it becomes serious.

5.1.4.4 Pump Control Scenarios

The table below lists pumps control at various wet well level instruments operating states given that the PLC is functional. In case the PLC fails, the pumps will be controlled through the Float Backup Control Panel.

Table 17 Pump Control and Various Failure Scenarios (applicable to each cell)

Item	Scenarios	Pump Control
1	Normal Operation Both LITs in service	Duty Level (using primary LIT)
2	One LIT failure	Duty Level (using backup LIT)
3	Both LIT failure	Float Backup Control (Relying on LSH to start and stop the pumps based on various timers)
4	PLC failure	Float Backup Control (Relying on LSH to start and stop the pumps based on and various timers)
6	Both LIT failure/PLC failure and backup float LSH is failed	Float Backup Control (LSH failure will start the pumps, pumps will run until an alarm generated to warn the operator about pumps running for too long under backup control)

5.1.4.5 Pump Duty Rotation

The duty rotation of pumps will apply as follows (All of which can be initiated from the HMI):

- Manual Duty Rotation
- Disabled
- All pumps stopped
- Timed Interval

Duty Assignment

Each pumping system consists of a known number of pumps (x). The automation will operate with a known number of Duty Pumps (y) and a known number of Standby Pumps (z). For the pumping systems, there is at least one (1) Standby Pump within each Duty Pump system. The Duty assignments will determine the sequence of operation for the respective pumps.

The Duty Pumps operate as Duty 1, Duty 2, etc., and the standby pumps operate as Standby 1 or Standby 2. Usually there are no more than two (2) standby pumps in a pumping system. The PLC

allows the operator to assign each pump to any duty position or standby position (no duplicate assignments are allowed).

Once the duty assignments have been set, if any Duty Pump fails, is in Delay-on-Restart or is removed from Remote-Auto operation, the PLC will automatically adjust the duty assignments of the remaining available pumps accordingly to replace the failed or unavailable pump. This is accomplished by "bumping up" higher numbered Duty Pumps to replace unavailable pumps.

Pump Availability

Each pump is defined as being available or unavailable as a Duty pump on the SCADA system. Typically, a pump is available if the following conditions exist:

- It is not in Fault
- It is not in Delay Restart (if applicable)
- It is in REMOTE-AUTO mode
- Both the pump inlet and outlet motorized isolation valves are open (applicable to Type Type IV Stations only)
- At least one Forcemain Discharge Valve is open (applicable to Type III or Type IV Stations only)

All Pumps Stopped

If on the duty select screen, "All Pumps Stopped" is selected by the operator from the HMI, rotation will take place each time there is a transition from at least one pump running to all pumps stopped.

When a rotation occurs, the first available pump, starting with the second duty, becomes the first duty pump. If no pump is available, no rotation takes place.

Note that a device can stop either because it has satisfied the process or because there is a failure of the device, either because of interlocks or alarms specific to the device.

Timed Interval

If on the duty select screen "Timed Interval" is selected by the operator from the HMI, pump duty rotation takes place at an operator-selected hour at an operator-selected interval. The interval is a whole number of days (e.g., every 7 days). A count of how many days since the last rotation is maintained and is displayed as "Timed Interval: X days remaining".

When a rotation occurs, the first available pump, starting with the second duty, becomes the first duty pump. If no pump is available, no rotation takes place.

{For VFD pumps, the Designer shall consider rotating the duty based on time to avoid excessive run times on a single pump when modulating speed}

5.1.4.6 Pump Protection

{Designer is to make adjustment based on the motor protection relay (MPR) arrangements and number of sensors installed; NOTE: when possible it is recommended that Leak sensors will be connected to MPR instead of providing a separate leakage protection system}

The pumping equipment will be provided with monitoring equipment to alert operators in the event of an alarm condition and to allow a pump to be shut down to prevent it from being damaged.

All motors greater than 22.4 kW (30 hp) are equipped with RTD temperature sensors. Pump and motor temperatures are monitored at several points, these pumps are equipped with motor protection relays in the respective motor starter and respective RTD temperature sensors are integrated into the motor protection relay. A pump will be shut down in the event of an alarm condition. Upon pump shutdown, the next duty pump start will be initiated.

Table 18 Raw Sewage Pump Monitoring Points

Alarm Event	Quantity per Pump	Trigger Value	Action
Motor outboard bearing	1	High Temperature	Alarm, Stop pump
Motor inboard bearing	1	High Temperature	Alarm, Stop pump
Motor stator windings	3	High Temperature	Alarm, Stop pump
Pump outboard bearing	1	High Temperature	Alarm, Stop pump
Pump inboard bearing	1	High Temperature	Alarm, Stop pump
Vibration monitoring	1	High Vibration	Alarm, Stop pump
Moisture and leakage sensor	2	Leakage detection	Stop pump

The sensors are connected to motor protection relay mounted on the motor starter. The temperature and vibration monitoring points have an “Alarm” (i.e. no shutdown) and a “Stop pump” shut down alarm for each point. The shutdown alarms are hardwired for a controlled shutdown of the motor application.

5.1.5 Forcemains

The Facility Name Sewage Pumping Station is equipped with *number (#)* forcemain(s) that discharges flows to the *name of downstream receiver (maintenance hole number, etc.)*. Table 19 presents the forcemain specifications.

Table 19 Forcemain Specifications

Forcemain	Nominal Size (mm)	Total length (m)	Primary Forcemain Pipe Material and Class	Motorized Isolation Valve?
Forcemain A				
Forcemain B				

{Designer is to make adjustment based on station type. Note: all station types except Type I have two forcemains}

{The following is applicable to Type II stations, designer must select the forcemain A or B as applicable. For Type I, remove reference to two forcemains}

Each forcemain is sized for peak flow. Under normal operating conditions, Forcemain (select A or B) is in operation. Forcemain (select B or A) remains as backup. Operators must manually alternate forcemains to test them and exercise the associated manual valving.

The PLC does not control or monitor which forcemain is in service since the associated isolated valves are manually-operated.

{The following is applicable to Type III and Type IV stations}

Each forcemain is sized for peak flow and is equipped with a motorized isolation valve that is monitored and controlled by the PLC. Under normal operating conditions (i.e., forcemain isolation valves are in REMOTE-AUTO), one of the forcemains is designated as the Duty Forcemain and the other as the Standby Forcemain.

The PLC allows the operator to alternate the duty/standby manually by assigning individual positions (no duplicate assignments are allowed). Operations are also able to select forcemain alternation to be:

- **Disabled -** Once a forcemain is assigned to Duty, the forcemain remains in Duty assignment unless the other forcemain is selected to Duty by the operator through the HMI screen or the forcemain becomes unavailable.
- **Timed Interval** - If on the forcemain duty select screen “Timed Interval” is selected by the operator from the HMI, forcemain duty rotation automatically takes place at an operator-selected hour at an operator-selected interval. The interval is a whole number of days (e.g., every 7 days). A count of how many days since the last rotation is maintained and is displayed as “Timed Interval: X days remaining”.
- **All Pumps Stopped and Valves Closed -** In this case, on a transition when either valve cycles from Open to Closed.

Should the duty forcemain become unavailable for operation (failed), the standby forcemain will become the duty forcemain regardless of the Operator selectable alternation mode. An alarm will be displayed on SCADA to annunciate the forcemain failure.

A forcemain is considered to be unavailable when its associated motorized isolation valve meets one of the following conditions:

- It is in FAULT condition
- It is not in REMOTE-AUTO mode (i.e. LOCAL or OFF)

Forcemains will remain in service/available even if respective flowmeter and pressure transmitter fails.

5.1.6 Raw Sewage Pumps Suction and Discharge Valves

{The following is applicable to Type IV Stations only – Designer to update as required}

The inlet and outlet isolation valves for each dry well pump are equipped with actuators to permit remote monitoring of valve position and to facilitate valve opening and closing. Under normal operation conditions, both inlet and outlet valves are open. The pump inlet and outlet valves are only closed when the associated pump is taken out of service for inspection or removal.

The actuators are normally placed in Local position and there will be no remote operation for these valve actuators, however the status will be monitored by SCADA.

When an inlet or outlet isolation valve is closed, the associated pump is not permitted to start in REMOTE-AUTO mode to avoid damaging the pump.

5.1.7 Forcemain Recirculation Valves

{The following is applicable to Type III and IV Stations only – Designer to update as required}

The discharge header for each forcemain is equipped with a recirculation line that directs flows to the wet well for mixing and resuspending accumulated solids.

The recirculation valve is not permitted to open when:

- Duty 1 not available (no pump available in Remote-Auto)
- Recirculation valve fault, or
- When Duty 2 or Duty 3 pumps are called to start.

The actuators are normally placed in REMOTE-AUTO position. Under typical operating conditions, when the first duty pump is called to start at the beginning of a pump cycle in REMOTE-AUTO mode, the recirculation line valve on the pump's corresponding discharge header fully opens for an operator-adjustable time while the duty 1 pump is running. After a pre-set time period has elapsed, the valve fully closes, and the pump continues operating according to its control logic.

5.1.8 Wet Well Mixers

{The following is applicable to Type III and IV Stations only – Designer to update as required}

Each wet well cell is equipped with a submersible mixer to agitate flows at the onset of a pump cycle. The mixer works in tandem with the recirculation line to maximize flow mixing in the wet well and minimize solids deposition. The wet well mixer is not permitted to start when:

- Duty 1 not available (no pump available in Remote-Auto)
- Mixer fault, or
- When Duty 2 or Duty 3 pumps are called to start.

The mixers are normally placed in REMOTE-AUTO position. Under typical operating conditions, when the first duty pump is called to start at the beginning of a pump cycle in REMOTE-AUTO mode, the mixer located in the pump's corresponding wet well cell operates for an operator-adjustable time while the duty 1 pump is running. After a pre-set time period has elapsed, the mixer stops, and the pump continues operating according to its control logic.

5.1.9 Surge Relief Valves

{Monitoring only, may be applicable only to Type IV, to be determined by the Designer. Only a single point is needed (open status).}

The pressure surge suppression/relief valves are required to prevent the pumping station and forcemains from being damaged by pressure surges that may occur in the event of inappropriate operation or a power failure at the station.

The surge relief valves have been supplied with limit switches such that if a surge relief valve opens to relieve system pressure, a signal will be sent to the SCADA system indicating the valve opening. The valves for the surge relief systems are set to open when the pressure exceeds the maximum allowable pressure, which will be determined by the transient analysis. The surge relief valve opening settings are field adjustable.

5.1.10 Emergency and Maintenance Storage Tank

{Designer to revise the text below to suit the specifics of the facility.}

The Emergency/Maintenance Storage Tank is intended to provide emergency storage of influent sewage flows beyond the capacity of the wet well and inlet sewer in the event of a total station failure. The Emergency/Maintenance Storage Tank is connected to the inlet maintenance hole at an elevation above the inlet sewer. The overflow maintenance hole structure is connected downstream of the Emergency/Maintenance Storage Tank at the critical overflow elevation.

Under normal operating conditions, the Emergency/Maintenance Storage Tank is empty. During a high flow event where the inflow exceeds the pumped flow rate or if all pumps fail to run, wet well level rises above the high-high level alarm; level in the inlet maintenance hole will rise, and flow eventually spills into the tank. An alarm is displayed on SCADA notifying operators once the level in the inlet maintenance hole reaches the Emergency/Maintenance Storage Tank float. This is not considered an overflow event since there is no discharge to the environment at this point and is only indicating that Emergency/Maintenance storage is utilized.

An overflow alarm level float is located in the Emergency/Maintenance Storage Tank at the invert level of the discharge pipe to the environment. When sewage level rises and reaches the float level, an alarm is displayed on SCADA indicating the start of an overflow episode. The overflow level is considered over when the level float is untipped.

Emergency/Maintenance storage tank is also equipped with a level transmitter for monitoring purpose and to indicate the available storage capacity.

{The following section is applicable only where a gravity drain to the wet well is available.}

Although there is a gravity drain from /Maintenance Storage tank to the wet wells, there is a normally closed valve on this line, as such the Emergency/Maintenance Storage Tank is not normally hydraulically connected to the wet well. Therefore, when the wet well level drops and normal pump operations resume, operators need to manually drain the Emergency/Maintenance Storage Tank by opening the manual buried drain valve back to the wet well.

{The following section is applicable where gravity drain to the wet well is not available and a submersible sewage pump is used to drain the Emergency/Maintenance Storage Tank.}

The Emergency/Maintenance Storage Tank is not normally hydraulically connected to the wet well. Therefore, when the wet well level drops, Operators will need to drop a submersible sewage pump in the Emergency/Maintenance Storage Tank to pump the tank back to the inlet maintenance hole.

The pump will be controlled by operators through local controls at the MCC or through the SPS-ICP-4XX PLC in REMOTE-MANUAL; a low level float is installed in the emergency storage tank and an alarm will be displayed on SCADA once it is triggered.

5.1.11 Overflow Maintenance Hole Flowmeter

A flowmeter is installed downstream of the Emergency and Maintenance Storage structure that provides following signals to SCADA for monitoring:

- Overflow Maintenance Hole Sewage Level (m)
- Overflow Flow Velocity (m/s)
- Overflow Sewage Flow Rate (L/s)

The Overflow Flowmeter is used to monitor and quantify any system overflows (discharges to the environment) for purposes of reporting to the MECP.

5.2 INTERLOCK AND PERMISSIVES

An interlock is a condition that must be satisfied before and during device operation. A permissive must only be satisfied before the device is allowed to operate but may change state during operation (having no effect on device operation). All permissives and interlocks must be satisfied prior to device operation. Pumping Stations contain both interlocks and permissives.

5.2.1 Interlocks

In the REMOTE mode, a motor cannot start if any interlock is not satisfied. If a stopped motor is called to start and its interlocks are not satisfied, it will not be started. Similarly, if a running motors interlocks are no longer satisfied, it is called to stop.

Typically, an interlock is used to assure safety or to avoid damage to equipment (e.g., sufficient suction pressure on a pump, overload tripped). Interlocks inherently include the power available signal to the controller such that no motor runs if power is not available.

Table 20 provides a summary of the interlocks at the pumping station.

Table 20 Interlock Summary

Tag	Description	Interlock (Hardwired)	Interlock (Software)
GRD4XX10	Inlet Grinder 1	• Jammed • Motor Overload • Motor High Temp • Emergency Stop	• Fail to Start/ Stop • Uncommanded Start/ Stop
GRD4XX20	Inlet Grinder 2	• Jammed • Motor Overload • Motor High Temp • Emergency Stop	• Fail to Start/ Stop • Uncommanded Start/ Stop
SP4XX10	Raw Sewage Pump 1	• General Failure • Emergency Stop • Wet Well Low Level Float Active	• Fail to Start/ Stop • Uncommanded Start/ Stop • Pump Suction or Discharge valve closed • Forcemain Discharge Pressure High High Alarm • Forcemain Discharge Pressure Low Low Alarm • Both Forcemain Valves Closed (When Available) • Both Forcemain Valves Failed •
SP4XX20	Raw Sewage Pump 2		
SP4XX30	Raw Sewage Pump 3		
SP4XX40	Raw Sewage Pump 4		
FV4XX01	Forcemain A Discharge Valve		• Fail to Open/Close • Uncommanded Open/ Close • Unknown Position
FV4XX02	Forcemain B Discharge Valve		• Fail to Open/Close • Uncommanded Open/ Close • Unknown Position
FV4XX03	Forcemain A Recirculation Valve		• Fail to Open/Close • Uncommanded Open/ Close • Forcemain Discharge Valve Failure

Tag	Description	Interlock (Hardwired)	Interlock (Software)
			• Forcemain Discharge Valve Unknown Position • Duty 1 pump not running
FV4XX04	Forcemain B Recirculation Valve		• Fail to Open/Close • Uncommanded Open/ Close • Forcemain Discharge Valve Failure • Forcemain Discharge Valve Unknown Position • Duty 1 pump not running
MX4XX10	Wet Well A Mixer	• General Failure • Emergency Stop	• Fail to Start/ Stop • Uncommanded Start/ Stop
MX4XX20	Wet Well B Mixer	• General Failure • Emergency Stop	• Fail to Start/ Stop • Uncommanded Start/ Stop

{Designer to add motorized valves interlocks as required}

5.2.2 Permissives

In the REMOTE mode, a motor cannot start if a permission to operate is not satisfied, otherwise known as a permissive (e.g., no lock-out events, power available, etc.). If a stopped motor is called to start and its permissives are not satisfied, it will not be started.

After a motor is started, there is a fixed delay of 240 seconds (per motor) during which no other motor can be started. This is to prevent excessive loads on the mains when recovering from a power failure.

Table 21 includes both permissives that have been hardwired into the control circuits, in addition to permissives that are to be programmed in the software. Interlocks included in the previous table are not included in this table.

Table 21 Permissive Summary

Tag	Description	Permissive (Hardwired)	Permissive (Software) Only for Remote-Auto
SP4XX10	Raw Sewage Pump 1		• Pump Restart inhibit timer Not active (if applicable) • One of the Forcemain Discharge Valves Open (if applicable) • Suction and Discharge valves opened
SP4XX20	Raw Sewage Pump 2		
SP4XX30	Raw Sewage Pump 3		
SP4XX40	Raw Sewage Pump 4		

Tag	Description	Permissive (Hardwired)	Permissive (Software) Only for Remote-Auto
FV4XX03	Forcemain A Recirculation Valve		• Duty 1 pump is in REMOTE-AUTO mode, • Duty 2 AND Duty 3 pumps are not running.
FV4XX04	Forcemain B Recirculation Valve		• Duty 1 pump is in REMOTE-AUTO mode, • Duty 2 AND Duty 3 pumps are not running.
MX4XX10	Wet Well A Mixer		• Duty 1 pump is in REMOTE-AUTO mode, • Duty 2 AND Duty 3 pumps are not running
MX4XX20	Wet Well B Mixer		• Duty 1 pump is in REMOTE-AUTO mode, • Duty 2 AND Duty 3 pumps are not running

{Designer to add motorized valves permissives as required}

5.3 FAULT RESPONSE

For all devices controlled by standard software modules, standard device fault response actions will occur for abnormal device function. These are summarized as follows, for full details refer to the PAIDS Standards.

To place a device into REMOTE-AUTO mode no related alarm conditions can be active and the device's ready to operate permissive must be true. If an alarm condition is active or the ready to operate permissive is not true, the device will be placed back into REMOTE-MANUAL mode.

5.3.1 Inlet Maintenance Hole Flowmeter

Should the Inlet Maintenance Hole flowmeter fail, the flow and total volume information will be unavailable for the flowmeter and an alarm will be displayed on SCADA to notify operations of the instrumentation failure. Pump operation is not impacted.

5.3.2 Inlet Grinder

Should the grinder fail, an alarm will be displayed on SCADA to notify operations. Pump operation is not impacted.

5.3.3 Wet Well Level Transmitters

If one level transmitter fails, then the next available level transmitter will automatically be used for pump level control.

If all level transmitters fail, the PLC will not attempt to start or stop any pumps, as the actual level is unknown in this situation. The pump operation will be carried out by means of the hardwired float switches. Any level transmitter failure is indicated at the HMI through a Loss of Signal Alarm. When neither of the level transmitter is available/selected as a duty for master level, no level transmitter available alarm will be displayed on SCADA.

5.3.4 Raw Sewage Pumps

In the event of a pump failure, an alarm will be displayed on SCADA to notify operations of the failure and the next available pump in the duty table will be called to start.

For a motor, the REMOTE-MANUAL and REMOTE-AUTO start and stop logic is a major part of the device routine. Start permissives must be in place in order for the motor to start. The start output command from the device module is a maintained contact.

Once a motor has been running and is stopped either in REMOTE or LOCAL mode, there is a period of time in which the motor should not be restarted. This is referred to as the “restart inhibit time”.

The following virtual (software generated) alarms are configured for a motor device:

- Fail to Start – Occurs if the running status for the motor is not received after a certain amount of time has elapsed since a request to start in REMOTE mode.
- Fail to Stop – Occurs if the stopped status for the motor is not received after a certain amount of time has elapsed since a request to stop in REMOTE mode.
- Uncommanded Start – Occurs if the pump motor starts in the absence of a request to start in REMOTE mode.
- Uncommanded Stop – Occurs if the pump motor stops but in the absence of a request to stop in REMOTE mode.
- Fail to Reach Speed Setpoint – Occurs if the analog speed feedback for the motor is not achieved after a certain amount of time has elapsed since the speed setpoint in REMOTE mode.

5.3.5 Pump Suction/Discharge Pressure Transmitters

Individual pumps suction/discharge pressure transmitters (if used based on station type) are not used for pump control; however, should a pump suction/discharge pressure transmitter fail, the pump operation will continue running and an alarm will be displayed on SCADA to notify operations of the instrumentation failure.

5.3.6 Forcemain Discharge Pressure Transmitters

Should a forcemain pressure transmitter fail, an alarm will be displayed on SCADA to notify operations of the instrumentation failure. In the event of a high or low pressure alarm recorded by the pressure transmitter, an alarm is displayed on SCADA. However, operation of the pumps is not interrupted.

The failure of forcemain discharge pressure will not interlock the pumps operation.

In type III and IV stations with two redundant discharge forcemain and motorized valves the valves will be cycled by PLC to switch to the second forcemain available. In case of both discharge pressure transmitter failures, an alarm will be displayed on SCADA, however the station will continue operation.

For type II station with two forcemains, since the valves are not motorized, operators must manually cycle the valves to use the alternate forcemain when required.

5.3.7 Forcemain Discharge Flowmeters

In case the forcemain discharge flowmeters fails, an alarm will be displayed on SCADA to notify operations of the instrumentation failure.

In type III and IV stations with two redundant discharge forcemain and motorized valves the valves will be cycled by PLC to switch to the second forcemain available. In case of both discharge flowmeter failures, an alarm will be displayed on SCADA, however the station will continue operation.

For type II station with two forcemains, since the valves are not motorized, operators must cycle the valves to use the alternate forcemain when required.

5.3.8 Pump and Forcemain Discharge Valves

For those valves/ gates that have REMOTE mode of control through the HMI, the PLC logic will inhibit control of the valve in the event that an alarm is generated by the valve and an alarm will be displayed on SCADA.

The following virtual (software generated) alarms are configured for a valve:

- Fail to Open – Occurs if the opened status for the valve is not received after a certain amount of time has elapsed since the request to open in REMOTE mode.
- Fail to Close – Occurs if the closed status for the valve is not received after a certain amount of time has elapsed since the request to close in REMOTE mode.
- Uncommanded Open – Occurs if the opened status for the valve is received in the absence of a request to open in REMOTE mode.
- Uncommanded close – Occurs if the closed status for the valve is received in the absence of a request to close in REMOTE mode.
- Unknown position – Occurs when physically impossible conditions are indicated such as valve is both opened and closed at the same time or is neither opened nor closed at the same time (except during valve travel).
- Fail to Reach Position Setpoint – Occurs if the analog position feedback for the valve is not achieved after a certain amount of time has elapsed since the position setpoint in REMOTE mode.

{The following is applicable to Type IV Stations only. Designer to adjust as required for other types}

In the event of failure of the pump motorized suction or discharge isolation valve, the corresponding pump is removed from the Duty table and becomes unavailable.

In the event that one of the forcemain discharge header motorized valve fails, forcemain duty rotates to the other forcemain. If both forcemain valves fail, then a critical alarm is displayed on SCADA, and an Operator must investigate the conditions on site to ensure that at least one valve is open.

5.3.9 Emergency and Maintenance Storage Tank

Should the Emergency and Maintenance Storage flowmeter fail, the flow and total volume information will be unavailable for the flowmeter and an alarm will be displayed on SCADA to notify operations of the instrumentation failure.

5.3.10 PLC Fault Response

In the event of a PLC failure, the sewage pump(s) will continue to operate based on the backup floats. The SCADA system will generate a critical alarm on SCADA to notify operations of the loss of communications to the PLC.

5.3.11 Communication Failure

In the event of Communication Failure between the sewage pumping station PLC and the SCADA servers, the PLC will continue to run the station in AUTO based on the current setpoints. A critical alarm is displayed on SCADA if the SCADA system loses communication with the local PLC. Note, when only the remote communications are affected by an outage, the local HMI at the pump station will continue to update and be functional monitoring and controlling the station.

5.3.12 Power Failure Response

In the event of a Power Failure, the Generator will automatically start and the Automatic Transfer Switch will transfer the pump station from normal power to generator power. The pumps revert to their previous state - if they were in AUTO, then they will remain in AUTO and start or stop as required based on the level setpoints. Upon transfer of the station back to normal power the generator enters a cool down period before shutting down. If the generator fails to shut down, a time-delayed alarm will be displayed on SCADA to inform the operator of the alarm condition.

Software and Hardwired alarms are suppressed should an Instrument Control Panel (SPS-ICP-4XX) power failure occur to prevent alarm nuisance on the HMI/SCADA system.

Following provides the list of hardwired alarms that are suppressed:

- Pump 1 E-Stop, High Temp, Leak, Vibration alarm, VFD/VSS fault, Motor Protection Trip

- Grinder E-Stop, High Temp, Overload and Jam

{Designer is to provide a preliminary list of alarms to be suppressed during the power failure to make sure various pumps and equipment mode remains in Remote-Auto during the power transition}

5.4 BUILDING SERVICES

5.4.1 Emergency Eyewash Station

If the eye wash station is activated and flow is detected, an alarm is displayed on SCADA , as this may indicate a personnel safety issue. This is defined as a critical alarm; however, it does not impact the process and pump or generator operation.

5.4.2 Smoke/ Carbon Monoxide Detection

In the event of smoke/CO detection in the building, the device will sound locally, and an alarm will be displayed on the SCADA. This is defined as a critical alarm; however, it does not impact the process and pump or generator operation.

5.4.3 Temperature Monitoring

The Sewage Pumping Station is equipped with two temperature transmitters; one is located in the instrument control panel, SPS-ICP-4XX and another in the Electrical Room.

These temperature transmitters are provided for monitoring and alarming only and are not connected to any heating equipment; heating system will be provided by its own dedicated thermostats and temperature sensors.

5.4.4 Sump Pumps/ Flood Protection

The sump pumps are hardwired to high and low level float switches and will start/stop as level float switches are triggered. Station PLC does not control or monitor the operating or fault conditions of the sump pumps; however, a flood float is provided and is monitored by the PLC to alarm on SCADA in case the sump pumps fail to operate.

Wet well pump operation will not be impacted by flood, and they will continue to operate based on wet well level.

5.4.5 Gas Detection

{Designer to remove this section if not applicable or adjust/add details if needed}

The station is provided with a gas detection system that monitors presence of hazardous and explosive gases in the station. The SCADA system does not monitor the value of individual gas concentrations. Refer to the gas detection panel system specifications for details.

If any of the monitored gases exceeds the specified limit in the gas detection panel, the gas detection system will activate the station general gas alarm which will create a warning on SCADA and will activate horns/strobes

Station PLC monitors the following signals:

- Station General Gas Alarm
- Station Gas Panel General Fault

5.4.6 Heating and Ventilation System

{Designer to update this section as required to suit the facility type if not applicable or adjust/add details if needed. Note that in Type IV stations, additional DI points may be required for the HVAC system to monitor the status of individual supply and exhaust fans, or air conditioning, RTU or AHU units. A wet well fan is required for Type III and Type IV stations only.}

Station PLC only monitors the following from ventilation system:

- Wet Well Fan Running Status
- Wet Well Fan General Fault
- HVAC System Running Status
- HVAC System General Fault

5.4.7 Fire Alarm Monitoring

{Designer to remove this section if not applicable or adjust/add details if needed}

A vendor supplied fire alarm panel is the primary means for alarming and monitoring of fire alarm conditions. The fire alarm system monitors the station using smoke and heat sensors installed in various locations; in case of a fire detection, separate fire alarm contacts are wired from fire alarm panel to PLC panel, HVAC panel and Security system panel.

The station PLC monitors the following signals from the Fire Alarm System:

- Station Fire Alarm
- Station Fire Alarm System Fault

Fire alarms will be displayed on SCADA . HVAC system will close all the dampers and shutdown the supply fans to stop air supply to the station. In case of an alarm condition in the station all the doors will be unlocked by security system.

Fire Alarm system is also monitored by authorized monitoring company that will dispatch the fire department to the station.

5.4.8 Security System

Building Security is managed by an Access Control System. Local control and monitoring is provided by a security system controller located in the Security System Control Panel (SPS-SEC-4XX). Each exterior door is monitored for open/ close status and is provided with a card reader for swipe access. Exterior doors use an electric strike which is released upon approved card credentials. A motion detector is installed on the interior side of these doors for unalarmed egress.

Hatches are monitored with magnetic contacts. To open access hatches, the operator must swipe into the exterior control panel doors and disable security to these devices by switching the "hatch contacts" selector switch to "disarm". The key switch operates with a single turn to the right which will toggle between armed and disarmed states. The hatches will need to be armed once work is done to secure the hatches.

The PLC monitors the following signal from the Security System Control Panel:

- Station Intrusion Alarm

5.5 EMERGENCY POWER OPERATION

The sewage pumping station will be provided with one (1) diesel generator which provides emergency power in case of a utility power outage, the generator has a prime rating of XXX kW and is sized to run all the loads in the station.

Upon utility power failure, an automatic transfer switch will sense the utility power failure, sends a run request to generator and once the emergency power is available it will transfer to feed the station from generator power.

During the power transition, PLC will mask the alarms from individual devices and equipment to avoid redundant/nuisance alarms. Alarm masking is done based on the Control Panel Power Failure Status, ATS normal and emergency power availability. Following alarms will be masked during the power transition (when wired Normally close):

- Grinder High Temperature
- Individual pump Failures
- Individual pump E-Stop

{Designer must provide the list all individual alarms masked/suppressed during power transition}

5.5.1 Fuel System

{This section is primarily applicable to diesel fuel. Designer to remove this section if not applicable or adjust/add details if needed for natural gas or dual fuel generator systems.}

6. HMI/SCADA TAGS

6.1 TAG NUMBERS

The P&IDs show each piece of equipment as having a unique tag number. All tag numbers on all equipment labels should match the tag numbers in the process schematic.

6.1.1 Discrete Status Statistics

Discrete status events that are monitored and/or controlled by the SCADA system shall be recorded, annunciated, and controlled as follows:

- Run time shall be calculated based on discrete run status for all equipment
- Discrete alarm status including but not limited to equipment failure, level switches, float switches, shall be time and date stamped as part of the alarm logging

6.1.2 Instrumentation

All process instrumentation equipped with analog signal output to the SCADA system (hard wired or via communications network) have the following programmed functions:

- Current value
- Current and Previous day minimum
- Current and Previous day maximum
- Current and Previous day average

For all flow transmitters, the following additional functions are programmed:

- Current day total
- Previous day total

Each analog signal is historically and instantaneously trended; and has adjustable high and low alarm settings complete with reset values as a minimum requirement.

6.1.2.1 HART Capable Instrumentation

HART is to be enabled for all channels in the PLC program that HART capable devices are wired to. The following parameters are to be monitored:

- Current Value (Instantaneous Value)
- Total Value (Flowmeters Only)
- Instrument Fault

6.1.3 Runtime Accumulators

The runtime for each pump is continuously accumulated. The runtime counter counts in hours and rolls over at 100,000 hours to maintain accuracy. For each pump, daily runtime hours are totalized and kept in the controller for a minimum of eight (8) days for transfer to the reporting system.

6.2 CONTROL SETPOINTS

Following table provides control setpoints for the pumping station:

Table 22 Control Setpoints

Tag Name	Description	Unit	Input Range		Default Value	Details	Operator Adjustable	Security Level
			Min	Max				

{Designer to adjust/add instruments as needed}

6.3 ALARM SETPOINTS

Following table provides alarm setpoints for the pumping station:

Table 23 Analog Instrument Setpoints

Alarm Description	Tag	Unit	Low Low			Low			High			High High			Operator Adjustable	Security Level
			DLY	DEF	PRI	DLY	DEF	PRI	DLY	DEF	PRI	DLY	DEF	PRI		
Wet Well A Level	LIT4XX01	m/%													Yes	Operator
Wet Well Master Level	LIT4XX0X	m/%													Yes	Operator

{Designer to add instruments and identify alarm delay, priorities and default values as needed}

6.4 CRITICAL ALARMS

Following table provides a list of the critical alarms for the pumping station.

Table 24 Critical Alarms

Tag	Description
GRD4XX10_MAH	Inlet Grinder 1 Failed to Start Alarm
GRD4XX10_MAL	Inlet Grinder 1 Failed to Stop Alarm
GRD4XX10_WAH	Inlet Grinder 1 Jammed
GRD4XX10_TAH	Inlet Grinder 1 Motor Winding High Temp
GRD4XX10_IAH	Inlet Grinder 1 Overload
GRD4XX10_HAN	Inlet Grinder 1 E-Stop
LIT4XX01_LOE	Wet Well A Level Transmitter 1 Loss of Echo
LIT4XX01_XAOC	Wet Well A Level Transmitter 1 Open Circuit
LIT4XX01_XALLL	Wet Well A Level Transmitter 1 Out Of Range Lo
LIT4XX01_XAHHH	Wet Well A Level Transmitter 1 Out Of Range Hi
LIT4XX02_XAOC	Wet Well A Level Transmitter 2 Open Circuit
LIT4XX02_XALLL	Wet Well A Level Transmitter 2 Out Of Range Lo
LIT4XX02_XAHHH	Wet Well A Level Transmitter 2 Out Of Range Hi
ML4XXXX_XA_XA	Master Wet Well Level No Transmitter Available Alarm
LIT4XX0X_XAHH	Master Wet Well Level HiHi Alarm
LIT4XX0X_XALL	Master Wet Well Master Level LoLo Alarm
FCP4XX01_ENB	Backup Float Control Enabled/ Bypassed
SP4XX10_FLOAT	Raw Sewage Pump 1 in Float Mode
SP4XX10_MAH	Raw Sewage Pump 1 Failed to Start
SP4XX10_MAL	Raw Sewage Pump 1 Failed to Stop
SP4XX10_MUAH	Raw Sewage Pump 1 Uncommanded Start
SP4XX10_MUAL	Raw Sewage Pump 1 Uncommanded Stop
SP4XX10_ZHXA	Raw Sewage Pump 1 Failed to Reach Speed Setpoint (if applicable)
SP4XX10_XA	Raw Sewage Pump 1 Overload/ VFD/SS Fault
SP4XX10_HAN	Raw Sewage Pump 1 Emergency Stop
SP4XX10_FAL	Raw Sewage Pump 1 Leak Alarm
SP4XX10_VAH	Raw Sewage Pump 1 Vibration Alarm
SP4XX10_TAH	Raw Sewage Pump 1 High Temp Alarm
SP4XX10_SAOC	Raw Sewage Pump 1 Speed Feedback Open Circuit (if applicable)
SP4XX10_SAHHH	Raw Sewage Pump 1 Speed Feedback Out of Range High (if applicable)
SP4XX10_SALLL	Raw Sewage Pump 1 Speed Feedback Out of Range Lo (if applicable)
SP4XX20_FLOAT	Raw Sewage Pump 2 in Float Mode
SP4XX20_MAH	Raw Sewage Pump 2 Failed to Start

Tag	Description
SP4XX20_MAL	Raw Sewage Pump 2 Failed to Stop
SP4XX20_MUAH	Raw Sewage Pump 2 Uncommanded Start
SP4XX20_MUAL	Raw Sewage Pump 2 Uncommanded Stop
SP4XX20_ZHXA	Raw Sewage Pump 2 Failed to Reach Speed Setpoint (if applicable)
SP4XX20_XA	Raw Sewage Pump 2 General Failure
SP4XX20_HAN	Raw Sewage Pump 2 Emergency Stop
SP4XX20_FAL	Raw Sewage Pump 2 Leak Alarm
SP4XX20_VAH	Raw Sewage Pump 2 Vibration Alarm
SP4XX20_TAH	Raw Sewage Pump 2 High Temp Alarm
SP4XX20_SAOC	Raw Sewage Pump 2 Speed Feedback Open Circuit (if applicable)
SP4XX20_SAHHH	Raw Sewage Pump 2 Speed Feedback Out of Range High (if applicable)
SP4XX20_SALLL	Raw Sewage Pump 2 Speed Feedback Out of Range Lo (if applicable)
PSV4XX01_ZSO	Feedermain A Surge Relief Valve Open Status
PSV4XX02_ZSO	Feedermain B Surge Relief Valve Open Status
LSH4XX85_LAH	Emergency and Maintenance Storage High Level Alarm
LSH4XX83_LAH	Valve Chamber Flood Alarm
JSL4XX01_JAL	Control Panel SPS-ICP-4XX Power Failure
UPS4XX01_XA	Control Panel SPS-ICP-4XX UPS Fault
PLC001_COMMS_ERROR	Loss of Communication to 10 Peel
PLC001_FAULT	PLC Controller Faulted
LSH4XXX01_FLOAT_XA	Float Mode Failure – Wetwell Cell A Stop Float Condition Did Not Reach (Backup Mode Running too Long)
LSH4XXX02_FLOAT_XA	Float Mode Failure – Wetwell Cell A Stop Float Condition Did Not Reach (Backup Mode Running too Long)

{Above list does not include all the critical alarms; designer is to evaluate alarm priorities during alarm management planning and propose the list of critical alarms(to be called out) for approval based on the site requirement; variable speed related alarms for pumps to be maintained only if VFDs are used; }

APPENDIX 1

I/O TABLE

APPENDIX 1 – I/O Table

{The following I/O table is provided as reference only and does not include all the input/output tags; this list must be updated to include all tags including but not limited to pumps, grinders, valves, instruments, and control and communication system tags and alarms. designer is to make adjustments in this based on station type, alarm management plans (i.e. alarming, priorities and delays) to suit the site requirement}

INPUTS/OUTPUTS (I/O)

Real/ Virtual	Type	Tag Name	Description	Event Logging	Alarming/PRI	PLC Alarm Delay	Trending	Historical Data Logging
REAL	AI	FIT4XX03_XICOND	Inlet Maintenance Hole Sewage Flow				✓	✓
VIRTUAL	DI	FIT4XX03_XA	Inlet Maintenance Hole Sewage Flowmeter Fault					
VIRTUAL	DI	FIT4XX03_XAHH	Inlet Maintenance Hole Sewage Flow HiHi Alarm		✓/TBD	TBD		
VIRTUAL	DI	FIT4XX03_XAH	Inlet Maintenance Hole Sewage Flow Hi Alarm					
VIRTUAL	DI	FIT4XX03_XAL	Inlet Maintenance Hole Sewage Flow Lo Alarm					
VIRTUAL	DI	FIT4XX03_XALL	Inlet Maintenance Hole Sewage Flow LoLo Alarm					
VIRTUAL	AI	FIT4XX03_XCHH	Inlet Maintenance Hole Sewage Flow HiHi Setpoint	✓				
VIRTUAL	AI	FIT4XX03_XCH	Inlet Maintenance Hole Sewage Flow Hi Setpoint	✓				
VIRTUAL	AI	FIT4XX03_XCL	Inlet Maintenance Hole Sewage Flow Lo Setpoint	✓				
VIRTUAL	AI	FIT4XX03_XCLL	Inlet Maintenance Hole Sewage Flow LoLo Setpoint	✓				
VIRTUAL	DI	FIT4XX03_XAOC	Inlet Maintenance Hole Sewage Flow Open Circuit		✓/TBD	TBD		
VIRTUAL	DI	FIT4XX03_XAHHH	Inlet Maintenance Hole Sewage Flow Out Of Range Hi		✓/TBD	TBD		
VIRTUAL	DI	FIT4XX03_XALLL	Inlet Maintenance Hole Sewage Flow Out Of Range Lo		✓/TBD	TBD		

Real/ Virtual	Type	Tag Name	Description	Event Logging	Alarming/PRI	PLC Alarm Delay	Trending	Historical Data Logging
VIRTUAL	DI	FIT4XX03_XARC	Inlet Maintenance Hole Sewage Flow Rate Of Change Alarm		✓/TBD	TBD		
VIRTUAL	AI	FIT4XX03_XCRC	Inlet Maintenance Hole Sewage Flow Rate Of Change Setpoint	✓				
VIRTUAL	AI	FIT4XX03_TMX	Inlet Maintenance Hole Sewage Flow Maximum Today					
VIRTUAL	AI	FIT4XX03_YMX	Inlet Maintenance Hole Sewage Flow Maximum Yesterday					
VIRTUAL	AI	FIT4XX03_TMN	Inlet Maintenance Hole Sewage Flow Minimum Today					
VIRTUAL	AI	FIT4XX03_YMN	Wet Well A Level Minimum Yesterday					
VIRTUAL	AI	FIT4XX03_TAV	Inlet Maintenance Hole Sewage Flow Average Today					
VIRTUAL	AI	FIT4XX03_YAV	Inlet Maintenance Hole Sewage Flow Average Yesterday					
VIRTUAL	AI	FIT4XX03_TTT	Inlet Maintenance Hole Sewage Flow Total Today					
VIRTUAL	AI	FIT4XX03_YTT	Inlet Maintenance Hole Sewage Flow Total Yesterday					
REAL	AI	FIT4XX03_LI_XICOND	Inlet Maintenance Hole Sewage Flow- Level				✓	✓
REAL	AI	FIT4XX03_SI_XICOND	Inlet Maintenance Hole Sewage Flow-Speed				✓	✓
REAL	DI	GRD4XX10_YN	Inlet Grinder 1 Control Mode	✓				
REAL	DI	GRD4XX10_MN	Inlet Grinder 1 Running Status	✓				
VIRTUAL	DI	GRD4XX10_REQYNA	Inlet Grinder 1 Rem-Auto Mode Request	✓				
VIRTUAL	DI	GRD4XX10_REQYNM	Inlet Grinder 1 Rem-Manual Request	✓				
VIRTUAL	DI	GRD4XX10_YNA	Inlet Grinder 1 Rem-Auto Mode Status	✓				

Real/ Virtual	Type	Tag Name	Description	Event Logging	Alarming/PRI	PLC Alarm Delay	Trending	Historical Data Logging
VIRTUAL	DI	GRD4XX10_YNM	Inlet Grinder 1 Rem-Manual Mode Status	✓				
VIRTUAL	DI	GRD4XX10_MAH	Inlet Grinder 1 Failed To Start Alarm		✓/TBD	TBD		
VIRTUAL	DI	GRD4XX10_MAL	Inlet Grinder 1 Failed To Stop Alarm		✓/TBD	TBD		
VIRTUAL	DI	GRD4XX10_MUAH	Inlet Grinder 1 Uncommanded Start Alarm		✓/TBD	TBD		
VIRTUAL	DI	GRD4XX10_MUAL	Inlet Grinder 1 Uncommanded Stop Alarm		✓/TBD	TBD		
REAL	DI	GRD4XX10_IAH	Inlet Grinder 1 Motor Overload Alarm		✓/TBD	TBD		
REAL	DI	GRD4XX10_TAH	Inlet 1 Motor Winding High Temperature		✓/TBD	TBD		
REAL	DI	GRD4XX10_XA	Inlet Grinder 1 General Failure		✓/TBD	TBD		
REAL	DI	GRD4XX10_HAN	Inlet Grinder 1 E-Stop		✓/TBD	TBD		
REAL	DI	GRD4XX10_WAH	Inlet Grinder 1 Over Torque Alarm		✓/TBD	TBD		
VIRTUAL	DI	GRD4XX10_VAH	Inlet Grinder 1 Vibration High Alarm					
VIRTUAL	DI	GRD4XX10_PAH	Inlet Grinder 1 Pressure High Alarm					
VIRTUAL	DI	GRD4XX10_FAL	Inlet Grinder 1 Low Flow Alarm					
VIRTUAL	DI	GRD4XX10_NA	Inlet Grinder 1 Not Available Status	✓				
VIRTUAL	DI	GRD4XX10_NAXA	Inlet Grinder 1 Not Available Alarm					
VIRTUAL	DI	GRD4XX10_YUXA	Inlet Grinder 1 Alarm Reset Request	✓				
REAL	DO	GRD4XX10_MH	Inlet Grinder 1 Start Command	✓				
REAL	DO	GRD4XX10_ML	Inlet Grinder 1 Stop Command	✓				
VIRTUAL	AI	GRD4XX10_KQI	Inlet Grinder 1 Running Hours					✓
VIRTUAL	AI	GRD4XX10_YQN	Inlet Grinder 1 Number of Starts					
VIRTUAL	AI	GRD4XX10_TKQI	Inlet Grinder 1 Running Hours Today					

Real/ Virtual	Type	Tag Name	Description	Event Logging	Alarming/PRI	PLC Alarm Delay	Trending	Historical Data Logging
VIRTUAL	AI	GRD4XX10_TYQN	Inlet Grinder 1 Number of Starts Today					
VIRTUAL	DI	GRD4XX10_KQC	Inlet Grinder 1 Running Hours Reset Request	✓				
VIRTUAL	DI	GRD4XX10_YQC	Inlet Grinder 1 Number of Starts Reset Request	✓				
REAL	AI	LIT4XX01_XICOND	Wet Well A Level 1				✓	✓
VIRTUAL	DI	LIT4XX01_XAHH	Wet Well A Level 1 HiHi Alarm					
VIRTUAL	DI	LIT4XX01_XAH	Wet Well A Level 1 Hi Alarm					
VIRTUAL	DI	LIT4XX01_XAL	Wet Well A Level 1 Lo Alarm					
VIRTUAL	DI	LIT4XX01_XALL	Wet Well A Level 1 LoLo Alarm					
VIRTUAL	AI	LIT4XX01_XCHH	Wet Well A Level 1 HiHi Setpoint					
VIRTUAL	AI	LIT4XX01_XCH	Wet Well A Level 1 Hi Setpoint					
VIRTUAL	AI	LIT4XX01_XCL	Wet Well A Level 1 Lo Setpoint					
VIRTUAL	AI	LIT4XX01_XCLL	Wet Well A Level 1 LoLo Setpoint					
VIRTUAL	DI	LIT4XX01_XAOC	Wet Well A Level 1 Open Circuit		✓/TBD	TBD		
VIRTUAL	DI	LIT4XX01_XAHHH	Wet Well A Level 1 Out Of Range Hi		✓/TBD	TBD		
VIRTUAL	DI	LIT4XX01_XALLL	Wet Well A Level 1 Out Of Range Lo		✓/TBD	TBD		
VIRTUAL	DI	LIT4XX01_XARC	Wet Well A Level 1 Rate Of Change Alarm		✓/TBD	TBD		
VIRTUAL	AI	LIT4XX01_XCRC	Wet Well A Level 1 Rate Of Change Setpoint	✓				
VIRTUAL	AI	LIT4XX01_TMX	Wet Well A Level 1 Maximum Today					
VIRTUAL	AI	LIT4XX01_YMX	Wet Well A Level 1 Maximum Yesterday					
VIRTUAL	AI	LIT4XX01_TMN	Wet Well A Level 1 Minimum Today					
VIRTUAL	AI	LIT4XX01_YMN	Wet Well A Level Minimum Yesterday					

Real/ Virtual	Type	Tag Name	Description	Event Logging	Alarming/PRI	PLC Alarm Delay	Trending	Historical Data Logging
VIRTUAL	AI	LIT4XX01_TAV	Wet Well A Level 1 Average Today					
VIRTUAL	AI	LIT4XX01_YAV	Wet Well A Level 1 Average Yesterday					
REAL	DI	LIT4XX01_LOE	Wet Well A Level 1 Transmitter Loss Of Echo		✓/TBD	TBD		
VIRTUAL	AI	LIT4XX0X_XICOND	Wet Well Master Level				✓	✓
VIRTUAL	DI	LIT4XX0X_XAHH	Wet Well Master Level HiHi Alarm		✓/TBD	TBD		
VIRTUAL	DI	LIT4XX0X_XAH	Wet Well Master Level Hi Alarm		✓/TBD	TBD		
VIRTUAL	DI	LIT4XX0X_XAL	Wet Well Master Level Lo Alarm		✓/TBD	TBD		
VIRTUAL	DI	LIT4XX0X_XALL	Wet Well Master Level LoLo Alarm		✓/TBD	TBD		
VIRTUAL	AI	LIT4XX0X_XCHH	Wet Well Master Level HiHi Setpoint	✓				
VIRTUAL	AI	LIT4XX0X_XCH	Wet Well Master Level Hi Setpoint	✓				
VIRTUAL	AI	LIT4XX0X_XCL	Wet Well Master Level Lo Setpoint	✓				
VIRTUAL	AI	LIT4XX0X_XCLL	Wet Well Master Level LoLo Setpoint	✓				
VIRTUAL	DI	LIT4XX0X_XAOC	Wet Well Master Level Open Circuit					
VIRTUAL	DI	LIT4XX0X_XAHHH	Wet Well Master Level Out Of Range Hi					
VIRTUAL	DI	LIT4XX0X_XALLL	Wet Well Master Level Out Of Range Lo					
VIRTUAL	AI	LIT4XX0X_TMX	Wet Well Master Level Maximum Today					
VIRTUAL	AI	LIT4XX0X_YMX	Wet Well Master Level Maximum Yesterday					
VIRTUAL	AI	LIT4XX0X_TMN	Wet Well Master Level Minimum Today					
VIRTUAL	AI	LIT4XX0X_YMN	Wet Well Master Level Minimum Yesterday					
VIRTUAL	AI	LIT4XX0X_TAV	Wet Well Master Level Average Today					
VIRTUAL	AI	LIT4XX0X_YAV	Wet Well Master Level Average Yesterday					

Real/ Virtual	Type	Tag Name	Description	Event Logging	Alarming/PRI	PLC Alarm Delay	Trending	Historical Data Logging
REAL	DI	MX4XX10_YN	Wet Well A Mixer Remote Mode	✓				
REAL	DI	MX4XX10_MN	Wet Well A Mixer Running Status	✓				
VIRTUAL	DI	MX4XX10_REQYNA	Wet Well A Mixer Rem-Auto Mode Request	✓				
VIRTUAL	DI	MX4XX10_REQYNM	Wet Well A Mixer Rem-Manual Request	✓				
VIRTUAL	DI	MX4XX10_YNA	Wet Well A Mixer Rem-Auto Mode Status	✓				
VIRTUAL	DI	MX4XX10_YNM	Wet Well A Mixer Rem-Manual Mode Status	✓				
VIRTUAL	DI	MX4XX10_MAH	Wet Well A Mixer Failed To Start Alarm		✓/TBD	TBD		
VIRTUAL	DI	MX4XX10_MAL	Wet Well A Mixer Failed To Stop Alarm		✓/TBD	TBD		
VIRTUAL	DI	MX4XX10_MUAH	Wet Well A Mixer Uncommanded Start Alarm		✓/TBD	TBD		
VIRTUAL	DI	MX4XX10_MUAL	Wet Well A Mixer Uncommanded Stop Alarm		✓/TBD	TBD		
VIRTUAL	DI	MX4XX10_IAH	Wet Well A Mixer Motor Overload Alarm					
VIRTUAL	DI	MX4XX10_TAH	Wet Well A Mixer High Temperature					
REAL	DI	MX4XX10_XA	Wet Well A Mixer General Fault	✓	✓			
REAL	DI	MX4XX10_HAN	Wet Well A Mixer E-Stop	✓	✓			
VIRTUAL	DI	MX4XX10_WAH	Wet Well A Mixer Over Torque Alarm					
VIRTUAL	DI	MX4XX10_VAH	Wet Well A Mixer Vibration Alarm					
VIRTUAL	DI	MX4XX10_PAH	Wet Well A Mixer Pressure High Alarm					
VIRTUAL	DI	MX4XX10_FAL	Wet Well A Mixer Leak Alarm					
VIRTUAL	DI	MX4XX10_NA	Wet Well A Mixer Not Available Status	✓				
VIRTUAL	DI	MX4XX10_NAXA	Wet Well A Mixer Not Available Alarm					
VIRTUAL	DI	MX4XX10_YUXA	Wet Well A Mixer Alarm Reset Request	✓				

Real/ Virtual	Type	Tag Name	Description	Event Logging	Alarming/PRI	PLC Alarm Delay	Trending	Historical Data Logging
REAL	DO	MX4XX10_MH	Wet Well A Mixer Start Command	✓				
REAL	DO	MX4XX10_ML	Wet Well A Mixer Stop Command	✓				
VIRTUAL	AI	MX4XX10_KQI	Wet Well A Mixer Running Hours					
VIRTUAL	AI	MX4XX10_YQN	Wet Well A Mixer Number of Starts					
VIRTUAL	AI	MX4XX10_TKQI	Wet Well A Mixer Running Hours Today					
VIRTUAL	AI	MX4XX10_TYQN	Wet Well A Mixer Number of Starts Today					
VIRTUAL	DI	MX4XX10_KQC	Wet Well A Mixer Running Hours Reset Request	✓				
VIRTUAL	DI	MX4XX10_YQC	Wet Well A Mixer Number of Starts Reset Request	✓				
REAL	DI	LSH4XX01_LAH	Raw Sewage Pump 1 Start Float Active	✓				
REAL	DI	LSH4XX01_LAHH	Raw Sewage Pump 2 Start Float Active	✓				
REAL	DI	LSH4XX01_LAL	Raw Sewage Pump 1 Stop Float Active	✓				
REAL	DI	LSH4XX01_LALL	Raw Sewage Pump 2 Stop Float Active	✓				
REAL	DI	LSH4XX02_LAH	Raw Sewage Pump 3 Start Float Active	✓				
REAL	DI	LSH4XX02_LAHH	Raw Sewage Pump 4 Start Float Active	✓				
REAL	DI	LSH4XX02_LAL	Raw Sewage Pump 3 Stop Float Active	✓				
REAL	DI	LSH4XX02_LALL	Raw Sewage Pump 4 Stop Float Active	✓				
REAL	DI	FCP4XX01_ENB	Backup Float Control Enabled/ Disabled	✓				
REAL	AI	SP4XX10_SI	Raw Sewage Pump 1 Speed Feedback (if applicable)				✓	✓
REAL	DI	SP4XX10_YN	Raw Sewage Pump 1 Remote Mode	✓				
REAL	DI	SP4XX10_MN	Raw Sewage Pump 1 Running Status	✓				

Real/ Virtual	Type	Tag Name	Description	Event Logging	Alarming/PRI	PLC Alarm Delay	Trending	Historical Data Logging
VIRTUAL	DI	SP4XX10_REQYNA	Raw Sewage Pump 1 Rem-Auto Mode Request	✓				
VIRTUAL	DI	SP4XX10_REQYNM	Raw Sewage Pump 1 Rem-Manual Request	✓				
VIRTUAL	DI	SP4XX10_YNA	Raw Sewage Pump 1 Rem-Auto Mode Status	✓				
VIRTUAL	DI	SP4XX10_YNM	Raw Sewage Pump 1 Rem-Manual Mode Status	✓				
VIRTUAL	DI	SP4XX10_MAH	Raw Sewage Pump 1 Failed To Start Alarm		✓/TBD	TBD		
VIRTUAL	DI	SP4XX10_MAL	Raw Sewage Pump 1 Failed To Stop Alarm		✓/TBD	TBD		
VIRTUAL	DI	SP4XX10_MUAH	Raw Sewage Pump 1 Uncommanded Start Alarm		✓/TBD	TBD		
VIRTUAL	DI	SP4XX10_MUAL	Raw Sewage Pump 1 Uncommanded Stop Alarm		✓/TBD	TBD		
VIRTUAL	DI	SP4XX10_ZHXA	Raw Sewage Pump 1 Failed to Reach Speed Setpoint (if applicable)		✓/TBD	TBD		
VIRTUAL	DI	SP4XX10_SAOC	Raw Sewage Pump 1 Speed Feedback Open Circuit (if applicable)		✓/TBD	TBD		
VIRTUAL	DI	SP4XX10_SAHHH	Raw Sewage Pump 1 Speed Feedback Out of Range Hi (if applicable)		✓/TBD	TBD		
VIRTUAL	DI	SP4XX10_SALLL	Raw Sewage Pump 1 Speed Feedback Out of Range Lo (if applicable)		✓/TBD	TBD		
REAL	DI	SP4XX10_IAH	Raw Sewage Pump 1 Motor Overload Alarm		✓/TBD	TBD		
REAL	DI	SP4XX10_TAH	Raw Sewage Pump 1 High Temperature		✓/TBD	TBD		
REAL	DI	SP4XX10_XA	Raw Sewage Pump 1 Overload/ VFD/ SS Fault		✓/TBD	TBD		
REAL	DI	SP4XX10_XA2	Raw Sewage Pump 1 Protection Relay Trip		✓/TBD	TBD		
REAL	DI	SP4XX10_HAN	Raw Sewage Pump 1 E-Stop		✓/TBD	TBD		
VIRTUAL	DI	SP4XX10_WAH	Raw Sewage Pump 1 Over Torque Alarm					
REAL	DI	SP4XX10_VAH	Raw Sewage Pump 1 Vibration Alarm		✓/TBD	TBD		

Real/ Virtual	Type	Tag Name	Description	Event Logging	Alarming/PRI	PLC Alarm Delay	Trending	Historical Data Logging
VIRTUAL	DI	SP4XX10_PAH	Raw Sewage Pump 1 Pressure High Alarm					
REAL	DI	SP4XX10_FAL	Raw Sewage Pump 1 Leak Alarm		✓/TBD	TBD		
VIRTUAL	DI	SP4XX10_NA	Raw Sewage Pump 1 Not Available Status	✓				
VIRTUAL	DI	SP4XX10_NAXA	Raw Sewage Pump 1 Not Available Alarm					
VIRTUAL	DI	SP4XX10_YUXA	Raw Sewage Pump 1 Alarm Reset Request	✓				
REAL	DO	SP4XX10_MH	Raw Sewage Pump 1 Start Command	✓				
REAL	DO	SP4XX10_ML	Raw Sewage Pump 1 Stop Command	✓				
REAL	AO	SP4XX10_SC	Raw Sewage Pump 1 Speed Setpoint (if applicable)					
VIRTUAL	AI	SP4XX10_YNMS	Raw Sewage Pump 1 Manual Speed Setpoint (if applicable)	✓				
VIRTUAL	AI	SP4XX10_YNAS	Raw Sewage Pump 1 Automatic Speed Setpoint (if applicable)					
VIRTUAL	AI	SP4XX10_KQI	Raw Sewage Pump 1 Running Hours					✓
VIRTUAL	AI	SP4XX10_YQN	Raw Sewage Pump 1 Number of Starts					
VIRTUAL	AI	SP4XX10_TKQI	Raw Sewage Pump 1 Running Hours Today					
VIRTUAL	AI	SP4XX10_TYQN	Raw Sewage Pump 1 Number of Starts Today					
VIRTUAL	DI	SP4XX10_KQC	Raw Sewage Pump 1 Running Hours Reset Request	✓				
VIRTUAL	DI	SP4XX10_YQC	Raw Sewage Pump 1 Number of Starts Reset Request	✓				
REAL	AI	FIT4XX01_XICOND	Forcemain A Discharge Flow				✓	✓
REAL	AI	FIT4XX01_FQ	Forcemain A Total Discharge Flow					✓

Real/ Virtual	Type	Tag Name	Description	Event Logging	Alarming/PRI	PLC Alarm Delay	Trending	Historical Data Logging
REAL	DI	FIT4XX01_XA	Forcemain A Discharge Flowmeter Fault		✓/TBD	TBD		
VIRTUAL	DI	FIT4XX01_XAHH	Forcemain A Discharge Flow HiHi Alarm					
VIRTUAL	DI	FIT4XX01_XAH	Forcemain A Discharge Flow Hi Alarm					
VIRTUAL	DI	FIT4XX01_XAL	Forcemain A Discharge Flow Lo Alarm					
VIRTUAL	DI	FIT4XX01_XALL	Forcemain A Discharge Flow LoLo Alarm					
VIRTUAL	AI	FIT4XX01_XCHH	Forcemain A Discharge Flow HiHi Setpoint					
VIRTUAL	AI	FIT4XX01_XCH	Forcemain A Discharge Flow Hi Setpoint					
VIRTUAL	AI	FIT4XX01_XCL	Forcemain A Discharge Flow Lo Setpoint					
VIRTUAL	AI	FIT4XX01_XCLL	Forcemain A Discharge Flow LoLo Setpoint					
VIRTUAL	DI	FIT4XX01_XAOC	Forcemain A Discharge Flow Open Circuit		✓/TBD	TBD		
VIRTUAL	DI	FIT4XX01_XAHHH	Forcemain A Discharge Flow Out Of Range Hi		✓/TBD	TBD		
VIRTUAL	DI	FIT4XX01_XALLL	Forcemain A Discharge Flow Out Of Range Lo		✓/TBD	TBD		
VIRTUAL	DI	FIT4XX01_XARC	Forcemain A Discharge Flow Rate Of Change Alarm		✓/TBD	TBD		
VIRTUAL	AI	FIT4XX01_XCRC	Forcemain A Discharge Flow Rate Of Change Setpoint	✓				
VIRTUAL	AI	FIT4XX01_TMX	Forcemain A Discharge Flow Maximum Today					
VIRTUAL	AI	FIT4XX01_YMX	Forcemain A Discharge Flow Maximum Yesterday					
VIRTUAL	AI	FIT4XX01_TMN	Forcemain A Discharge Flow Minimum Today					
VIRTUAL	AI	FIT4XX01_YMN	Forcemain A Discharge Minimum Yesterday					
VIRTUAL	AI	FIT4XX01_TAV	Forcemain A Discharge Flow Average Today					

Real/ Virtual	Type	Tag Name	Description	Event Logging	Alarming/PRI	PLC Alarm Delay	Trending	Historical Data Logging
VIRTUAL	AI	FIT4XX01_YAV	Forcemain A Discharge Flow Average Yesterday					
VIRTUAL	AI	FIT4XX01_TTT	Forcemain A Discharge Flow Total Today					
VIRTUAL	AI	FIT4XX01_YTT	Forcemain A Discharge Flow Total Yesterday					
REAL	DI	FV4XX01_YN	Forcemain A Discharge Valve Control Mode	✓				
VIRTUAL	DI	FV4XX01_YNA	Forcemain A Discharge Valve Rem- Auto Mode Status	✓				
VIRTUAL	DI	FV4XX01_YNM	Forcemain A Discharge Valve Rem-Manual Mode Status	✓				
REAL	DI	FV4XX01_ZSO	Forcemain A Discharge Valve Opened Status (Forcemain A in Service)	✓				
REAL	DI	FV4XX01_ZSC	Forcemain A Discharge Valve Closed Status	✓				
VIRTUAL	DI	FV4XX01_ZX	Forcemain A Discharge Valve Intermediate Status	✓				
REAL	DI	FV4XX01_NA	Forcemain A Discharge Valve Not Available	✓				
VIRTUAL	DI	FV4XX01_ZXA	Forcemain A Discharge Valve General Alarm	✓				
VIRTUAL	DI	FV4XX010_REQYNA	Forcemain A Discharge Valve Rem-Auto Request	✓				
VIRTUAL	DI	FV4XX01_REQYNM	Forcemain A Discharge Valve Rem-Manual Request	✓				
REAL	DO	FV4XX01_VC	Forcemain A Discharge Valve Close Request	✓				
REAL	DO	FV4XX01_VO	Forcemain A Discharge Valve Open Request	✓				
VIRTUAL	DI	FV4XX01_YQC	Forcemain A Discharge Valve Cycle Counts Reset Request	✓				
VIRTUAL	DI	FV4XX01_YUXA	Forcemain A Discharge Valve Alarm Reset Request	✓				
VIRTUAL	DI	FV4XX01_ZAH	Forcemain A Discharge Valve Failed To Open Alarm		✓/TBD	TBD		

Real/ Virtual	Type	Tag Name	Description	Event Logging	Alarming/PRI	PLC Alarm Delay	Trending	Historical Data Logging
VIRTUAL	DI	FV4XX01_ZAL	Forcemain A Discharge Valve Failed To Close Alarm		✓/TBD	TBD		
VIRTUAL	DI	FV4XX01_ZUAH	Forcemain A Discharge Valve Uncommanded Open Alarm		✓/TBD	TBD		
VIRTUAL	DI	FV4XX01_ZUAL	Forcemain A Discharge Valve Uncommanded Close Alarm		✓/TBD	TBD		
VIRTUAL	DI	FV4XX01_ZUXA	Forcemain A Discharge Valve Unknown Position Alarm		✓/TBD	TBD		
VIRTUAL	DI	FV4XX01_NAXA	Forcemain A Discharge Valve Not Available Alarm		✓/TBD	TBD		
VIRTUAL	AI	FV4XX01_YQN	Forcemain A Discharge Valve Cycle Counts					✓

Appendix D: Sewage Pumping Station Standard Drawings

Drawing No.	Drawing Title
SPS-101	General Legend
SPS-102	SPS Type I Process Flow Diagram
SPS-103	SPS Type II Process Flow Diagram
SPS-104	SPS Type III Process Flow Diagram
SPS-105	SPS Type IV Process Flow Diagram
SPS-106	Emergency and Maintenance Storage
SPS-107	Wet Well Operating Levels
SPS-108	Bypass Piping and Inspection Port Detail
SPS-109	Wet Well Clean-Out Pipe Detail
SPS-110	Wet Well Ventilation and Accessories
SPS-111	Hatch Details
SPS-112	Personnel Davit Sleeve, Travel Restraint, Anchor Point and Grab Bar Details
SPS-113	Air Valve Detail
SPS-114	Duplex Sump Pump Detail
SPS-115	Building Water Service Plumbing
SPS-116	Pressure Monitoring Assembly Detail
SPS-117	Single Forcemain Outlet Chamber
SPS-118	Dual Forcemain Outlet Chamber
SPS-201	Electrical Legend
SPS-202	ATS with Bypass Detail
SPS-203	Pump X FVNR Starter Control Schematic 1
SPS-204	Pump X FVNR Starter Control Schematic 2

Drawing No.	Drawing Title
SPS-205	Pump X VFD Control Schematic 1
SPS-206	Pump X VFD Control Schematic 2
SPS-207	Pump X Soft Starter Control Schematic 1
SPS-208	Pump X Soft Starter Control Schematic 2
SPS-209	Pump X Pump Controls – Panel Layouts
SPS-210	Inlet Grinder Control – Panel Schematic
SPS-211	Inlet Grinder Control – Panel Layout
SPS-212	Junction Box Installation Details
SPS-213	Wet Well EYS Seal Detail - Pump Cable Junction Box
SPS-214	Dry Well/Valve Chamber Ventilation Fan Control Panel Schematic
SPS-215	Backup Float Control Panel
SPS-301	P&ID Legend
SPS-302	Type I P&ID
SPS-303	Type II P&ID
SPS-304	Type III P&ID 1 of 2
SPS-305	Type III P&ID 1 of 2
SPS-306	Type IV P&ID 1 of 2
SPS-307	Type IV P&ID 2 of 2
SPS-308	Building Services P&ID
SPS-309	Normal and Standby Power P&ID
SPS-310	Level Transducer Mounting Detail 1
SPS-311	Level Transducer Mounting Detail 2
SPS-312	Level Float Switch Mounting Details
SPS-313	Gas Sensor Mounting Details

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