WASTEWATER LIFT STATION DESIGN GUIDELINES

October 2016

Table of Contents

APPENDIX A MASTER CONTROL PHILOSOPHY

LIST OF FIGURES

1.0 GENERAL

A. Introduction

This document was developed by Water Resources and Water Services hereby jointly addressed as "**Water**" to outline the minimum design requirements to build wastewater lift stations for The City of Calgary. Recognizing that each lift station operates uniquely, it is the responsibility of the Design Engineer (internal and/or consultant) to ascertain that the minimum standards are met and that additional considerations are taken into account for the station to operate as intended.

Modifications to *existing lift stations* must meet the requirements outlined in this document where applicable. Any deviations from this Guideline require approval from **Water**.

B. Applicable Regulations

It is the responsibility of the owner or designated consultant undertaking the project to comply with all statutory requirements governing the work. These include regulations published by Occupational Health and Safety, Alberta Environment and Sustainable Resource Development, The City of Calgary Building Codes and Regulations, The Canadian Electrical Code, National Building Code of Canada, National Plumbing Code, National Fire Protection Association 820 and others as applicable.

C. Applicable City of Calgary Specifications and Guidelines

This guideline must be used in conjunction with the most current edition of the following documents:

1. Standard Specifications, Sewer Construction
2. Standard Specifications, Waterworks Construction
3. Standard Specifications, Roads Construction
4. Standard Specifications, Landscape Construction
5. Standard Specifications, Street Lighting Construction
6. Design Guidelines for Development Site Servicing Plans
7. Design Guidelines for Subdivision Servicing

These documents can be found at The City of Calgary Urban Development website using the link:
http://www.calgary.ca/PDA/pd/Pages/Urban-Development/Urban-Development-publications.aspx

2.0 SUBMISSION and APPROVAL PROCESS

A. Review and Approval

This section provides information on the general steps and procedures that are followed when reviewing design applications for both public and private lift stations for The City of Calgary. Submission requirements are outlined to help applicants meet Water's minimum requirements and other regulatory compliance requisites. **Figure 1** shows the typical application and approval process.

1. Area Structure Plan (ASP)

Area Structure Plan lays out the following: preliminary land use, transportation and servicing information which are developed by The City, Developer and impacted stakeholders. During this time, The City will define the conceptual sanitary servicing strategy for the ASP area including any requirement for lift stations. This servicing strategy will be based on the projected population in the sanitary catchments.

ASP Process is initiated by Planning and Development (P&D)-Community Planning. Infrastructure Planning (IP)–Development Planning is responsible for the ASP Process to go through efficiently within Water.

At the ASP Stage, the lift station is put into the City's Budget with rough cost estimates and schedule. Lift Stations can be done in the following three scenarios:

a. Developer Funded/Developer Built – The developer is financing the project and is responsible for interfacing with relevant City entities to ensure that all required specifications are adhered to. Once completed, the lift stations can be operated and maintained by the Developer or later donated to The City for operation and maintenance.

b. City Funded/Developer Built – These are lift stations that are designed and built by the Developer and turned-over to The City once the Construction Completion Certificate (CCC) is issued. Upfront costs of permitting, designing and constructing the lift station falls on the Developer, however, The City reimburses them at a later date. Construction Finance Agreement (CFA) needs to be in place for this setup.

c. City Funded/City Built – As the name implies, The City is responsible for setting aside budget to finance the construction of the lift station throughout the full life cycle of the project.

In any of the above three scenarios, the steps outlined below need to be followed with appropriate guidance from The City, regardless of the applicant's origin.

2. Land Use, Outline Plan and Road Closure (LOC)

The LOC Process starts with Planning and Development-Community Planning Team. Infrastructure Planning-Development Approvals is responsible for reviewing the LOC Process and IP–Development Planning identifies funding obligations.

As an advisory comment to the LOC process, The City will identify the funding obligations (City or Developer funded), status and timeline for the construction of the lift station (for City-funded sites). At the discretion of The City, the following funding and financing options may be considered:

a. **Developer Funded**: A Development Agreement will be executed and the developer is responsible for all costs associated with the design and construction of the lift station. This will include provisions regarding maintenance periods and responsibilities. Any associated Development Permits will be appropriately conditioned for compliance with the Development Agreement.

b. **City Funded but Developer Financed**: This is applied in situations where The City assumes funding obligations to build the lift station but the Developer requests construction to start prior to availability of City funds. Construction Finance Agreement (CFA) is required to establish the construction and financing conditions between The City and the Developer.

3. Sanitary Servicing Study (SSS)

The City will require that a Sanitary Servicing Study (SSS) be submitted by the Applicant (City or Developer), and accepted as a "Prior to Approval" condition of the LOC. The SSS will establish proposed sewer catchment areas, anticipated population densities and peak flows, and sanitary servicing phasing.

The study will need to outline the required building footprint and access to support the proposed land use designation for the parcel to be utilized for the station. The SSS will also confirm any need for sanitary lift stations, and update the conceptual servicing strategy in the event that these lift stations were not identified at the ASP stage.

4. Pre-Submission Engagement

Developer Built - Once funding requirements, Development Agreements and Sanitary Servicing Study have all been approved, the applicant can contact the Leader of Development Approvals (DA) to arrange for a pre-submission meeting with key stakeholders: DA, Project Engineering-Underground (PE-U), Field Services (FS), Control Systems Services (CSS) and Electrical, Instrumentations and Controls (EIC).

City Built - All pre-submission engagement and preliminary/detailed design and construction submission should be directed through the assigned Project Manager from Infrastructure Delivery, Project Engineering-Underground (PE-U).

This meeting will facilitate a first round review of the project. High level information of the proposed lift station like project background and design considerations can be put into a *memorandum letter* for discussion purposes during the meeting.

5. Preliminary Design Report

After gathering input from stakeholders during the pre-submission meeting, Preliminary Design Report can now be submitted to Development Approvals if developer-built or to PE-U Project Manager for City-built projects. This report includes high level information on the background of the proposed lift station that would give all parties a good understanding of the project scope. Refer to **Table 1**: Submission Package Requirements for more details.

Temporary elements such as propane tanks, access roads, as well as phased elements (wet well expansion, additional pump installation and electrical/gas demand changes) will be detailed in the report.

6. Technical Design Brief Report / Construction Design Drawings

After commentaries from the preliminary design report have all been addressed, the applicant can now submit Technical Design Brief Report together with Design Drawings which contain more detailed information of the proposed lift station facility. During this stage, design details are considered to be 60-90% complete. Three hard copies and a PDF of the report must be submitted for review.

City Built – 60-90% Detail Drawings Review

Developer Built – Prelim and Final Detail Drawings Review

7. Development Liaison/Development Permit (DL/DP)

Following approval of the Technical Design Brief, DL/DP application can then be submitted to Planning and Development–Calgary Approval with the following information: building site, parcel size, location, and utility connections in accordance with standard DL/DP submittal requirements. Detailed interior building mechanical plans must be included in the drawings. A PDF of the application is required.

8. Development Site Servicing Plan

After approval of Technical Design Brief Report and DP/DL, Development Site Servicing Plan (DSSP) can now be submitted to Planning and Development – Development Site Servicing. This ensures that water, storm and sanitary service connections are designed according to all applicable codes and design standards.

9. Building Permit

All lift stations require an approved Building Permit before construction starts. Refer to calgary.ca for more information on building permit application requirements.

10. Construction

Construction can be started once IFC Drawings (City-built) /Final Detail Drawings (Developer-built) and all regulatory permits including building permit are obtained. Infrastructure Delivery-Capital Inspectors as well as Field Services, Control Systems Services and Electrical, Instrumentations and Controls must be engaged during construction. Notice of Installation from Infrastructure Delivery is required for all lift stations.

11. Operation and Maintenance Manual

Prior to the Lift Station start-up, the Applicant submits the Operation and Maintenance (O&M) Manual to Development Approvals. It must be approved prior to issuance of the CCC. The O&M Manual will include complete equipment manufacturers' operation, maintenance, service and repair instructions. Complete workshop manuals and parts lists for all mechanical and electrical equipment is required.

12. Construction Completion Certificate (CCC)

CCC process is initiated by the Applicant through engagement with Infrastructure Delivery-Capital Inspections. Capital inspectors conduct the CCC inspection together with Field Services (FS) staff. Operations and maintenance obligations are defined in the Development Agreement. Maintenance period of two years commences on the date when Construction Completion Certificate is issued.

13. Final Acceptance Certificate (FAC)

Final Acceptance Certificate can be requested once all deficiencies have been addressed and when the maintenance period is almost finished. FAC will be granted when Field Services is satisfied that the lift station is operating as intended and as-built drawings and O&M Manuals have been verified to be accurate.

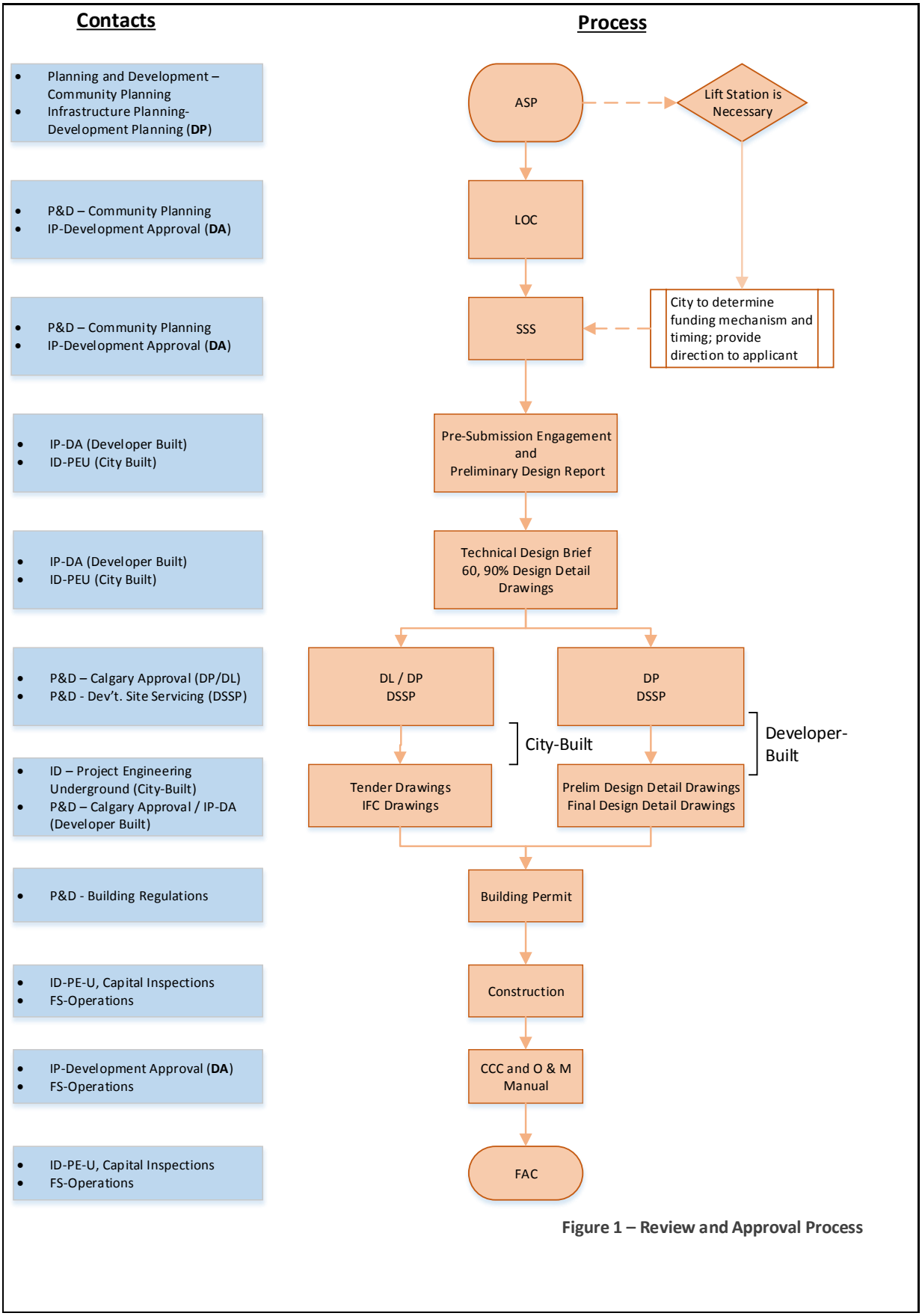


Figure 1 – Review and Approval Process

B. Documents Required for Submission

All lift station design projects must have the following submissions:

1. Preliminary Design Report – High level information on the background of the proposed lift station project and submitted before proceeding with Technical Design Brief Report.

   The Preliminary Design Report should also address all options for servicing the area under consideration and do a TBL or cost/benefit analysis to justify the recommended option. If there are outstanding risks involved with the recommended option, the report should outline how these will be mitigated.

2. Technical Design Brief Report – Detailed information on the background of the proposed lift station that forms the basis of the 90% detailed design drawings.

Table 1.0 Submission Package Requirements

Preliminary Design Report	Technical Design Brief Report
Introduction: ▪ Background ▪ Project Scope ▪ Purpose of the Report	Introduction: ▪ Background ▪ Project Scope ▪ Purpose of the Report
Site Description and Conditions ▪ Location, conditions and existing grade ▪ Lot delineation and dimensions, land use designation, building outline and dimensions ▪ Preliminary site plan (roads, access, general site drainage, existing site and surrounding topography)	Site Description and Conditions ▪ Location, conditions and existing grade ▪ Lot delineation and dimensions, land use designation, building outline and dimensions ▪ Overall site plan (roads, access, general site drainage, existing site and surrounding topography) ▪ Site drainage should be addressed in the Storm Water Management Report for the phase of development in which the station is located ▪ Geotechnical conditions
Design Considerations ▪ General compliance of design with AENV Standards and Guideline for Municipal Waterworks, Wastewater and Storm Drainage Systems	Design Considerations ▪ Detailed compliance of design with AENV Standards and Guideline for Municipal Waterworks, Wastewater and Storm Drainage Systems
Phased Design Flow Rate Calculations ▪ Phase of Development Area ▪ Number of units and type ▪ Assumed population ▪ Per capita flow rate ▪ Infiltration average and peak ▪ Average total flow rate estimate ▪ Peak flow rate and peak factor ▪ Appropriate Service Phasing	Phased Design Flow Rate Calculations ▪ Phase of Development Area ▪ Number of units and type ▪ Assumed population ▪ Per capita flow rate ▪ Infiltration average and peak ▪ Average total flow rate estimate ▪ Peak flow rate and peak factor ▪ Appropriate Service Phasing
Final Development Area Information ▪ Population density ▪ Area to be serviced ▪ Per capita flow rate	Final Development Area Information ▪ Population density ▪ Area to be serviced ▪ Per capita flow rate

▪ Infiltration average and peak ▪ Average total flow rate estimate ▪ Peak flow rate and peak factor Forcemain Sizing and Hydraulic Grade Line Analysis ▪ Pipe size and material ▪ Flow rates designed according to City design criteria ▪ Design average flow and peak flow ▪ Consideration of velocities during initial development stages and at completion ▪ Hydraulics included in design drawing package ▪ Pump working pressure and shut-off pressure ▪ Pipe pressure rating	▪ Infiltration average and peak ▪ Average total flow rate estimate ▪ Peak flow rate and peak factor Forcemain Sizing and Hydraulic Grade Line Analysis ▪ Pipe size and material ▪ Forcemain plan and profile ▪ Flow rates designed according to City design criteria ▪ Design average flow and peak flow ▪ Consideration of velocities during initial development stages and at completion ▪ Hydraulics included in design drawing package ▪ Pump working pressure and shut-off pressure ▪ Pipe pressure rating ▪ By-pass measures
Wet well sizing ▪ Capacity (include pump calculations)	Wet well sizing ▪ Active capacity (include pump calculations) ▪ Maximum storage capacity (include pump calculations) ▪ Dimensions of all wet well areas, location and elevation of influent main within wet well
Station Overflow ▪ Mitigation measures for outages or failures ▪ Level of redundancy	Station Overflow ▪ Mitigation measures for outages or failures ▪ Level of redundancy for each potential failure mode
Lift Station Layout Details ▪ General description ▪ Fencing and access	Lift Station Site and Building Layout Details ▪ General description ▪ Architectural and landscape description ▪ Fencing and access ▪ Security considerations (e.g. fencing design, exterior lighting, etc.) ▪ Site drainage and Low Impact Development strategies when applicable ▪ Full size Civil Plan ▪ Full size Building Plan
Equipment Overview ▪ Pump (include forcemain and pump curve) ▪ HVAC (include blower and furnace sizing)	Equipment and Instrumentation Overview ▪ Pump (include forcemain and pump curve) ▪ Masticators and mixers ▪ Wet well liquid level monitoring systems ▪ Piping and Instrumentation Single Line Diagram ▪ HVAC (include blower and furnace specifications) ▪ Odor Control for wet well exhaust ▪ Full size mechanical Plan
Electrical and Controls System ▪ Utility power supply ▪ Back-up power generator sizing ▪ Control system and monitoring	Electrical and Control System ▪ Utility power supply, and ENMAX transformer and utility line location ▪ Power quality meter, transient voltage surge

	suppressor, main breaker size ▪ Back-up power generator specifications and related systems (e.g. automatic transfer switch, battery charger, etc.) ▪ Station interior and exterior lighting ▪ Primary and secondary pump control systems ▪ Lift Station Monitoring System and network architecture
Temporary Elements ▪ Propane tanks, potable water tanks, access roads ▪ Phased elements (wet well expansion, additional pump installation , electrical/gas demand changes	Temporary Elements ▪ Propane tanks, potable water tanks, access roads ▪ Phased elements (wet well expansion, additional pump installation , electrical/gas demand changes
Projected present value of annual operating costs over service life of facility	Projected present value of annual operating costs over service life of facility

3. Design Guideline Checklist (Refer to Appendices C)
4. Control Process Narrative (Refer to Appendix A)
5. 90% Detailed Drawings

   Pump curves, forcemain system curve(s), NPSH curves, air valve operational document and transient calculations must be included in the construction drawings. At the discretion of **Water**, certified pump curves may be requested. This information must be submitted prior to pump installation.
6. Issued for Tender Drawings for City-Built Lift Stations
7. Issued for Construction Drawings (City-Built) /Final Detailed Design Drawings (Developer-Built)
8. Contract Specifications
9. Shop drawings for pumps, generators, MCC, PLC and Factory Acceptance Testing documentation. Additional shop drawings may be requested by The City's Engineer.
10. PLC Program in PDF and submitted electronically in a USB Drive.
11. Detailed Commissioning Plan and Checklist
12. Commissioning Report (outlining deficiencies)
13. Follow-up Commissioning Report (confirming all deficiencies have been rectified)
14. Record Drawings. Original drawings must be stamped and signed, plus electronic copy in PDF and CAD files.
15. Operations and Maintenance Manual. Details regarding the temporary or phased construction must be included in the Operations & Maintenance Manual explaining the nature of each temporary or phased construction element.
16. Construction Completion Certificate (CCC).
17. As-built Drawings showing all changes from approved drawings.
18. Final Acceptance Certificate (FAC).

3.0 SITE LAYOUT

A. Land Use

All new lift stations should be located on a separate Public Utility Lot (PUL) with S-CRI land-use designation. Consultation with Water Resources, Development Approval is required for different land-use designations. If it is an existing lift station, the current land-use designation may remain, unless otherwise directed to change. The final legal plans must be submitted to The City. Encroachments are not permitted within the lot unless approved by Water Resources.

Location of the lift station must comply with all setback requirements as set out by the land-use designation and other significant infrastructure (i.e. collector roads). Contact Water Resources-Development Engineering for more information on setback requirements.

B. Topography

Lift station site must be conducive to encourage gravity flow from the sewer mains into the lift station. Any future drainage areas must also be considered in site selection. Additionally, the site must have proper drainage to ensure all surface water is sufficiently directed away from the site. If applicable, reference in detail the related Master Drainage Plan for the land area that includes the lift station site.

Lift stations within a 1:100 year floodplain must obtain written approval by Water Resources.

C. Access

Vehicle access and parking space must be provided at the lift station (minimum 4.0m clearance around the lift station building is required). Minimum of 2 hard surface parking spaces are required conforming to the Land Use Bylaw. Vehicle access road minimum width is 4.0m (13 feet) and road and parking area must be paved. Pavement structure must be robust enough to handle loads from heavy trucks (HS 20). Please refer to The City of Calgary Road Design Specifications for more details.

A turning movement diagram must be submitted to demonstrate that the vehicle can maneuver around the site with no difficulty. The diagram is to be submitted as part of the detailed design drawings.

D. Fencing and Signage

A security fence must be installed around the perimeter of the lift station site. The fence must be at least 1.8 m high and have a 1 m wide man-gate and a double 2.4 m (4.8 m total) swinging gate for access. The access gate must be large enough to allow entry by a 35' Vactor type truck. All gates must swing open all the way and have provision for chains and locks. All posts will be set in concrete.

Please refer to the most recent version of *The City of Calgary, Corporate Security, Security Standards for Building and Sites* for more details and additional requirements.

Appropriate signage must be affixed on the fence listing the following information:

1. Lift station name
2. Building Address
3. City contact number (i.e. 3-1-1), or in the case of private lift station, contact number of the operating group.
4. "No Trespassing" Statement

E. Landscaping

Landscaping around the wastewater lift station fence line is permitted if it is required to match the subdivision's aesthetics. Otherwise, the landscaping must blend into the surroundings; should require less water and low maintenance. Landscaping around the lift station must not impede on building components such as generator exhaust, access roads, and odor control ventilation.

F. Overhead Clearance

The lift station must not be located in proximity to any overhead utilities. Designers must comply with any setback requirements outlined by the utility provider. In addition, maintenance equipment cannot interfere with overhead utilities or structures.

4.0 SITE SERVICING

A. Potable Water

A minimum of 50 mm diameter (2 inch) water service with appropriate backflow prevention must be provided. The water service will be used for domestic purposes as well as to clean the wet well. Special considerations must be made on the water supply and the size of the wet well. In some cases, 50mm water service may not provide sufficient pressure or supply to clean larger wet wells. Upsizing the service pipe may be required on these situations.

All domestic cold water piping is to be labeled "domestic cold water". The piping in the dry well and wet well service area should be labeled as "non-potable water". If a water service installation is not possible prior to the lift station starting to operate, a temporary water tank may be used to service the lift station. Temporary water system designs require approval from **Water** prior to installation. Sizing of the tank must take into consideration uses within the lift station. Water for cleaning the wet wells will have to be brought in by a water truck. However, all provisions required to receive potable water must be installed in advance. The permanent water service line must be installed prior to FAC.

B. Natural Gas

Building stand-by generator will be serviced by natural gas via continuous piped supply service. The gas lines servicing the building and stand-by generator must be designed by a qualified professional engineer to meet the pressure and load requirements specified by this equipment. This information is to be documented in the Operation & Maintenance Manual. The required service pressure and load must be verified by simultaneous testing of the stand-by generator (and HVAC, if applicable) at full capacity. The testing must be completed prior to FAC, and documented in the Operation & Maintenance Manual.

Any temporary gas systems are to be approved in writing prior to installation and replaced with the permanent gas service prior to FAC.

C. Station Power

The main power supply will be underground 600 V, AC 3 phase, 3-wire. Power supply will be sized to handle all design capacity loads at full build-out plus an additional 25% to account for unaccounted future loads. This requirement is applicable for lift stations that will be expanded in the future. Stand-by Power is discussed in Section 9.0.

5.0 LIFT STATION BUILDING

A. Building Interior

At a minimum, the building interior must have the components listed below. It is the responsibility of the design engineer to identify any additional items that should be included inside the building that would aid in the day-to-day operations of the lift station.

1. The wet well area will be separated by a wall from the rest of the lift station. The wet well side will meet Class 1, Zone 2 of the Canadian Electrical Code. These electrical components must be explosion proof or in explosion proof enclosures. All other electrical components (i.e. PLC, MCC, etc.) will be located in the other side of the lift station.
2. Provide the lift station with a unisex washroom that has a tankless hot water heater, sink, mop sink and dual-flush low-water toilet.
3. Provide floor drains for each separate room or section that cannot share a common drain (e.g. boiler room).
4. A hose bib and hose rack will be provided in the wet well area of the building. The hose bib will match the size of the incoming water service outlined in Section IV, A (minimum 50 mm).
5. There will be an entrance large enough to facilitate the removal of the generator, if required.
6. Equip all doors with an interior panic bar.
7. Equip lift station with CO, H2S and LEL (NOX as required) gas sensors and transmitters for rooms or sections around the hazardous areas (e.g. stand-by generators, boilers, natural gas area heaters, wet wells). The gas sensors and transmitter must be rated to operate between -30 deg C and +60 deg C, and 5% and 95% relative humidity (non-condensing), be CSA approved Class 1, Division 1, Groups B, C, and D, and meet the National Electrical Manufacturers 4X enclosure rating. The transmitter must also have 4-20mA output, sensor diagnostics, remote reset capabilities, and be capable of sensor separation distances of at least 100 feet. Placement of these sensors must be shown in the detailed design drawings. Refer to Appendix B for more details. Equip lift station with heat and smoke detectors. The heat detector fixed temperature setting will be 57° Celsius. The smoke detector will be dual ionization/photoelectric type. Placement of these sensors must be shown in the detailed design drawings.
8. Equip lift station buildings with an intrusion alarm for each exterior door and access hatch. All detectors are to be connected to the control panel (see Appendix B for remote annunciation).
9. All lift station buildings will have a non-strobe warning beacon that turns from green to red in the alarm state, inside and outside the lift station, with an auditory alarm inside the lift station. Warning beacons shall be installed adjacent to the entry doors that are inside and outside the hazardous areas. The warning beacon inside the wet well area must comply with Class 1 Zone 2 regulations. These warning beacons will activate upon the following alarms:
    a. High H_2S levels *(set to the OH&S 8 hour exposure limit).*
    b. High CO levels *(set to the OH&S exposure limit).*
    c. High LEL and NOX, if applicable
    d. Heat/smoke alarm.
10. Provide a hoist system with rail and electric hoist for pump removal. Any hoists rated 1.0 ton or less can be manually operated. The hoist rail is to provide access from immediately above the pump hatch and extend at least 1.0 m outside the pump room to facilitate loading on to a truck. The hoist and support must be certified by the Manufacturer and Structural Engineer.

11. Fall protection and safety retrieval equipment is required in each station. Approved fall protection and safety retrieval equipment must meet current Alberta OH & S code and regulations. Fall protection products shall be DBI-SALA or equivalent. No platforms or ladders used will interfere with retrieval operation from the wet wells. Details of engineered connections are to be contained in the record drawings. Fall protection must be provided for entry into confined/restricted spaces and tie-off areas for working over open hatches. Ladder cages are not permitted. Removable handrails around all hatches must be provided.

12. Wall mounted eye wash stations will be located in the wet well area beside the exit, dry well (if applicable) beside the entrance stairs and beside the main entrance door to the building.

B. Building Exterior

At a minimum, the building exterior must have the components listed below. It is the responsibility of the design engineer to identify any additional items that should be included outside the building that would aid in the day-to-day operations of the lift station.

1. All lift station buildings will have a non-strobe warning beacon that turns from green to red in the alarm state installed at the exterior of the building above the main entrance where it can be easily seen. These warning beacons will activate upon the following alarms:

    a. High H_2S levels *(set to the OH&S 8 hour exposure limit).*
    b. High CO levels *(set to the OH&S exposure limit).*
    c. High LEL and NOX, if applicable
    d. Heat/smoke alarm.

2. Motion detector lights will be installed at the front entrance, sides and at the back of the lift station. Include by-pass switch to allow exterior lights to be turned-on manually with switch just inside the entry door.

3. All lift station buildings will have secure skylights to promote natural lighting in the above ground rooms.

4. Architectural specifications require **Water**'s approval.

5. The wet well will have a separate entrance from the rest of the lift station.

6. All doors will have concrete entrance pads flush with the bottom of the door and appropriate weather stripping.

6.0 LIFT STATION WELLS

A. Wet Well

1. Buoyant forces for empty wet well are to be considered during the design. The consultant will indicate the factor of safety used in their design. Should be designed to withstand buoyancy of 1:100 yr. Return period flood, if applicable.

2. Wet wells are to be sized such that:

    a. It can accommodate the peak wet weather flow at full build-out with the forcemain draining back to the wet well through a failed check valve without the pumping flow rate exceeding the firm capacity of the lift station.
    b. Pump starts do not exceed the pump manufacturer's maximum starts per hour during peak wet weather flow at build out, and where the forcemain is draining back to the wet well through a failed check valve.

c. Maximum time between pump cycles does not exceed two hours during minimum dry weather flow.

3. Construct wet wells from sulfate resistant (Type 50) concrete. Steel wet wells are not acceptable. Use of FRP and other non-metallic wet well requires approval from **Water**.

4. The exterior of the wet well will have the appropriate waterproofing to ensure that there is no infiltration going into the lift station.

5. The wet well interior will have waterproofing up to 12" past the high-high water level. The waterproofing must be able to withstand sewage and durable enough to withstand high pressure washing. Coatings applied to concrete surfaces are subject to approval by **Water** prior to installation.

6. A visual hydrostatic test of the wet well MUST be completed after internal waterproofing is complete and before external waterproofing and backfilling. There is zero tolerance for leakage; any evidence of leakage is a just cause for failure. In the event of failure, wet well must be re-coated and re-tested to the satisfaction of **Water**.

7. All concrete joints and all penetrations through the concrete will be grouted with non-shrink grout on both sides of the joint or penetration.

8. Design the bottom of chamber to prevent the accumulation of waste matter. Wet well floors should have a minimum slope of 1:1 to a hopper-type bottom.

9. Only one inlet pipe or channel may connect to the wet well. If there are multiple sanitary sewers, they must connect at a chamber or manhole outside the lift station.

10. Provide a control structure inside the wet well on the inlet pipe (e.g. slide gate). The control structure must be operational on main ground level where it is clear of any obstacles (i.e. roads, landscaping, etc.)

11. Corrosion resistant bolts, fasteners and fixtures (such as grade 316 stainless steel) will be used within the wet well.

12. Provide masticators on the wet well inlet pipe. Screens and baskets are not acceptable. For replacement lift stations, the need for masticators can be reviewed depending on the sewage characteristics.

13. Provide access to wet well by staircases where possible. Use corrosion resistant materials such as FRP, concrete, aluminum, or 316 Stainless Steel. The staircase will meet applicable building and safety codes. If access can only be facilitated by a ladder, requirements for fall protection will apply as outlined in Section V, A. The ladder will be constructed of the materials noted above. Ladder cages are not permitted. The ladder must extend above the entry level for ease of entry and egress.

14. Depending on the shape and size of the wet well, a means to access all sides of the wet well must be provided for cleaning. This will be assessed on a case-by-case basis. For example, a catwalk may need to be installed along the perimeter of the longest length of the well to allow for the operator to walk the length of the well for cleaning.

15. Removable equipment must be accessible via hatch positioned directly above.

16. Minimum hatch size must accommodate removal of equipment (pumps, valves, check valves, etc.) but in no case be less than 750 mm by 750 mm (30" by 30"). Use corrosion resistant materials such as FRP, concrete, aluminum, or 316 Stainless Steel. Minimum hatch loading rating is 14.4 kPa (300 lb/ft^2). All access hatches for dry wells must be watertight. Hatch frames must be poured in place or if mechanically fastened, shall be surface mounted on the slab.

17. If staging the wet well with partition walls each chamber must have a mixer and also have a water tight valve or gate isolating it from the adjacent wet well chamber. Storage volumes for capturing peak wet weather flows must have floor elevations above the pump stop elevation, and sloped toward the wet well volume at a 2% or greater slope. Provide mechanical ventilation as required in Section B: Dry Well #11.

B. Dry Well

Lift stations with valves of 200 mm or greater will have a dry well configuration. This configuration will greatly help in the maintenance and access of the larger valves.

1. Buoyant forces for the empty dry well are to be considered during the design. The consultant will indicate the factor of safety used in their design. Should be designed to withstand buoyancy of 1:100 yr. return period flood, if applicable
2. Construct dry wells from sulfate resistant (Type 50) concrete.
3. The exterior of the dry well will have the appropriate waterproofing to ensure that there is not infiltration going into the lift station.
4. The dry well will be sized so that there is sufficient space between the pumps for the operator to access and remove them if necessary. In addition, there will be enough space for associated piping and other ancillary equipment.
5. Provide sump and pump for all dry wells and including isolation valve and two check valves. Discharge the sump pump to the wet well above the high-high water level of the wet well. Slope the dry well floor toward the sump. The sump pump will operate via level switch.
6. Special attention is to be given to the dry well pump inlet pipe to minimize pipe entrance effects. For inlet pipes 150 mm (6 in) diameter and less the inlet pipe opening must be at least twice the diameter of the inlet pipe diameter. For pipes greater than 150 mm diameter the inlet pipe opening will be at least twice the cross-sectional area of the inlet pipe.
7. All joints in the concrete and all penetrations through the concrete will be grouted with non-shrink grout on both sides of the joint or penetration.
8. Pressure pipe penetrations between the wet well and dry well will be secured with the appropriate link seal and grouted.
9. The design for installation of the dry well pumps must take into consideration keeping vibration at acceptable levels to avoid fatigue, noises and wear. Use adequate pipe and pump support/anchors and flexible joints at the pump tie-ins.
10. Provide access to dry well by staircases. Use corrosion resistant materials such as FRP, concrete, aluminum, or 316 Stainless Steel. The staircase will meet applicable building and safety codes. If access can only be facilitated by a ladder, requirements for fall protection will apply. The ladder must extend above the entry level for ease of entry and egress. Ladder cages are not permitted.
11. Provide permanent mechanical ventilation for the dry well. All systems must be capable of 6 air changes per hour when occupied. See Section 7.0 (Process Mechanical).
12. Pumps must be mounted on a minimum 100 mm housekeeping pad.
13. Provide a hoist system with rail and electric hoist for pump removal in the dry well. Any hoists rated 1.0 ton or less can be manually operated.

14. Provide access to the dry well by staircases where possible. Use corrosion resistant materials such as FRP, concrete, aluminum, or 316 Stainless Steel. The staircase will meet applicable building and safety codes. If access can only be facilitated by a ladder, requirements for fall protection will apply. The ladder will be constructed of the materials noted above. Ladder cages are not permitted. The ladder must extend above the entry level for ease of entry and egress.

7.0 PROCESS MECHANICAL

A. Pumps

1. Use pumps designed specifically for wastewater pumping. Presently only close coupled submersible Flygt, Sulzer and KSB pumps are approved for both wet well and dry well applications. N-type Flygt, Sulzer Contrablock Plus and KSB E-Max pumps are preferred if they are able to handle the duty range of the lift station otherwise, other types can be considered. If substitution is warranted, supporting documentation must be provided at the preliminary design stage. Pumps 20 kW (25 HP) and larger must be able to pass solids up to 75 mm (3 inch) diameter through the impeller without damage to the pump.

   Other brands would require written approval from **Water**. A reason with supporting documentation must be provided and included in the Preliminary Design Report.

2. Dry well pumps will be mounted on a base designed for the application with the proper supports included.

3. For duplex lift stations (two pumps), each pump will be sized for 100% firm capacity at peak design flow. This will allow for 100% redundant pumping capacity. For triplex systems (or more), units will have capacity such that, with any one unit out of service, the remaining units will have firm capacity to handle the peak wastewater design flow

4. Select pumps to minimize energy consumption and maximize pumping efficiency. Minimum power factor of 0.9 (or higher) is required on pumps greater than 40 HP.

5. NPSH design information, pump curve and system curve for the pumps must be included in the detailed design drawings.

6. Use identical sewage pumps in multi-pump applications. Provide one (1) spare impeller.

7. Each pump shall have "HAND, OFF, AUTO" (HOA) switch at MCC, ON/OFF momentary push button control and emergency stop button at each pump hatch. A water level indicator shall be added near the ON/OFF switch.

8. Provide quick-connect/disconnect power supply cables and mechanical connections so that pumps can be easily taken out of service and replaced by a spare if necessary. The quick connect will be located above ground on the main level. The quick connect will adhere to electrical requirements to meet Class 1, Zone 2 classification.

9. Quick connect should be designed for safe disengagement under load.

10. Use variable frequency drives for pumps 40 HP and above for transient control. Soft starts are required for pumps 10 to 39 HP.

11. Pump start frequency should not exceed pump manufacturer's specifications.

12. The pump manufacturer or authorized vendor representative must go to site once the pumps are installed to complete verification testing. This task and the results must be noted in the Commissioning Report. Proper documentation of this verification testing must be included in the Operations and Maintenance Manual and the Commissioning Report. **Water** will be present to witness the verification testing.

B. Process Piping

1. Use only steel pipe for pump header piping with external corrosion resistant coating. The coating specification must be included in the relevant drawings and manuals. Plastic pipe for headers is not acceptable. Plastic pipes (PVC, HDPE) may be used for the forcemain outside the lift station. Transition pipe from header through wall and connecting to FM must be 316 Stainless Steel and shall extend beyond any roof overhang by a minimum of 2m.
2. Include provision for a pig launch in the pipe work for the launching of pipe pigs or inspection equipment.
3. Pipe materials are to withstand twice the maximum anticipated pressure for all fittings.
4. Weld neck type flanges will be used in process piping.
5. Arrows indicating direction of flow will be placed on process piping.
6. Install an isolating valve and a check valve between the pump and the header (check valve closest to the pump). Knife valves are not acceptable alternatives. Hand-wheels will be provided for larger isolation valves.
7. Install two pressure gauges on a horizontal portion of the pump header. One analog gauge (for local display) and one digital gauge (connected to the programmable logic controller). All pressure gauges shall use Red Valve Series 40 Pressure Sensor body or an approved alternative. Gauges may be on the same pressure tap.
8. A magnetic-type flow meter will be installed on the forcemain, inside the lift station. The flow meter will be able to capture instantaneous and totalized flow. Installation of the meter will follow the recommendations of the manufacturer. The display screen will be mounted in such a way that is visible and accessible to the operators.
9. Do not bury pump header outside the lift station. The header and other process piping must be accessible for inspection and maintenance purposes.
10. Provide an isolating valve on the forcemain. If the lift station has more than one forcemain, each forcemain must have a separate valve. All valves and appurtenances on the pumps and header must be contained within the lift station. Burying valves outside the wet wells or dry wells are not acceptable except for bypass piping.
11. Corrosion protection features on metal pipes must be specified in the drawings and follow the current edition of the Standard Specifications Waterworks Construction.
12. Ensure the pump header and forcemain can be drained into the wet well. The discharge will be located above the high-high-high water level (HHHL).
13. Use tracer wire on all non-ferrous metal forcemains.
14. Provide a by-pass connection on the forcemain to the exterior of the building terminating in a Camlock connector. See Figure 1 for a schematic of the by-pass valving shall be stainless steel or epoxy-coated steel suitable for HS service. Camlock fitting to face the location of the tanker truck.

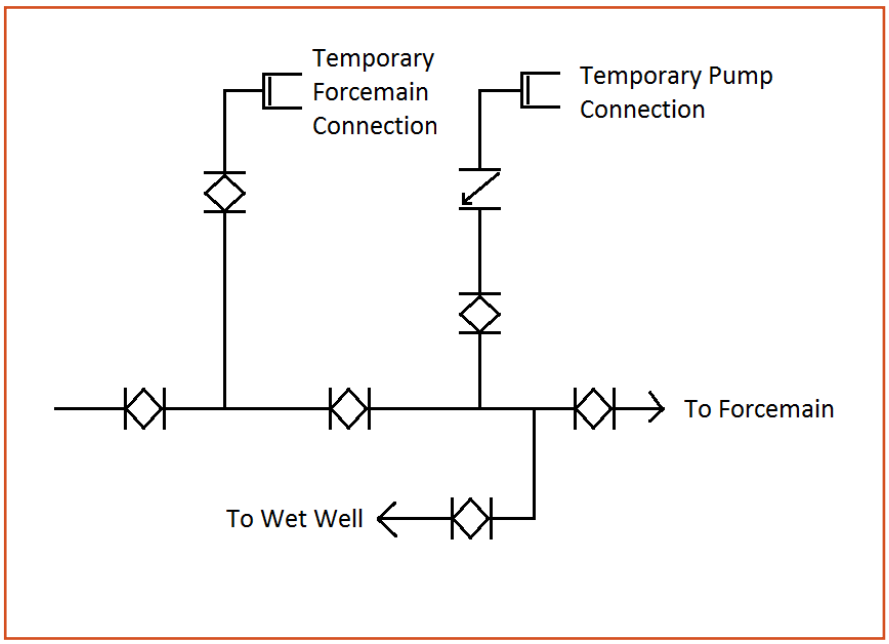


FIGURE 2 - BY-PASS DESIGN SCHEMATIC DIAGRAM

15. All forcemains and pump header piping within the wet well/dry well will be supported and mechanically restrained as required. Process piping may not be cast in concrete for supporting or restraining the pipe.

16. All process piping must be pressure designed to ensure they can handle 2 times design pressures. Pressure testing of the system will be required. Results from the pressure testing must be noted in the Commissioning Report. Proper documentation of this verification testing must be included in the Operations and Maintenance Manual Commissioning Report.

17. Design wet wells to provide easy access to all valves and equipment without the use of ladders or scaffolding. If possible, valves and equipment should be located on the main floor of the lift station. Access includes for easy removal using permanently installed hoist. Also, piping should be configured so removal of multiple pieces isn't required to remove a given piece.

18. Wheel chains will be provided for elevated equipment (i.e. valves) that cannot be operated on the main floor. Otherwise, permanent platforms will be provided. Design of the platforms will be approved of by **Water**.

C. Instrumentation Tagging

1. The instrumentation tagging to follow this format: **YYYCCC-XX**

   Where:

   YYY - Functional Identification Code as shown in **Appendix C** (i.e. IP = influent / sewage pump), adapted from The City of Calgary, Wastewater Treatment

   CCC - Station code designated by The City

   XX - Tag number

2. Lamacoid labels of appropriate size will be affixed on or near pertinent functional equipment (as outlined in the P&ID). The lamacoid will be white Helvetica lettering on black. The label will indicate the following:

Line 1: Name / Description of the equipment as per the P&ID.

Line 2: Voltage, Phase, HP

8.0 BUILDING MECHANICAL

A. Heating, Ventilation and Air Conditioning (HVAC)

1. Separate positive pressure ventilation and exhaust ducts will be supplied for the wet well chamber and the wet well main floor. A minimum of 6 air changes per hour is required. The temperature will be thermostatically controlled by a heater manufactured by Dexon Canada or approved equal. The system must maintain an ambient temperature of 10 degrees Celsius.
2. All HVAC equipment within the wet well chamber must be rated for a Class 1 Division 2 environment. Provision will be made to ensure that there is enough distance between the exhaust and intake to prevent cross-over. The intakes and exhausts will be free of any impedance (i.e. landscaping, snow removal locations, storage, etc.) at all times. HVAC system must be set to maintain an ambient temperature of 15 to 25 degrees Celsius in this area.
3. Ventilation sizing calculations must be provided. There will be a separate ventilation system for the remainder of the building (i.e. electrical, mechanical and dry well rooms). A minimum of 6 air changes per hour is required. Ventilation will be thermostatically controlled. Operations must be able to control the room temperature within the lift station building by either manual or electronic thermostat. Pneumatic control lines are not acceptable.
4. Electrical room fresh air intakes must have removable dust filters, and the pressure differential across the filters is monitored by the HVAC controls to visually indicate the need for cleaning or replacement All fresh air intakes must be located sufficiently separated from any exhausts to ensure good air quality in the building. Exhaust system must permit the installation of odour control system that is accessible from the floor level.
5. Supplemental unit heaters (with built-in thermostats) will be installed in the lift station building, including a baseboard heater in the washroom. Electric unit heaters are preferred to gas-fired heaters.
6. The HVAC system may use natural gas and must have a thermal efficiency of 90% or greater. If propane gas is to be used because natural gas is unavailable, the equipment must be able to be converted to natural gas. Conversion must be completed at time of FAC.
7. When HVAC systems are operating, the noise levels adjacent to the lift station building cannot exceed The City's Noise Bylaw 5M2004, Part 9.
8. Fire dampers will be installed at appropriate locations throughout the lift station.

B. Area Classification

The area classification of each distinct space within the lift station should be described, along with any requirements required to designate the area as such. The design should ensure equipment is rated to operate for the classification in of the area.

If an unclassified space is connected to a classified space via openings or unsealed wall penetrations in the wall, floor, or ceiling, positive air pressure shall be maintained in the classified space. Effective safeguards shall be provided against failure of the ventilation system, and an alarm light and horn shall be triggered in the event of a failure. Glands and/or seals shall be added between unclassified and classified spaces.

9.0 ELECTRICAL AND CONTROL SYSTEMS

A. Stand-by Power

At a minimum, the stand-by generator will have the following components:

1. An electrical single line diagram will be included in the design drawings to show the load requirements of each electrical component and the generator rating. At a minimum, generator sizing must take into account of all loads at the lift station. Sizing of the generator should be for all pumps running with up to one pump starting at any given time, taking into account the in-rush current of the pumps. The Design should ensure that only one pump starts at any given time.
2. Generator sizing calculations shall be submitted for City records.
3. Use models that are common to the North American market for the stand-by generator and stand-by generator engine with service and parts available upon 24 hours notice. **Water** will provide final approval of the recommended stand-by generator.
4. The stand-by generator will be fuelled by natural gas. Alternative fuel sources must be approved of by **Water**. However, the generator must be able to be converted to natural gas.
5. Size the stand-by generator so that 75% generator load capacity meets 100% of the total possible lift station electrical demand. For triplex systems (or more), the load must meet the requirements outlined in Section V, A, 3. If the lift station is to be expanded over time, compare the life cycle of the generator to the projected timeline for expansion.
6. Generator engines will be cooled with radiators. The louvers for generator cooling must be powered directly by the generator.
7. A battery charger and block heater must be incorporated with stand-by generator.
8. When the generator is operation the noise levels adjacent to the lift station building cannot exceed The City's Noise Bylaw 5M2004, Part 9.
9. Use an automatic transfer switch with full phase protection for the stand-by generator.
10. Test the stand-by generator to full load capacity to verify functionality. Any deficiencies must be recorded and repaired before CCC is issued. The results must be noted in the Commissioning Report. Documentation of the verification testing must be included in the Operations and Maintenance Manual.

B. Electrical Building Provisions

At minimum, the lift station building will have the following:

1. Convenience receptacles (120V, 20A) will be provided inside and outside the building (including the washroom) for the use of appurtenant electrical devices. Outdoor receptacles will be located by entrances and be weather proof.
2. When there is a likelihood of expansion of the pumping station in the future, future conduits for power cables that are through the walls and floors should be provided.
3. Single phase cut-out protection will be provided for three phase motors.
4. Lightning arrestors will be provided for the building.

C. Lighting

1. All lighting at the lift station shall be LED type.

2. Use explosion proof fixtures in wet wells. Fixtures shall be accessible without ladders, scaffolding or any special equipment.

3. Motion sensing `and photo cell controlled light fixtures shall be added to the building exterior.

4. Emergency lighting shall be included in the design and MUST be powered through battery packs and not through the generator. In addition, pictogram LED exit signs shall be provided.

D. Level Sensors

1. The ultrasonic level sensor:
    i. Shall be installed with a submersion shield.
    ii. Shall be at a suitable elevation so that it is not submerged by elevated wet well water levels, but can be easily accessed without a ladder or an elevated platform.
    iii. Shall not be located within a confined space.
    iv. Shall not use a stilling well that is located within the wet well.

2. The float bulbs:
    i. Shall be appropriately located within a stable portion of the wet well where they are not disturbed by the water's motion.
    ii. Shall be accessible from a wet well platform to permit cleaning and removal of debris.
    iii. The cable terminations shall be outside of the wet well.
    iv. Shall be removable from the wet well without entering the wet well.

3. Alternative level sensor technologies will require approval by Water.

E. Motor Control Centre (MCC)

At minimum, the Motor Control Centre or central distribution panels will have the following:

1. Provide 100 mm high housekeeping pads for the MCC (and other electrical equipment) mounted on the floor.

2. Distribution panels must have 10% spare circuit breakers for future loads. This is in addition to any provisions made for future expansion of the lift station.

3. A minimum of one spare MCC bucket shall be provided in additional to any provisions made for future expansion of the lift station.

4. Panels must have provision for lockout/tag out for a minimum of two locks.

5. HP rated electrical quick disconnects

6. Use LED type indicator lights for visual indicators. The convention to be used for indicating equipment status is:

    a. Device Off/switch open/circuit de-energized – green light
    b. Device on/switch closed/circuit energized – red light
    c. Faults (include MiniCAS faults) – amber light

7. A smart meter power monitoring GE Multiline or approved equal (non-revenue) will be included to monitor energy consumption and quality. This will be located inside the MCC, and interfaced to the PLC

8. A hand-off-auto switch must be included in the MCC for the pumps, grinder and mixers (as applicable). On the main level of the wet well side, there will be a start/stop station and an

emergency stop button for each of the pumps, grinder and mixer. The start stop functionalities shall be separate push buttons and the station will be labeled according to the pump number. Water Services field staff will turn the HOA switch at the MCC and then use the start/stop station in the wet well. The main breaker, automatic transfer switch, and pump starters are to form a part of the MCC. Pump starters must have provision for VFDs, should they be used in the future. The transformer will be wall mounted above the 120/208V wall mounted distribution panel and not inside the MCC.

9. If the MCC is not visible from the Start/Stop station, indicator lights (Green/Red/Amber)should also be displayed there. A level indicator display should be placed by the start/stop station to allow Operations to view the water level.

10. MCC panels and switchgear to have labels indicating the Arc Flash incident energy rating. The arc flash labels shall follow the latest CSA Z462 standards. Arc Flash study report shall be submitted during the project stage (60%, 90%) as well as a final submittal at the end of the project. The electrical model should be completed using the latest version of ETAP and submitted to The City as part of the final submittal.

F. Programmable Logic Controller (PLC)

There will be a dedicated control panel for the programmable logic controller (PLC) and related components (i.e., touch screen HMI, cellular modem, network switch, power supply, terminal blocks and fuses, etc.) See typical PLC and Telemetry control system architecture drawing. The panel will be sized appropriately to house all components with sufficient space for maintenance. A Panduit (or equivalent) will be used to house wiring, with no wire splices within the Panduit. All I/O will be individually fused. Where applicable, 24 V DC components are to be used. On the outer door of the control panel, a SCADA alarm bypass switch will be provided labeled within two lines with "SCADA Alarm" (top line) and "NORMAL–BYPASS" (bottom line) on a lamacoid. This bypass is to suspend alarms send out to Operators from SCADA. In addition, a switch for building intrusion alarm to be provided and labelled with "ARM-DISARM" lamacoid.

Automated Control of the lift station process equipment will be through a PLC. The manufacturer and model will be approved by **Water**, typically Allen Bradley Control Logix controller family. The PLC will be a current model for the year of the lift station construction. The PLC model should be determined based on the station I/O and process control requirements. Provide a minimum of 10% spare I/O. The PLC will be mounted in a horizontal orientation and have provision for integrated P&ID Control.

The PLC will be located as close to the MCC unit as possible. A color touch screen human-machine interface (HMI) will be installed on the outer door of the control panel such that it is easily accessible by an operator. The HMI will be an Allen Bradley PanelView with a minimum size of 1250mm.

G. PLC Communication

Communications between the PLC and HMI is to be Ethernet. Wiring shall be to EIA/TIA Category 6 requirements.

The PLC shall contain communication cards located in the PLC chassis between the PLC and field devices as needed, such as remote communication devices (leased telephone serial communications and wireless cellular).

HART analog communication is preferred, but SMARTBUS modes that have been approved by CSS will be considered for station end devices (i.e. Flow meters, pressure transmitters, motor drives).

H. PLC and HMI/SCADA Software and Programming

It is The City's preference that PLC and HMI software, PLC logic configuration and HMI graphic screen development be provided by Control System Services (CSS). In cases where a Developer is responsible for the station over an extended period of time, CSS can provide PLC control algorithm and HMI graphic templates that can be included in the Lift Station Design Specifications.

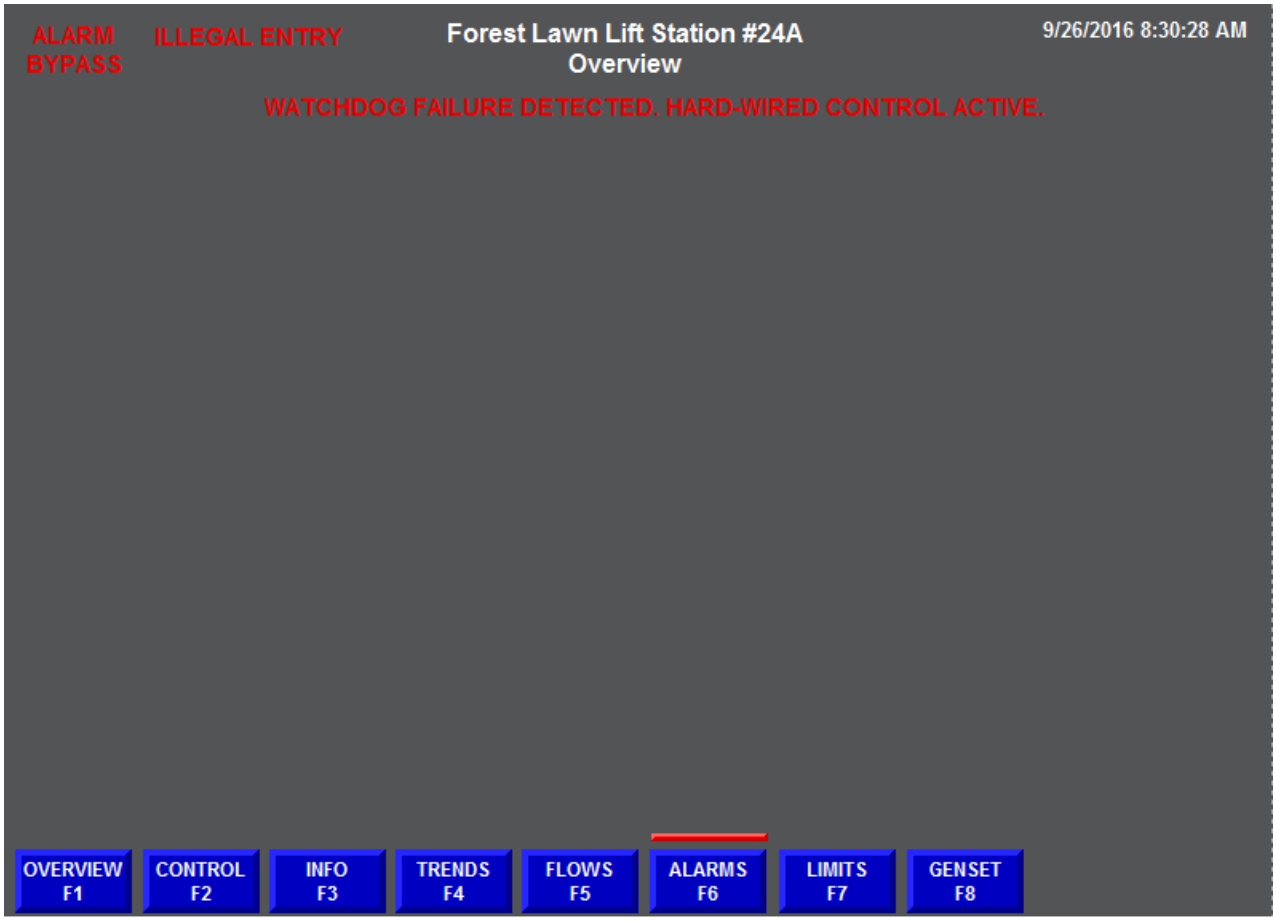
For new lift stations, CSS will work closely with Consultants and Contractors to provide guidance and programming framework. Contact *Mike Landers, Process Computer System Coordinator* at (403) 875-4580 or at Michael.Landers@calgary.ca for programming assistance and to obtain a template program that can be utilized in the proposed lift station.

The City's HMI standards are presented below followed by individual HMI screen details. Equipment I/O, PLC calculations and alarms are specified after.

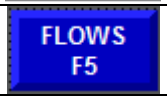
1. HMI Color & Background Standards

Example Graphic	Description	Font Type	Font Size	Color		
				R	G	B
	Main display header	Arial	12	255	255	255
	Text, headers units	Arial	10	255	255	255
	Button text	Arial	09	255	255	255
	Non-alarmed equipment sate	Arial	10	0	0	255
	Active running state	Arial	10	0	255	0
	Active alarm state	Arial	10	255	0	0
	Inactive state	Arial	10	128	128	128
	Analog values or PLC calculated values	Arial	10	0	255	0
	Current PLC commands to pumps	Arial	10	255	255	0
	Communication error	Arial	9	255	0	0
	Background	N/A	N/A	82	84	86
	HMI background	N/A	N/A	82	84	86
	Grouping background	N/A	N/A	63	63	63

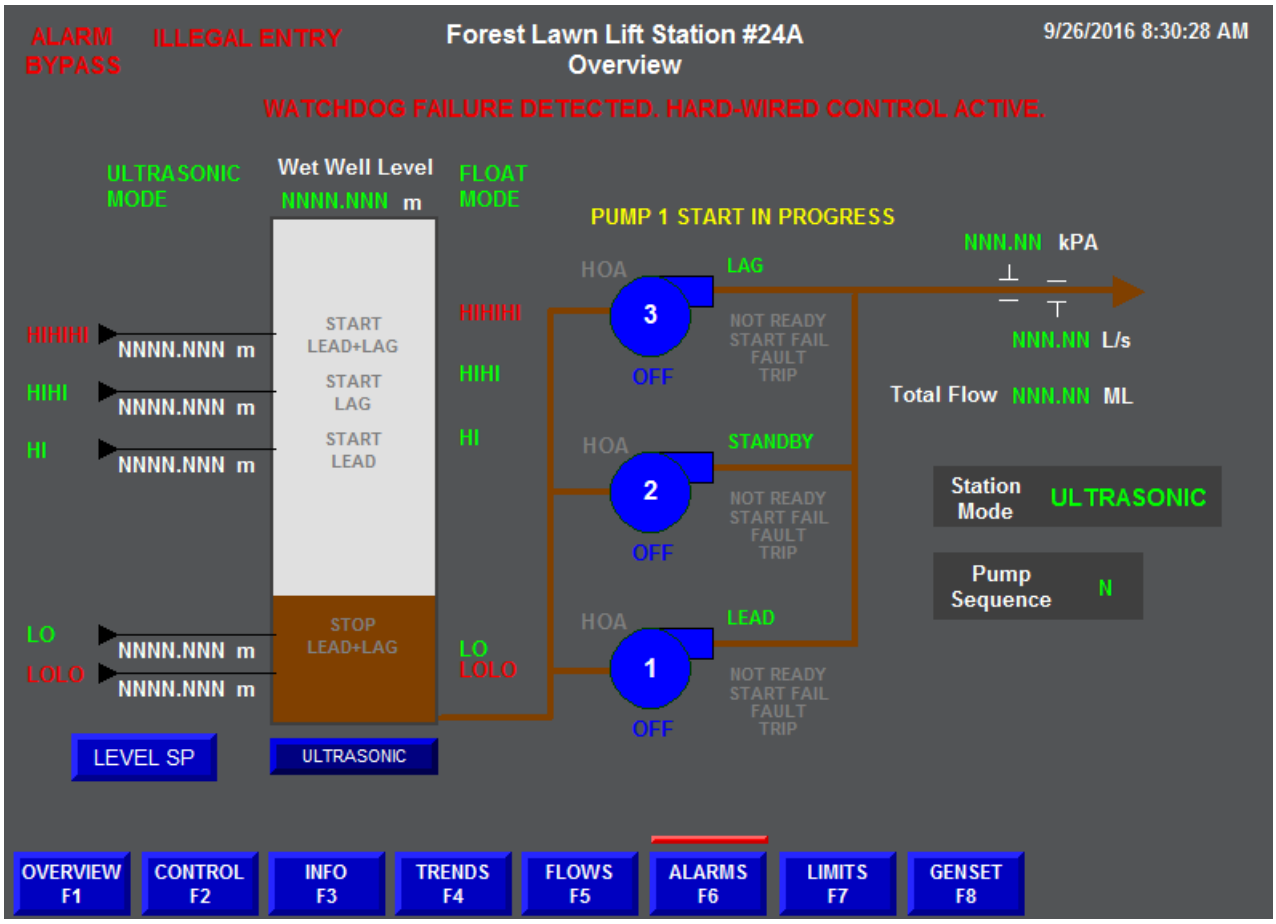
2. HMI Screen Template

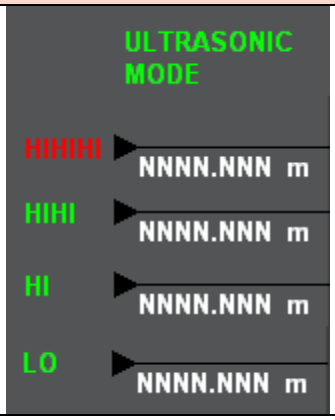


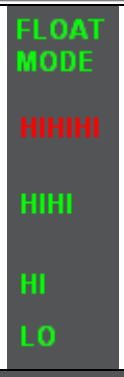
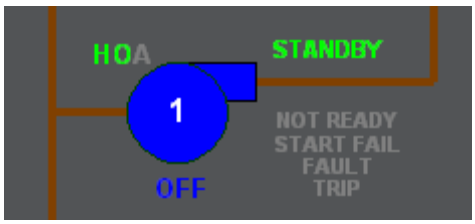
Graphic	Function
Forest Lawn Lift Station #24A Overview	The HMI overview screen of a lift station includes a location description before the word "Lift Station" followed by "#" and the area designation. Below the location description, the HMI screen is identified. In this case, the HMI screen is the overview screen.
6/11/2015 3:13:03 PM	The PLC's data and time is displayed in the format DD/MM/YYYY HH:MM:SS (AM or PM).
ALARM BYPASS	When ALARMS.BYP is active text "ALARM BYPASS" is visible, otherwise text is invisible
ILLEGAL ENTRY	When ALARMS.Illegal_Entry is active, text "ILLEGAL ENTRY" is visible, otherwise text is invisible.
WATCHDOG FAILURE DETECTED. HARD-WIRED CONTROL ACTIVE.	When ALARMS.PLC_Watchdog is active, text "WATCHDOG FAILURE DETECTED. HARDWIRED CONTROL ACTIVE" is visible, otherwise text is invisible

	Button jumps to HMI overview screen, can use F1 for shortcut
	Button jumps to HMI control screen, can use F2 for shortcut
	Button jumps to HMI info screen, can use F3 for shortcut
	Button jumps to HMI trends screen, can use F4 for shortcut.
	Button jumps to HMI flows screen, can use F5 for shortcut.
	Button jumps to HMI alarm summary screen, can use F6 for shortcut Flashing red bar appears above alarms button if an alarm is active.
	Button jumps to HMI limits screen, can use F7 for shortcut
	Button jumps to HMI limits screen, can use F8 for shortcut

3. HMI Overview Screen

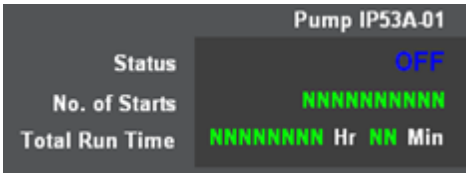
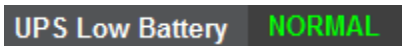


Graphic	Function
	Ultrasonic mode (primary mode) uses the user selected set points to control the pumps. The set points are displayed in white, shown as NNNN.NNN m. If the level goes above set point, the corresponding level descriptor goes from grey to green. HIHIHI is an immediate alarm therefore the colors are grey/red. (Note: Set point lines up with PLC action shown in flood bar, i.e. HIHI lines up with start lag text)
	Ultrasonic level set point, jumps to HMI limits screen for set point configuration.
	Analog display of pipe pressure (PITXXX-10).
	Analog display of lift station's outflow (FITXXX-10).
	Daily totalizer for lift station's outflow (FQTXXXR).

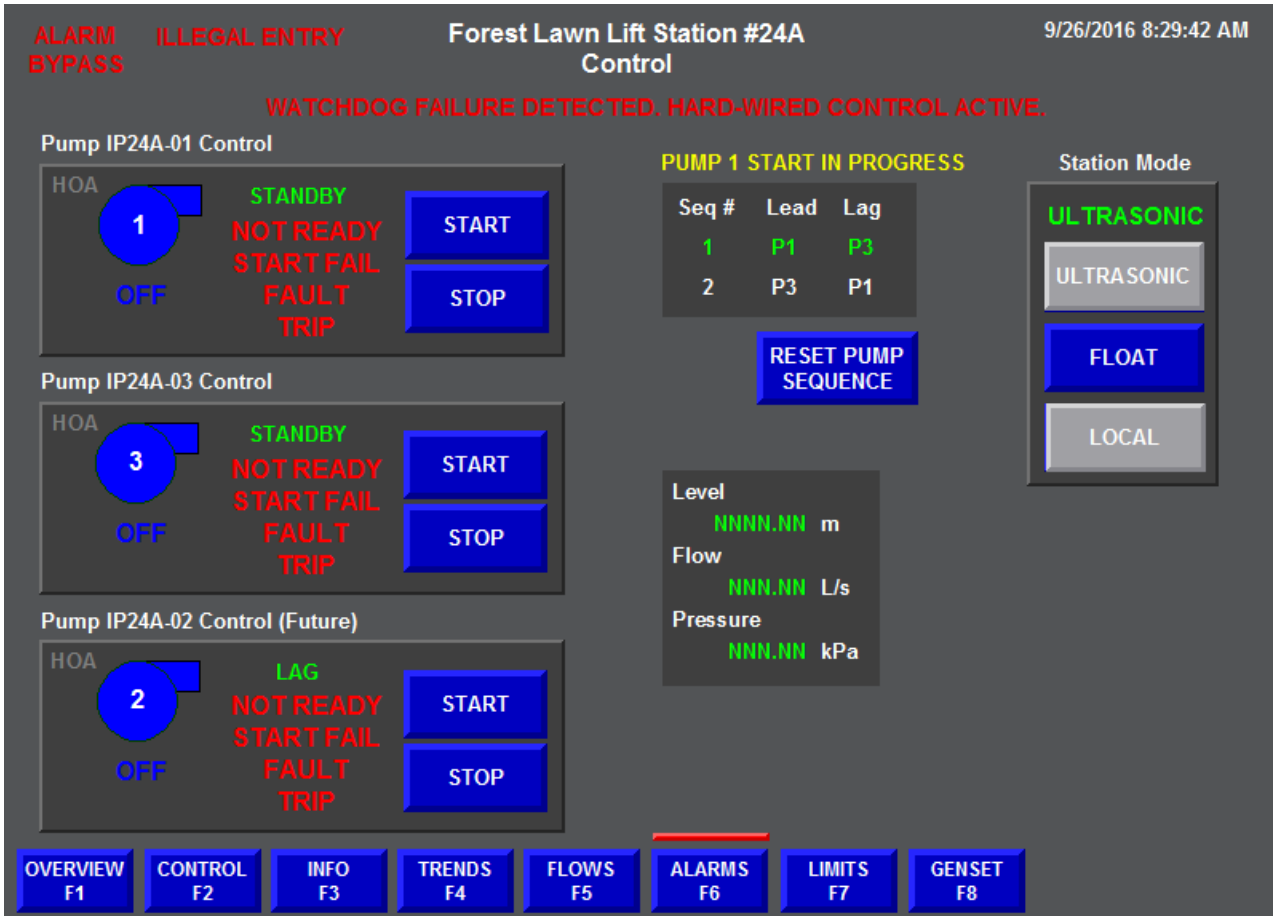
	The wet well analog level (LITXXX-1X) in meters is displayed. A flood bar based on level percent is displayed in brown. A quick descriptor of what action the PLC takes if a certain level is reached is displayed in grey. For example, when the HI set point is reached, "START LEAD" indicates the PLC will issue a start to the selected lead pump.
	In float mode, level switches (LSHIHIHI-10, LSHIHI-10, etc) are displayed in grey. If the level switch is tripped, the corresponding level descriptor goes from grey to green. HIHIHI is an immediate alarm therefore the colors are grey/red. (Note: level descriptor do not lines up with PLC action shown in flood bar as ultrasonic set points are set below corresponding level switch)
	Text indicates PLC commands sent to pumps.
	Pumps are shown in blue when off and green when pump is running. The pump number is in the middle. Hand, Off and Auto (HOA) and their corresponding letter are shown. If pump is in hand, the letter H becomes green. Note: if pump is in OFF, the letters "H" and "O" are green. Otherwise letters are grey. The "standby" text shows the pumps designation, i.e. Lead, Lag and Standby. The grey texts are alarm feedback or applicable PLC signals that turns red when active.
	Displays which mode (Ultrasonic or Float) the lift station is currently in.
	Button to select lift station mode, jumps HMI control screen
	Tag displays which pump sequence is currently active. The number matches the sequence selected/described in control screen.

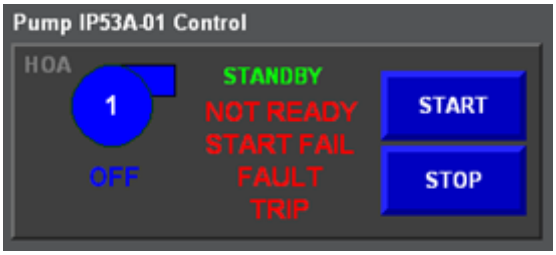
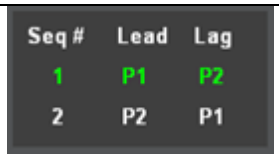
4. HMI Station Information Screen

Graphic	Function
Phone Number Legal Address RTU No. Cypress Modem	Lift Station specific information such as Phone Number, Legal Address, RTU number and Cypress Modem IP address.
H2S Detection NNN.NN ppm	Analog display of pump room's H2S level (AITXXX-10).
LEL Detection NNN.NN %LEL NNN.NN %LEL	Analog display of pump room/electrical room LEL level (AITXXX-11/14).
CO Detection NNN.NN ppm	Analog display of electrical room's CO level (AITXXX-12).
NOX Detection NNN.NN ppm	Analog display of electrical room's NOx level (AITXXX-13).
Temperature NNN.NN °C NNN.NN °C	Analog display of wet well's/electrical room's temperature (TITXXX-10/11).

	Digital feedback display of lift station door status (DOORXXX-10).
	Digital feedback display of lift station security state (SECUXXX-10).
	Analog display of remaining seconds on armed timer for station security (SECUXXX-10).
	Pump Status & Totalizers Digital display of applicable pumps (IPXXX-0X) run status. Analog display of number of starts totalizer (IPXXX-XXSTR). Counts the number of transitions from off to running states. Analog display of running time totalizer (IPXXX-XX). Commutative time of running state of applicable pump.
	Digital feedback display of UPS's (UPSXXX-01) on battery alarm.
	Digital feedback display of UPS's (UPSXXX-01) low battery alarm.
	Digital feedback display of UPS's (UPSXXX-01) fault.

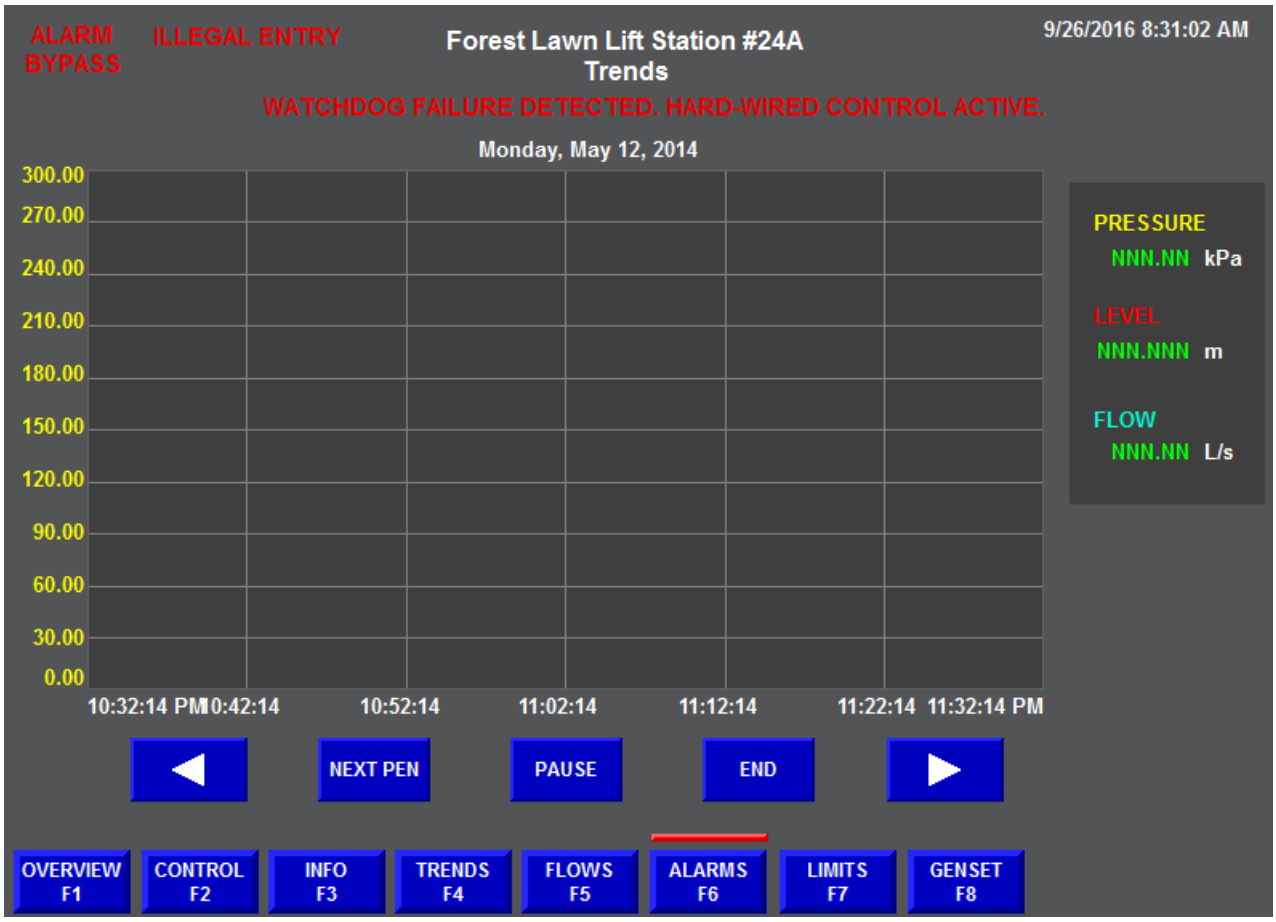
5. HMI Control Screen



Object	Function
	Pumps are shown in blue when off and green when pump is running. The pump number is in the middle. Hand, Off and Auto (HOA) and their corresponding letter are shown. If pump is in hand, the letter H becomes green. Note: if pump is in OFF, the letters "H" and "O" are green. Otherwise letters are grey. The "standby" text shows the pumps designation, i.e. Lead, Lag and Standby. The grey texts are alarm feedback or applicable PLC signals that turns red when active.
	Text indicates PLC commands sent to pumps.
	Displays possible sequences for pumps and their mode, whether lead/lag etc, in white. Sequence highlighted in green is the current sequence operating.

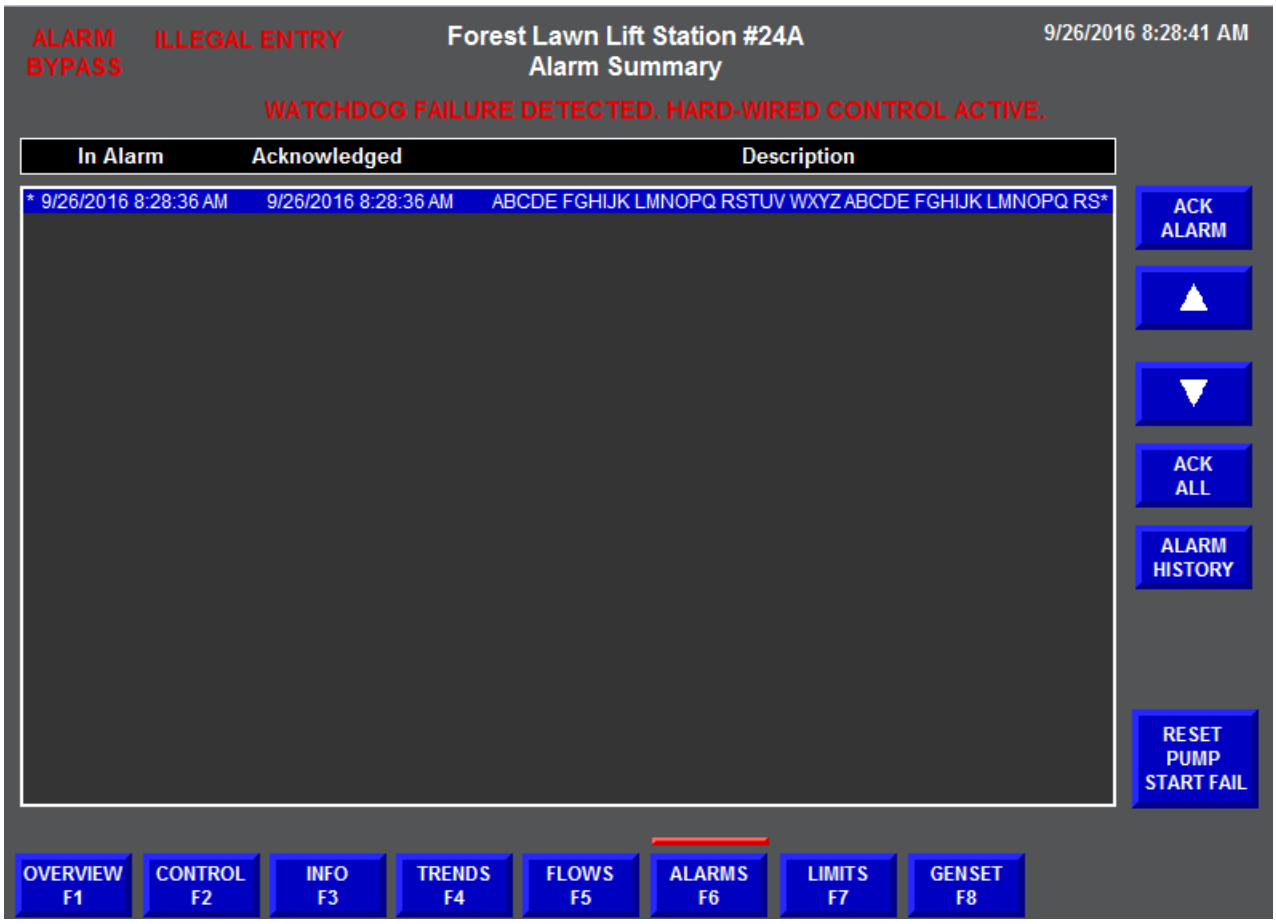
	Button resets pump sequence to 1.
	Allows selection lift station control mode: Ultrasonic (Primary mode) uses defined set points against analog level (FITXXX-10) to activate selected sequence. Float (Secondary mode) uses the level switches to activate selected sequence. Local only allows local control of pumps. (Note local control is a future function to disable control from SCADA) Current mode displayed on top. Blue button shows available mode, click to switch. Grayed out button show unavailable modes.
	Analog display of wet well level (LITXXX-1X).
	Analog display of wet well outflow (FITXXX-10).
	Analog display of wet well outflow pipe pressure (PITXXX-10).

6. HMI Trends Screen



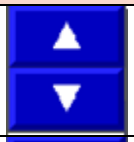
Graphic	Function
	Button for previous 24 hour time period for selected pen, if available.
	Button for next 24 hour time period for selected pen, if available.
	Button for next preset pen. One graph screen is preset with lift station's wet well level(s), pipe pressure and flow. Additional pens on new graphs are select by button.
	Button to pause real time update of graph.
	Button to bring pen and graph to real-time/current time frame.

7. HMI Alarm Summary Screen

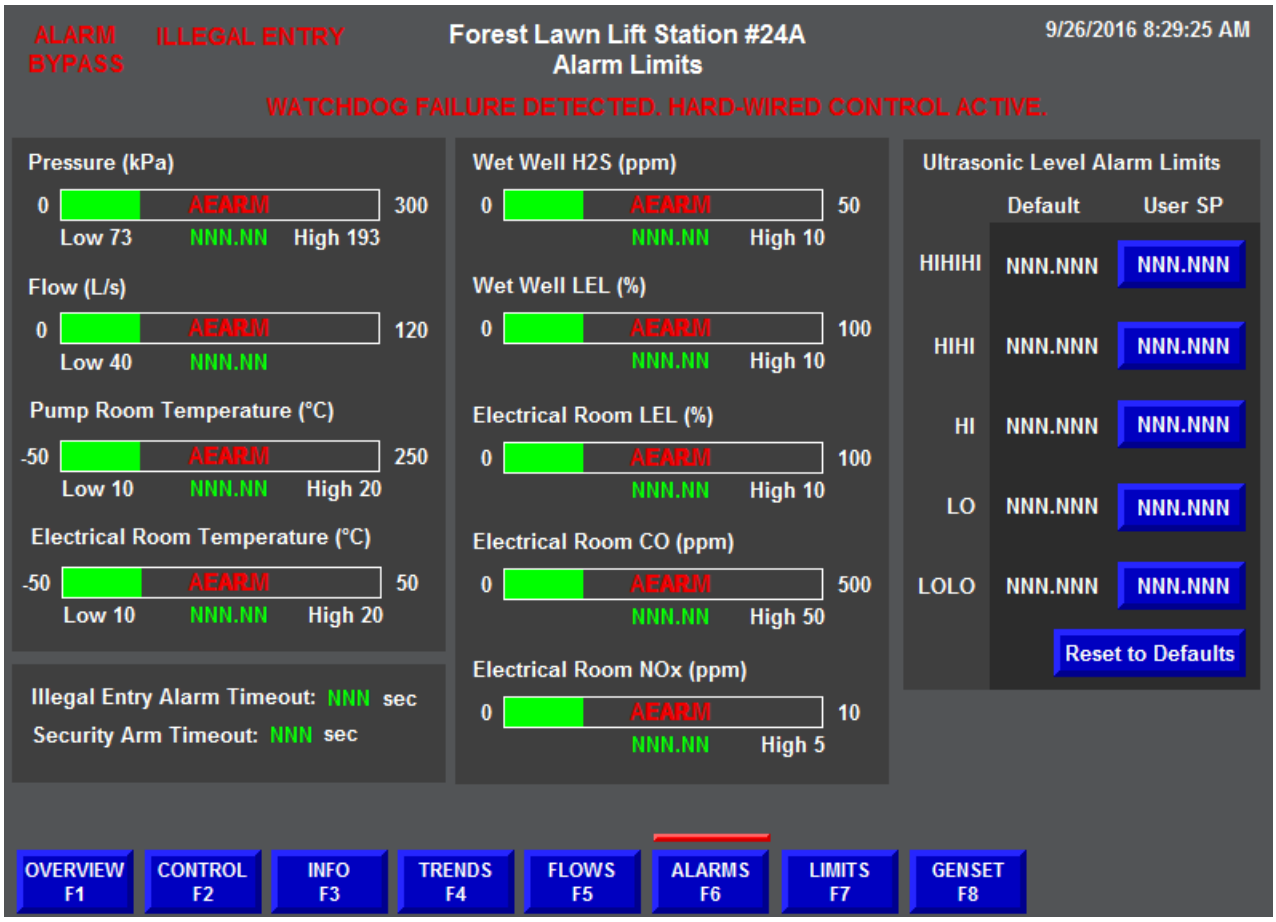


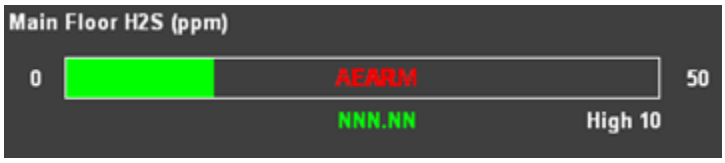
Graphic	Function
▲ ▼	Arrow buttons to move selection up or down in alarm list.
ACK ALARM	Button to acknowledge currently selected alarm.
ACK ALL	Button to acknowledge all alarms in alarm summary.
ALARM HISTORY	Button to jump to HMI alarm history screen.
RESET PUMP START FAIL	Button to reset pump fail start software interlock.

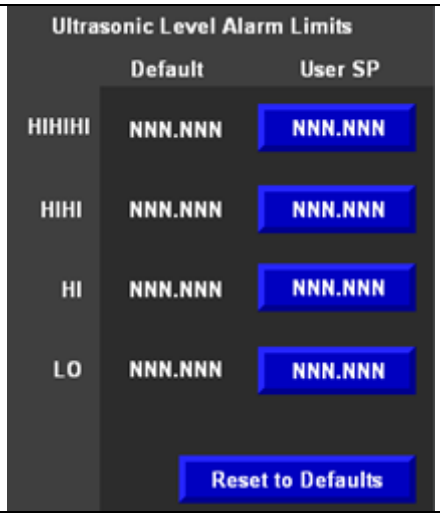
8. HMI Alarm History Screen

Graphic	Function
	Arrow buttons to move selection up or down in alarm list.
	Button to jump to HMI alarm summary screen.

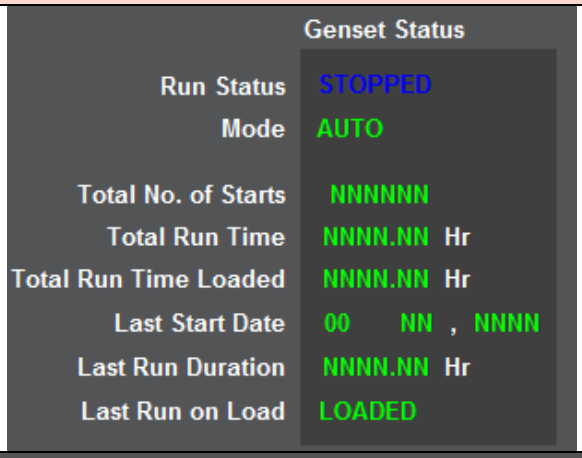
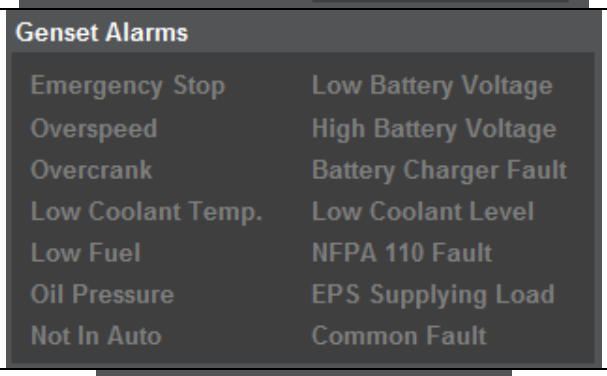
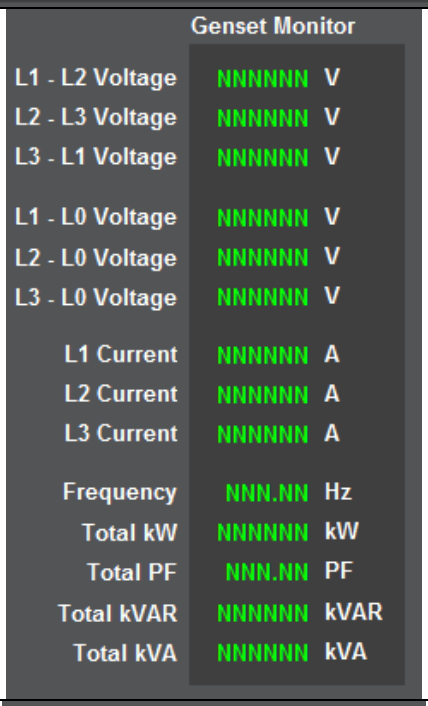
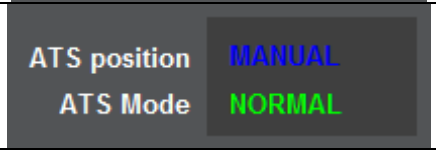
9. HMI Limits Screen



Graphic	Function
	Analog display transmitter alarms. Lower and upper limits of analog range in white on either side of flood bar. Number displayed beside “High” is alarm set point. High and loss of transimitter alarm text becomes visible, shown in red and located inside flood bar.

	Default settings for HIHIHI, HIHI, HI, LO and LOLO shown in white under default column. Current setting for HIHIHI, HIHI, HI, LO and LOLO shown in blue button and in white. To change setting, click on button and enter new value. Reset to default button sends all default values for HIHIHI, HIHI, HI and LO to user set point
	Analog display of remaining count on illegal entry alarm timer.
	Analog display of remaining count on security arm timer.

10. HMI Generator / UPS Screen

Graphic	Function
	Digital feedback display of generator's (GENXXX-01) run status, auto/manual mode and last run on load status. Analog feedback display of generator's (GENXXX-01) total number of starts, total run time, total run time with generator load, last start date and last run duration.
	Digital feedback of generator's (GENXXX-01) of emergency stop, overspeed, overcrank, low coolant temperature, low fuel, oil pressure, not in auto, low battery voltage, high battery voltage, battery charger fault, low coolant level, NFPA 110 fault, EPS supply loading and common fault.
	Analog feedback display of generator's (GENXXX-01) line 1 to line 2 voltage, line 2 to line 3 voltage, line 3 to line 1 voltage, line 1 to line 0 voltage, line 2 to line 0 voltage, line 3 to line 0 voltage, line 1 current, line 2 current, line 3 current, frequency, total kW, total power factor, total kVAR and togal kVA. Power Quality Monitor (PQM) follows the same layout as generator monitor.
	Digital feedback (Normal/Common Fault) display of generator's (GENXXX-01) fault.

The following numbered list specifies The City's minimum requirements for a lift station's PLC program:

11. PLC I/O List

Motors/Generators

Equipment	Description	Feedback			
		Analog			Digital
		Description	Range	Units	
IPXXX-0X	Wet Well Submersible Pump #X	None	None	None	Run Status, Ready, Fault, Trip, Hand, Off, Auto, Reset
GENXXX-01 / PQMXXX-01	Onsite Backup Generator with Power Quality Monitor	Total # of Starts	N/A	Count	Run Status, Auto, Error, Off, Running, Fault, Emergency Stop, Overspeed, Overcrank, Low Coolant Temp, Low Fuel, Oil Pressure, Not in Auto, Low Battery Voltage, High Battery Voltage, Battery Charger Fault, Low Coolant Level, NFPA 110 Fault and EPS Supplying Load
		Total Run Time	N/A	Hr	
		Total Run Time Loaded	N/A	Hr	
		Last Start Date	N/A	Date	
		Last Run Duration	N/A	Hr	
		L1-L2 Voltage	Site spec.	V	
		L2-L3 Voltage	Site spec.	V	
		L3-L1 Voltage	Site spec.	V	
		L1-L2 Voltage	Site spec.	V	
		L2-L3 Voltage	Site spec.	V	
		L3-L1 Voltage	Site spec.	V	
		L1 Current	Site spec.	A	
		L1 Current	Site spec	A	
		L1 Current	Site spec	A	
		Frequency	0-60	Hz	
		Total kW	Site spec	kW	
		Power Factor	0-1	PF	
		Total kVAR	Site spec	kVAR	
		Total kVA	Site spec	kVA	
UPSXXX-01	Universal Power Supply	None	None	None	On Battery, Low Battery and Fault

Transmitters:

Equipment	Description	Feedback			
		Analog			Digital
		Description	Range	Units	
PITXXX-1X	Wet Well Pipe Pressure	Pressure	0 – 300	kPA	XTRM Fail
LITXXX-1X	Wet Well Ultrasonic Tank Level	Level	0 – site specific	m	XTRM Fail, Loss of Echo
FITXXX-1X	Wet Well Pipe Flow	Flow	0 – site specific	L/s	XTRM Fail
AITXXX-10	Pump Room H2S Gas Detector	H2S Level	0 - 50	ppm	XTRM Fail
AITXXX-11	Pump Room LEL Gas Detector	LEL Level	0 – 100	%	XTRM Fail
AITXXX-12	Electrical Room CO Detector	CO Level	0 – 50	ppm	XTRM Fail
AITXXX-13	Electrical Room NOX Detector	NOX Level	0 – 10	ppm	XTRM Fail
AITXXX-14	Electrical Room LEL Gas Detector	LEL Level	0 – 100	%	XTRM Fail
AITXXX-15	Electrical Room H2S Gas Detector	H2S Level	0 - 50	ppm	XTRM Fail
TTXXX-10	Electrical Room Temperature	Temperature	-50 – 50	°C	XTRM Fail
TTXXX-11	Wet Well Temperature	Temperature	-50 – 50	°C	XTRM Fail

Switches:

Equipment	Description	Feedback - Digital
ATSXXX-01	Automatic Transfer Switch from switchgear	Normal/Emergency, Manual/Auto
LSHHHXXX-1X	Wet Well High-High-High Level Switch	Normal/Alarm
LSHHXXX-1X	Wet Well High-High Level Switch	Normal/Alarm
LSHXXX-1X	Wet Well High Level Switch	Normal/Alarm
LSLXXX-1X	Wet Well Low-Level Switch	Normal/Alarm
LSLLXXX-1X	Wet Well Low-Low Level Switch	Normal/Alarm
LSLLLXXX-1X	Wet Well Low-Low-Low Level Switch	Normal/Alarm
DOORXXX-1X	Magnetic Door Contacts	Open/Close
OCUXXX-01	Odor Control Unit	Normal/Alarm

BHXXX-0X	Blower Alarm Status	Normal/Alarm
BYPXXA-01	Alarm Bypass Switch	Normal/Bypass
XAXXXX-01	Gas Alarm Reset/Mute	Normal/Muted
PLCXXX-01	Watchdog	Normal/Alarm
SECUXXX-01	Station Security Armed Status	Armed/Disarmed

12. PLC Conditioned Alarms

Alarm Name	Description	Devices Used	Other Conditions
ALARMS.HHH_Level	Wet Well full service alarm	LITXXX-01 LSHHHXXX-1X	LITXXX-01.Level > (Site specific set point) OR LSHHHXXX-1X = Alarm
ALARMS.HH_Level	Wet Well HiHi Alarm	LITXXX-01 LSHHXXX-1X	(LITXXX-01.Level > (Site specific set point) OR LSHHHXXX-1X = Alarm) AND 15 minute timer finishes
ALARMS.LL_Level	Wet well Low alarm	LITXXX-01 LSHHXXX-1X	(LITXXX-01.Level < (Site specific set point) AND 3 Minute timer finishes) OR LSLLXXX-1X = Alarm
ALARMS.LLL_Level	Wet Well Empty service alarm	LITXXX-01 LSHHHXXX-1X	LITXXX-01.Level > (Site specific set point) OR LSLLLXXX-1X = Alarm
ALARMS.High_Pressure	Pipe pressure above set point with any pump running	PITXXX-1X IPXXX-0X	PITXXX-1X.Pressure > (Site specific set point) AND Any pump running
ALARMS.Low_Flow	Flow below site specific set point with any pump running	FITXXX-1X	PITXXX-1X.Pressure < (Site specific set point) AND Any pump running AND 30 Second timer finishes
ALARMS.Ultra_Mode_ Failed	Failure of any pump when requested by PLC, lift station in Ultrasonic (primary mod)	IPXXX-0X	Station in ultrasonic mode and either Lead/Lag/ Standby pump fail when requested by PLC

ALARMS.Station_Not_ Armed	Lift Station security left disarmed for 30 minutes	SECUXXX-10	SECUXXX-10 = 0 AND 30 minute timer expires
ALARMS.Illegal_Entry	Left Station armed and door open for 2 minutes	SECUXXX-10 DOORXXX-10	SECUXXX-10 = 1 AND DOORXXX-10 = 0 AND 30 minute timer expires
ALARMS.Temp_WetWell_ Low	Wet well temperature is below 8°C	TTXXX-10	Latch alarm < 6°C Unlatch alarm > 8°C
ALARMS.Temp_ElecRm_ High	Electrical room temperature above 28°C	TTXXX-11	Latch alarm > 28°C Unlatch alarm < 26°C
ALARMS.H2S_Wetwell_ High	Wet well H2S above 10 ppm	AITXXX-10	AITXXX-10.H2S > 10 AND Latched until alarm acknowledged
ALARMS.LEL_ PumpRm _ High	Pump room LEL above 10%	AITXXX-11	AITXXX-11.LEL > 10 AND Latched until alarm acknowledged
ALARMS.CO_ElecRm_ High	Electrical room CO above 50 ppm	AITXXX-12	AITXXX-12.CO > 50 AND Latched until alarm acknowledged
ALARMS.NOX_ElecRm_ High	Electrical room NOX above 5 ppm	AITXXX-13	AITXXX-13.NOX > 5 AND Latched until alarm acknowledged
ALARMS.LEL_ElecRm_ High	Electrical room LEL above 10%	AITXXX-14	AITXXX-14.LEL > 10 AND Latched until alarm acknowledged
ALARMS.BYP_Gas	Alarm Bypass switch is on for over 1 hours Prevents alarms/sirens/horns activated with Gas detection	XAXXX-01	XAXXX-01.MUTED AND 1 hour timer finishes
ALARMS.BYP	Alarm Bypass switch is on for over 2 hours. Prevents alarms getting generated by PLC	BYPXXX-01	BYPXXX.BYPASS AND 2 hour timer finishes
ALARMS.P00X_Hand	Pump is in Hand mode for 30 minutes (for each pump)	IPXXX-0X	IPXXX-0X.HAND = 1 AND 30 minute timer finishes

ALARMS.Pumps_Hand_ ALL	All available pumps are simultaneously in Hand mode	IPXXX-0X	IPXXX-01.HAND = 1 AND IPXXX-02.HAND = 1 AND IPXXX-03.HAND = 1 (if applicable)
ALARMS.P00X_Off	Pump is in Off mode for 30 minutes (for each pump)	IPXXX-0X	IPXXX-0X.OFF = 1 AND 30 minute timer finishes
ALARMS.Pumps_Off_ ALL	All available pumps are simultaneously in Off mode	IPXXX-0X	IPXXX-01.OFF = 1 AND IPXXX-02.OFF = 1 AND IPXXX-03.OFF = 1 (if applicable
ALARMS.PLC_Watchdog	PLC watch dog	PLCXXX-XX	PLC fails to register two consecutive 5 second pulses

13. PLC Calculations

PLC Tag Name	Description	Equation/Formula	Units
PCNT_WET_WELL_X	Wet Well Level in %	PCNT_WET_WELL_X = (LITXXX.LEVEL) / (Height of Wet Well) * 100	%

14. PLC Calculated Totalizers

PLC Tag Name	Description	Input	Rate	Units
FQTXXXT	Running total flow out of Lift Station, Resets at 32,000 ML	FITXXX.FLOW	1 Sec	ML
FQTXXXR	Daily total flow out of Lift Station. Resets at Midnight, 8 Days' worth of data stored locally	FITXXX.FLOW	1 Sec	ML
IPXXX-XXRT	Pump Run Times	IPXXX.RUNNING and SYSTEM_TIME	1 Sec	HH:MIN:SEC
IPXXX-XXSTR	Counts number of pump starts by counting number jumps from 0 to 1 on feedback	IPXXX.RUNNING	N/A	# of

15. Software Interlocks

Interlock Description	Conditions	Action
PLCXXA Watch Dog Fails	PLC Watch Dog 5-second pulses fail	Hardwire Pump Controls take over and any PLC commands are blocked
Pump Start Interlock (Applicable to All pumps)	Pump Not in Fault OR Trip or Failed to Start	Prevents Start command to Pump
Auto enabled for each pump	Applicable pump has AUTO = 1	Allow Start/Stop Command to Pump
Hand or Off enabled for each pump	Applicable pump has HAND or OFF = 1	Prevents Start/Stop Command to Pump
Pump fail interlock	PLC sends start command to applicable pump and doesn't receive feedback in 60 seconds	PLC locks out pump until operator hits reset on HMI screen or reset button on pump MCC.

I. Supervisory Control and Data Acquisition (SCADA)

The design intent of the lift station's remote communication system shall allow for remote monitoring and control of the Lift Station by the City of Calgary's existing OASyS Field Services SCADA system. Currently, primary communication is by serial communication over a TELUS leased line. Wireless communication is achieved by cellular and shall be implemented as a secondary form of communication. Cellular Modem with power cable (provided by The City and installed by the contractor) and external antenna will be used to communicate with the Water Services SCADA host through ModBus Serial. Data communications to SCADA shall be available prior to CCC being awarded. PLC to SCADA interface is as follows:

PLC Register	Description	PLC Input / Output	Data Type
1 Bit 0	Station in local mode	Output	Boolean
1 Bit 1	Station in remote mode	Output	Boolean
1 Bit 2	Station in primary/ultrasonic mode	Output	Boolean
1 Bit 3	Station in secondary/float mode	Output	Boolean
1 Bit 4	SECUXXX-10, armed = 1	Output	Boolean
1 Bit 5	DOORXXX-10, normal = 1	Output	Boolean
1 Bit 6	BYPXXX-10, bypass = 1	Output	Boolean
1 Bit 7	XAXXX-10, mute = 1	Output	Boolean
1 Bit 8	Gas Detector Override, Override = 1	Output	Boolean
1 Bit 9	PLC battery Low Voltage, Active = 1	Output	Boolean
1 Bit 10	Odor Control Unit, Running = 1	Output	Boolean

1 Bit 11	Wet well Blower Heater Alarm, Normal = 1	Output	Boolean
1 Bit 12	Pump room blower Heater Alarm, Normal = 1	Output	Boolean
2 Bit 0	Wet Well Pipe Pressure XMTR F ailed, Alarm = 1	Output	Boolean
2 Bit 1	Wet Well Tank level XMTR Failed, Alarm = 1	Output	Boolean
2 Bit 2	Wet Well Pipe Flow XMTR Failed, Alarm = 1	Output	Boolean
2 Bit 3	Electrical Room Temperature XMTR Failed, Alarm = 1	Output	Boolean
2 Bit 4	Wet Well H2S Gas Detector XMTR Failed, Alarm = 1	Output	Boolean
2 Bit 5	Pump Room LEL Gas detector XMTR failed, Alarm = 1	Output	Boolean
2 Bit 6	Electrical Room CO Gas Detector XMTR failed, Alarm = 1	Output	Boolean
2 Bit 7	Electrical Room NOx gas detector XMTR Failed, Alarm = 1	Output	Boolean
2 Bit 8	Electrical Room LEL Gas Detector XMTR Failed, Alarm = 1	Output	Boolean
3 Bit 0	LSHIHIHIXXX-1X, Alarm = 1	Output	Boolean
3 Bit 1	LSHIHIXXX-1X, Alarm = 1	Output	Boolean
3 Bit 2	LSHIXXX-1X, Alarm = 1	Output	Boolean
3 Bit 3	LSLOXXX-1X, Alarm = 1	Output	Boolean
3 Bit 4	LSLOLOXXX-1X, Alarm = 1	Output	Boolean
3 Bit 5	PLC tag LITXXX-1X.HIHIHI, Active = 1	Output	Boolean
3 Bit 6	PLC tag LITXXX-1X.HIHI, Active = 1	Output	Boolean
3 Bit 7	PLC tag LITXXX-1X.HI, Active = 1	Output	Boolean
3 Bit 8	PLC tag LITXXX-1X.LO, Active = 1	Output	Boolean
3 Bit 9	PLC tag LITXXX-1X.LOLO, Active = 1	Output	Boolean
3 Bit 10	LITXXX-1X Loss of Echo, Alarm = 1	Output	Boolean
3 Bit 11	PLC Watch Dog Pulse	Output	Boolean
4 Bit 0	IPXXX-01 Motor Running, Running = 1	Output	Boolean
4 Bit 1	IPXXX-01 Motor Fault Status, Alarm = 1	Output	Boolean
4 Bit 2	IPXXX-01 Motor Trip Status, Alarm = 1	Output	Boolean
4 Bit 3	IPXXX-01 Ready, Ready = 1	Output	Boolean

4 Bit 4	PLC Tag IPXXX-01 Failed to Start, Alarm = 1	Output	Boolean
4 Bit 5	IPXXX-01 Off, Off = 1	Output	Boolean
4 Bit 6	IPXXX-01 Off, Off = 1	Output	Boolean
4 Bit 7	IPXXX-01 Auto, Auto = 1	Output	Boolean
4 Bit 8	IPXXX-03 Motor Running, Running = 1	Output	Boolean
4 Bit 9	IPXXX-03 Motor Fault Status, Alarm = 1	Output	Boolean
4 Bit 10	IPXXX-03 Motor Trip Status, Alarm = 1	Output	Boolean
4 Bit 11	IPXXX-03 Ready, Ready = 1	Output	Boolean
4 Bit 12	PLC Tag IPXXX-03 Failed to Start, Alarm = 1	Output	Boolean
4 Bit 13	IPXXX-03 Off, Off = 1	Output	Boolean
4 Bit 14	IPXXX-03 Off, Off = 1	Output	Boolean
4 Bit 15	IPXXX-03 Auto, Auto = 1	Output	Boolean
5 Bit 0	Lift station power failure	Output	Boolean
5 Bit 1	GENXXX-0X Run Status, Running = 1	Output	Boolean
5 Bit 2	ATSXXX-10 Position, Open/Normal = 0, Closed/Alarm = 1	Output	Boolean
5 Bit 3	ATSXXX-10 Mode, Auto = 1	Output	Boolean
5 Bit 4	UPSXXX-01 On Battery, Alarm = 1	Output	Boolean
5 Bit 5	UPSXXX-01 Low Battery, Alarm = 1	Output	Boolean
5 Bit 6	UPSXXX-01 Fault, Alarm = 1	Output	Boolean
5 Bit 8	GENXXX-01 Emergency Stop, Alarm = 1	Output	Boolean
5 Bit 9	GENXXX-01 Over Speed, Alarm = 1	Output	Boolean
5 Bit 10	GENXXX-01 Over Crank, Alarm = 1	Output	Boolean
5 Bit 11	GENXXX-01 Low Coolant Temp, Alarm = 1	Output	Boolean
5 Bit 12	GENXXX-01 Low Fuel, Alarm = 1	Output	Boolean
5 Bit 13	GENXXX-01 Oil Pressure, Alarm = 1	Output	Boolean
5 Bit 14	GENXXX-01 Low Battery Voltage, Alarm = 1	Output	Boolean
5 Bit 15	GENXXX-01 High Battery Voltage, Alarm = 1	Output	Boolean
6 Bit 0	ALARMS.HHH_Level	Output	Boolean
6 Bit 1	ALARMS.HH_Level	Output	Boolean
6 Bit 2	ALARMS.LL_Level	Output	Boolean

6 Bit 3	ALARMS.LLL_Level	Output	Boolean
6 Bit 4	ALARMS.High_Pressure	Output	Boolean
6 Bit 5	PLC Alarm Low pressure for 30 seconds	Output	Boolean
6 Bit 6	ALARMS.Low_Flow	Output	Boolean
6 Bit 7	ALARMS.Ultra_Mode_Failed	Output	Boolean
6 Bit 8	ALARMS.Station_Not_Armed	Output	Boolean
6 Bit 9	ALARMS.Illegal_Entry	Output	Boolean
6 Bit 10	Pump room high temperature	Output	Boolean
6 Bit 11	ALARMS.Temp_WetWell_Low	Output	Boolean
6 Bit 12	ALARMS.Temp_ElecRm_High	Output	Boolean
6 Bit 13	Electrical Room low temperature	Output	Boolean
6 Bit 14	ALARMS.H2S_WetWell_High	Output	Boolean
6 Bit 15	ALARMS.CO_ElecRm_High	Output	Boolean
7 Bit 0	ALARMS.NOX_ElecRm_High	Output	Boolean
7 Bit 1	ALARMS.LEL_PumpRm_High	Output	Boolean
7 Bit 2	ALARMS.LEL_ElecRm_High	Output	Boolean
7 Bit 3	ATS Not in Auto alarm	Output	Boolean
7 Bit 4	ALARMS.P001_Hand	Output	Boolean
7 Bit 5	ALARMS.P003_Hand	Output	Boolean
7 Bit 6	ALARMS.Pumps_Hand_ALL	Output	Boolean
7 Bit 7	ALARMS.Pumps_Off_ALL	Output	Boolean
7 Bit 8	ALARMS.P001_Off	Output	Boolean
7 Bit 9	ALARMS.P002_Off	Output	Boolean
7 Bit 10	ALARMS.BYP	Output	Boolean
7 Bit 11	GENXXX-01 Battery Charger Fault, Alarm = 1	Output	Boolean
7 Bit 12	GENXXX-01 Low Coolant Level, Alarm = 1	Output	Boolean
7 Bit 13	GENXXX-01 NFPA 110 Fault, Alarm = 1	Output	Boolean
7 Bit 14	GENXXX-01 Emergency Supply Load (EPS) , Alarm = 1	Output	Boolean
7 Bit 15	GENXXX-01 Common Fault, Alarm = 1	Output	Boolean

8 Bit 0	GENXXX-01 Maintenance Unloaded/Loaded, Loaded = 1	Output	Boolean
8 Bit 7	IPXXX-01 Auto, Auto = 1	Output	Boolean
8 Bit 8	IPXXX-02 Motor Running, Running = 1	Output	Boolean
8 Bit 9	IPXXX-02 Motor Fault Status, Alarm = 1	Output	Boolean
8 Bit 10	IPXXX-02 Motor Trip Status, Alarm = 1	Output	Boolean
8 Bit 11	IPXXX-02 Ready, Ready = 1	Output	Boolean
8 Bit 12	PLC Tag IPXXX-02 Failed to Start, Alarm = 1	Output	Boolean
8 Bit 13	IPXXX-02 Off, Off = 1	Output	Boolean
8 Bit 14	IPXXX-02 Off, Off = 1	Output	Boolean
8 Bit 15	IPXXX-02 Auto, Auto = 1	Output	Boolean
11	Local PLC Time - Year	Output	Integer
12	Local PLC Time - Month	Output	Integer
13	Local PLC Time - Day	Output	Integer
14	Local PLC Time - Hour	Output	Integer
15	Local PLC Time - Minute	Output	Integer
16	Local PLC Time - Seconds	Output	Integer
17	Wet well pipe pressure (PITXXX-1X), multiplied by 100	Output	Integer
18	Wet well pipe flow (FITXXX-1X), multiplied by 100	Output	Integer
19	Wet well tank level (LITXXX-1X), multiplied by 100	Output	Integer
20	Electrical room temperature (TITXXX-1X), multiplied by 100	Output	Integer
21	Wet well H2S gas (AITXXX-10), multiplied by 100	Output	Integer
22	Wet well LEL combustible gas (AITXXX-11) multiplied by 100	Output	Integer
23	Electrical Room CO gas (AITXXX-12), multiplied by 10	Output	Integer
24	Electrical Room NOX gas (AITXXX-14), multiplied by 10	Output	Integer
25	Electrical Room LEL combustible gas (AITXXX-11) multiplied by 100	Output	Integer
26	Pump room temperature (TITXXX-1X), multiplied by 100	Output	Integer

27	IPXXX-01STR	Output	Integer
28	IPXXX-01 Run Time – Hours	Output	Integer
29	IPXXX-01 Rum Time – Minutes	Output	Integer
30	IPXXX-03STR	Output	Integer
31	IPXXX-03 Run Time – Hours	Output	Integer
32	IPXXX-03 Rum Time – Minutes	Output	Integer
33	GENXXX-01 Total Number of Starts	Output	Integer
34	GENXXX-01 Maintenance Total Hours	Output	Integer
35	GENXXX-01 Total Run Hours	Output	Integer
36	GENXXX-01 Maintenance kW Hours	Output	Integer
37	GENXXX-01 Maintenance Last Start Date - Day	Output	Integer
38	GENXXX-01 Maintenance Last Start Date - Month	Output	Integer
39	GENXXX-01 Maintenance Last Start Date - Year	Output	Integer
40	GENXXX-01 Maintenance Last Start Date - Hour	Output	Integer
41	GENXXX-01 Maintenance Last Start Date - Minutes	Output	Integer
42	GENXXX-01 Maintenance Last Run Length (Hours) multiplied by 100	Output	Integer
43	GENXXX-01 Monitoring: Error = 0, Auto = 1, Off = 2, Running = 3	Output	Integer
46	IPXXX-02STR	Output	Integer
47	IPXXX-02 Run Time – Hours	Output	Integer
48	IPXXX-02 Rum Time – Minutes	Output	Integer
51	Current Lead Pump	Output	Integer
52	Current Lag Pump	Output	Integer
53	Current Standby Pump	Output	Integer
54	Lead/Lag Sequence	Output	Integer
55	Lift Station Daily Flow History – 1 Day Ago	Output	Integer
56	Lift Station Daily Flow History – 2 Day Ago	Output	Integer
57	Lift Station Daily Flow History – 3 Day Ago	Output	Integer
58	Lift Station Daily Flow History – 4 Day Ago	Output	Integer
59	Lift Station Daily Flow History – 5 Day Ago	Output	Integer

60	Lift Station Daily Flow History – 6 Day Ago	Output	Integer
61	Lift Station Daily Flow History – 7 Day Ago	Output	Integer
62	Lift Station Daily Flow History – 8 Day Ago	Output	Integer
63	FQTXXXT – Running Total Flow	Output	Float
64			
100	Global SCADA Time, Year	Input	Integer
101	Global SCADA Time, Month	Input	Integer
102	Global SCADA Time, Day	Input	Integer
103	Global SCADA Time, Hour	Input	Integer
104	Global SCADA Time, Minute	Input	Integer
126 Bit 0	Remote command from SCADA	Input	Boolean
126 Bit 1	Primary/Ultrasonic mode command from SCADA	Input	Boolean
126 Bit 2	Secondary/Float mode command from SCADA	Input	Boolean
126 Bit 3	Used to reset pump fail software interlock from SCADA	Input	Boolean
126 Bit 5	IPXXX-01 Remote Start Command	Input	Boolean
126 Bit 6	IPXXX-01 Remote Stop Command	Input	Boolean
126 Bit 7	IPXXX-02 Remote Start Command	Input	Boolean
126 Bit 8	IPXXX-02 Remote Stop Command	Input	Boolean
126 Bit 9	IPXXX-03 Remote Start Command	Input	Boolean
126 Bit 10	IPXXX-03 Remote Stop Command	Input	Boolean

J. UPS

The UPS will be wall mounted outside the PLC panel. The UPS requires its own cabinet. Also, UPS must be connected to the power supplies for the Pump Soft Starters or VFDs.

K. Control Philosophy

Refer to **Appendix A:** Master Control Philosophy for Duplex and Triplex Lift Stations. This document outlines the minimum requirement for lift station controls. All lift stations must be designed and programmed to operate in this manner. It is the responsibility of the designer to add additional control philosophy to meet the operating needs of their lift station.

APPENDIX A
Master Control Philosophy

1.0 General (Control Narrative)

Pump control in automatic mode will be based on the water level in the wet well, as well as upstream and downstream system capacity limitations, and any other limitations that may exist (e.g. electrical power). Pump operation when pump control is in hand mode (i.e. manual mode) or off mode will not be tied to water level in the wet well. The pump start/stop sequence will be controlled by the primary level control (ultrasonic level transmitter) and secondary level control (level/float bulbs).

There will be a gap between the pre-programmed levels of the ultrasonic level transmitter and installed elevations of the level bulbs. The level bulb will start a pump at a higher elevation for HL and HHL and stop the pump at a lower elevation for LL compared to the ultrasonic transmitter; see Figure 1-1 below.

The two modes of operation can be selected by the HMI-:Ultrasonic and level bulb mode. Under primary ultrasonic operation, both the ultrasonic level transmitter and the level bulbs would be operating. If the water level reaches the ultrasonic HL, then the ultrasonic would start the lead pump. If the lead pump does not start when water level reaches level bulb HL then the level bulb will start the lead pump. If the water continues to rise, under normal operation, the ultrasonic should start the lag pump at HHL.

If the water rises to the ultrasonic HHHL, the ultrasonic HHHL will start all pumps (staggered start sequencing, time delay to determined on case by case basis) and send an alarm via the PLC. If ultrasonic fails (e.g. loss of echo, cable fault), the lift station will switch entirely to level bulb mode until the operators go to site, diagnose the failure and physically turn the system from level bulb mode to ultrasonic mode on the HMI.

The two modes can be selected on the HMI by the operator. For example, if the ultrasonic level transmitter needs to be replaced, then the operator can select level bulb mode and the system will run under normal operations in level bulb mode.

There are two emergency level bulbs installed at the HHHL and LLL. These two level bulbs are hard wired to the pump control panel and they are only connected to the station PLC for alarms. If the water level reaches HHHL, the system will bypass the PLC and ALL pumps (staggered start sequencing, time delay to determine on case by case basis) will turn on AND send an overflow alarm. If the water level reaches LLL, all pumps will stop and an alarm will be sent via the PLC. In the case where the HHHL float is activated, it will override both the PLC and all other floats to start all pumps.

To avoid duplication of alarms when HHL and HHHL are reached due to the gap between the ultrasonic level transmitter and the level bulb levels, the ultrasonic should initiate alarm first. Should the water level reach the respective level bulbs, the PLC should query if an alarm was sent out by the ultrasonic. If yes, then an alarm would not be initiated at the floats. If an alarm was not sent out by the ultrasonic then the floats should send an alarm.

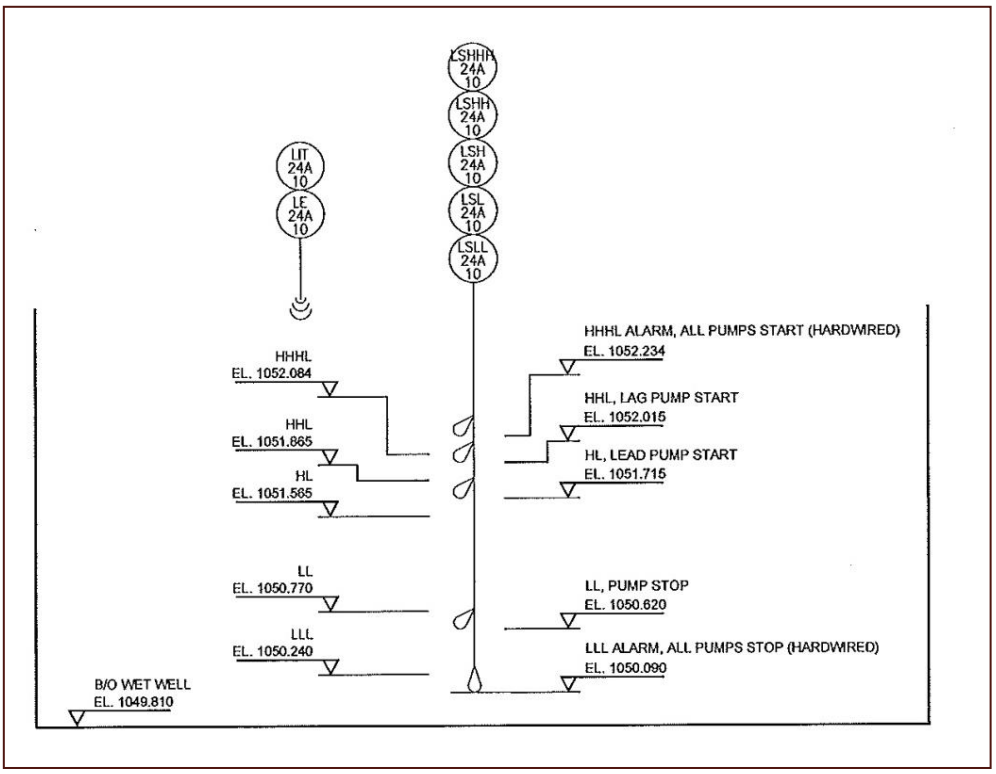


FIGURE 3 – EXAMPLE OF PRIMARY AND SECONDARY LEVEL CONTROL

1.1 Primary Level Control

Table 2 - Wet well rising levels from LLL to HHHL (ultrasonic)

Level	Duplex System	Triplex System
HHHL	Overflow - alarm clear.	Overflow - alarm clear.
HHL	Clear HHL alarm.	Clear HHL alarm.
HL	No action.	No action.
LL	Stop all pumps.	Stop all pumps.
LLL	If low-low level persists for more than 3 minutes (adjustable), alarm for LLL. This alarm will clear automatically on rising water level in the wet well.	If low-low level persists for more than 3 minutes (adjustable), alarm for LLL. This alarm will clear automatically on rising water level in the wet well.

Table 3 - Wet well falling levels from HHHL to LLL (ultrasonic)

Level	Duplex System	Triplex System
HHHL	Overflow - alarm clear.	Overflow - alarm clear.
HHL	Clear HHL alarm.	Clear HHL alarm.
HL	No action.	No action.
LL	Stop all pumps.	Stop all pumps.
LLL	If low-low level persists for more than 3 minutes (adjustable), alarm for LLL. This alarm will clear automatically on rising water level in the wet well.	If low-low level persists for more than 3 minutes (adjustable), alarm for LLL. This alarm will clear automatically on rising water level in the wet well.

1.2 Secondary Level Control

Table 4- Wet well level bulbs (rising water levels from LLL to HHHL, LSLLXXX-10, LSLXXX-10, LSHXXX-10, LSHHXXX-10, LSHHHXXX-10)

Level Switch	Duplex System	Triplex System
LLL (LSLLXXX-10)	No action.	No action.
LL (LSLXXX-10)	No action.	No action.
HL (LSHXXX-10)	Start lead pump.	Start lead pump.
HHL (LSHHXXX-10)	Start lag pump and alarm for HHL.	Start lag pump and alarm for HHL.
HHHL (LSHHHXXX-10)	Overflow alarm. Start all pumps.	Overflow alarm. Start all pumps.

Table 5 - Wet well level bulbs (falling water levels from HHHL to LLL, LSHHHXXX-10, LSHHXXX-10, LSHXXX-10, LSLXXX-10, LSLLXXX-10)

Level Switch	Duplex System	Triplex System
HHHL(LSHHHXXX-10)	Clear overflow alarm.	Clear overflow alarm.
HHL(LSHHXXX-10)	Clear HHL alarm.	Clear HHL alarm.
HL(LSHXXX-10)	No action.	No action.
LL(LSLXXX-10)	Stop all pumps.	Stop all pumps.
LLL(LSLLXXX-10)	Stop all pumps and alarm for LLL. This alarm will clear automatically on rising water level in the wet well.	Stop all pumps and alarm for LLL. This alarm will clear automatically on rising water level in the wet well.

Two systems are installed to provide redundancy for level monitoring and pump control. The primary level system will be ultrasonic sensor and the backup system will be float bulbs. The float bulbs are to override the ultrasonic system.

If operators need to pump the wet well water below the LL and LLL level for cleaning, they will need to do so by switching operation to HAND and operate a Start/Stop station. The pumps will be protected by built-in motor temperature and leakage sensors.

The ultrasonic level transmitter will be set up in the following manner based on elevation:

Low Low Level (LLL)	Elevation required so when the pump stops the water level is at the minimum required as per pump spec (wet well setup). Elevation required so when the pump stops the water level is at the minimum required to not air-lock the pumps (dry well setup)
Low Level (LL)	Elevation above LLL, where the difference between them is equal to a draw-down time of 120 seconds with 1 pump running with an influent rate of zero.
High Level (HL)	Elevation above LL, where the elevation is such that the number of pump starts does not exceed the maximum defined by the pump or pump starter spec, and the residency time in the wet well does not exceed 2 hours.
High High Level (HHL)	Elevation between HL and HHHL, where the difference between HL and HHHL is multiplied by one third, and added to HL.
High High High Level (HHHL)	Elevation equal to the invert of the influent pipe.

To improve the visibility of level bulbs and elevations at which they activate, a white plastic board will be installed behind the bulbs with black markings identifying the 0% to 100% tank levels in 10% level increments.

Pump sequence is to be automatically rotated based on the pump "on-cycle" such that the last pump on is the next pump off in the sequence of operation. In a three-pump scenario pumps will be sequenced in sets of three.

As a fail-safe condition of the float bulb logic the High-high-high Level Alarm will override the Low-low Level alarm (should they occur at the same time) and start all pumps. HHHL will be hard wired to start all pumps, while in automatic mode, and send an alarm via the PLC. An ultrasonic failed condition shall be programmed to automatically start pumps given that the level bulb control logic is satisfied.

The PLC control system will be able to reset to operating mode following power failure where the UPS battery has run down or failed.

The following lift station parameters will be monitored but will not be limited to:

a. Level sensor, LEXXX-10 in the wet well, including the loss of echo and transmitter failure

b. Level bulbs in the wet well, LSLLXXX-10, LSLXXX-10, LSHXXX-10, LSHHXXX-10, and LSHHHXXX-10

c. Pressure transducer on pump header, PITXXX-10

d. Flow meter - instantaneous flow and totalized volume, FEXXX-10 (mag meter)

e. Pump status - on/off, run time hours, number of pump starts, pump failed to start, pump motor leak detection, pump bearing temperature

f. Building temperature (Electrical/Generator Room and Pump Room)

g. Intrusion alarm for the lift station, Electrical/Generator Room and Pump Room

h. Power consumption - power (kW), total energy (kWh), voltage per phase, and current per phase

i. Generator status - on/off, auto/not auto, voltage and current, over speed, over crank, vibration overlimit, engine temperature, oil level, pressure and temperature, coolant level, pressure, and temperature, battery voltage

j. H_2S and combustible gas levels in Pump Room

k. CO, NOx, and combustible gas levels in Electrical/Generator Room

l. Ventilation equipment – On/Off, Auto/not Auto, Intake and Exhaust temperature, air velocity.

2.0 Pump Control

2.1 HMI

Setpoints

All of the setpoints will be displayed on the HMI and all adjustments will be password protected. The login will automatically time out after 30 minutes.

Graphics

Graphics and PLC programming can be provided by Control Systems Services. Refer to Section 9 (Electrical – PLC and HMI/SCADA Software and Programming) for contact information.

For Developer driven lift stations where programming is done by contractors, The City must review and have full access to the program. Refer to Appendix C for a sample HMI Screen Shots.

2.2 Philosophy

The pumps will start in the following sequence using the wet well ultrasonic level transmitter (LEXXX-10):

Table 6 - Duplex:

Start Set Point Sequence No.	Ultrasonic (LEXXX-10)	Pump Failed to Start
1	Pump 1	Pump 2
2	Pump 2	Pump 1

Table 7 -Triplex:

Start Set Point Sequence No.	Ultrasonic (LEXXX-10)	Pump Failed to Start
1	Pump 1	Pump 2
2	Pump 2	Pump 3
3	Pump 3	Pump 1

Pump start failure out of sequence

If Pump is in "OFF" mode (OFF position selected on the HAND-OFF-AUTO), it is out of sequence.

If Pump is in "HAND" mode, it is still in sequence.

If the pump fails to start or is "Not Ready" to start, the lag pump will start and the pump that failed to start will be removed from the sequence until the pump alarm is acknowledged or the HOA switch is in the "AUTO Position". The lag pump will operate in place of the failed pump in the sequence - trigger alarm.

If one of the pumps is "not ready" to start due to the HOA switch in the pump room being in the "OFF" or "HAND" position, start the lag pump and after 30 minutes alarm that the pump is in HAND or OFF position.

If both pumps are in HAND position - alarm.

If both pumps are in OFF position – alarm.

Upon station power failure, pump No. 1 to be the first (lead) pump in sequence to start.

A watchdog timer will need to be in place to ensure the communication between the PLC and the SCADA system.

2.3 Alarms

a) Pump failed to start (typical for pump 1, pump 2 and pump 3). If PLC does not receive the pump run status 1 minute after the pump receives the start command, declare the pump as "failed to start".

b) Pumps in HAND or OFF position will be in alarm state - alarm to activate if pump is in OFF position, alarm to activate if pump remains in HAND for 30 minutes.

c) HHH Level Alarm (ultrasonic).

d) HH Level alarm persists 15 minutes (adjustable) with two pumps on.

e) HHH Level alarm (level switches with ultrasonic failure).

f) HH Level alarm if level persists 15 minutes (adjustable) with two pumps on (level switches with ultrasonic failure). Alarm the supervisor on duty.

g) LLL Level alarm (level switches with ultrasonic failure).

h) Overload alarm (typical for pump 1, pump 2, pump 3, PLC input).

i) High temperature/Leakage alarm (typical for pump 1, pump 2, pump 3, PLC input).

j) VFD or Soft Starter alarm.

3.0 Pressure and Flow Transmitter

3.1 Setpoints

Pressure Alarm Setpoint - to be set during commissioning.

3.2 Graphics

a) Pressure indicated on Process Screen (kPa and ms)

b) Instantaneous (L/s) and total flow (ML) indicated on Process Screen (flow meter to track total flow up to 32000 ML, then reset)

c) High Pressure Alarm limit (kPa) on Setpoint Screen

d) Low Pressure Alarm limit (kPa) on Setpoint Screen (pipe leak)

e) Low Flow Alarm limit (L/s) on Setpoint Screen (discharge line plugged).

3.3 Philosophy

a) When header pressure exceeds the pressure alarm setpoint for adjustable time period (nominally 2 minutes), trigger alarm

b) Provide reset for flow totalizer on HMI (after 32,000 LM).

3.4 Alarms (while pumps running)

a) High pressure alarm on pump header, PITXXX-10

b) Low pressure alarm on pump header, PITXXX-10

c) Low Flow Alarm on pump header when one or more pumps are on, FITXXX-10.

4.0 Electrical/Generator and Pump Room Temperature

4.1 Setpoints

a) High Temperature

b) Low Temperature

4.2 Graphics

High and Low Temperature

4.3 Philosophy

a) On low temperature in Electrical/Generator Room trigger alarm (PLC input)

b) On low temperature in Pump Room trigger alarm (PLC input)

c) On high temperature in the Pump Room trigger alarm (PLC input)

d) On high temperature in the Electrical Room/Generator Room trigger alarm (PLC input).

4.4 Alarms

a) Low temperature in Electrical/Generator Room (Below 10 Degree Celsius)

b) Low temperature in Pump Room (Below 10 Degree Celsius)

c) High temperature in Pump Room (Above 30 Degree Celsius)

d) High temperature in Electrical/Generator Room (Above 30 Degree Celsius)

5.0 Intrusion Alarm-Both Electrical/Generator Room and Pump Room

5.1 Setpoints

Time to arm/disarm security setpoint(s) – Electrical / Generator Room and Pump Room

5.2 Graphics

a) Security Active indication on Process Screen

b) Time to arm/disarm security setpoint on setpoint screen.

5.3 Philosophy

a) If the ARM/DISARM switch is in the ARM position and a door contact is opened (PLC input), an Illegal Entry alarm will be triggered if the ARM/DISARM switch is not put into the DISARM position before the Time to Arm/Disarm Security Setpoint times out

b) Upon the ARM/DISARM switch changing states from DISARM to ARM, an operator will have arm/disarm setpoint time to leave the building (and ensure all the doors are closed) before the system resets itself (Security Active)

c) Intrusion alarm will activate the non-strobe warning beacon on the outside of the building.

5.4 Alarms

Illegal entry

6.0 Utility

6.1 Setpoints

None

6.2 Graphics

Show the following on Utility Screen:

a) Power (kW)
b) Total energy (kWh)
c) Voltage
d) Current
e) Pump status - on/off
f) Generator status - on/off
g) Generator voltage
h) Generator current.
i) ATS position
j) Natural gas flow/pressure.

6.3 Philosophy

a) Display values on HMI
b) Provide reset for Total Energy on HMI

6.4 Alarms

a) No power
b) Genest Alarms to SCADA/PI:
- Generator Failed to Start
- Generator Run Status
- Low Fuel Level (diesel generator, N/A for Forest Lawn)
- Low Coolant
- Over Speed
- Low Oil
- Pre-Low Oil Press
- High Temp
- Pre-High Temp
- High Coolant Temp
- Charger AC Failure
- Low Battery Voltage
- Not in Auto
- Supplying Load
- Common Alarm.

7.0 H_2S Gas Detection

7.1 Setpoints

High level H_2S Pump Room and Wet Well: 0 - 50 ppm.

7.2 Graphics

High Level – display value.

7.3 Philosophy

a) On High level H_2S turn on warning beacon and audible alarm, if level reduces turn off warning light and audible alarm

b) On High level H_2S trigger alarm

7.4 Alarms

High level H2S detected > 10 ppm

8.0 Combustible Gas Detection

8.1 Setpoints

High level in Pump Room and the Wet Well: 0 - 25% of LEL (Lower Explosive Limit).

8.2 Graphics

High Level – display value.

8.3 Philosophy

a) When combustible gas reaches high level, turn on warning beaconand audible alarm, if level reduces turn off warning beaconand audible alarm

b) On high level combustible gas trigger alarm (PLC input) and turn on an exhaust fan. After the level drops and a certain elapsed time, turn off the exhaust fan.

8.4 Alarms

High level combustible gas detected > 15% LEL

9.0 Carbon Monoxide and Nitrogen Oxide Detection

9.1 Setpoints

High level in Generator/Electrical Room:

a) CO: 25 ppm (8 hour occupational exposure limit)

b) NOx 25 ppm (8 hour occupational exposure limit).

9.2 Graphics

High Level – display value.

9.3 Philosophy

a) When either NOx or CO levels reach high levels, turn on warning beacon and audible alarm, if level reduces turn off warning beacon and audible alarm.

b) On high level gas detection, room ventilation is switched on (hard wired to ventilation units) and gas detection is put in alarm (PLC input). If level of CO or NOx gas detection is reduced, ventilation resumes typical control philosophy.

10.0 UPS Alarms

a) UPS on battery
b) Low battery voltage
c) Common fault alarm

11.0 Ventilation Equipment Alarms

a) No air flow
b) Odour control unit - media to be changed
c) Common fault alarm

11.1 Setpoints -

None

11.2 Graphics

None

11.3 Philosophy

Ventilation designed to be continuously run (PLC inputs).

11.4 Alarms

Ventilation equipment failure (alarm to annunciate failure of specific equipment). Turn on warning beacon and audible alarm.

12.0 Typical PLC Telemetry Control System Architecture

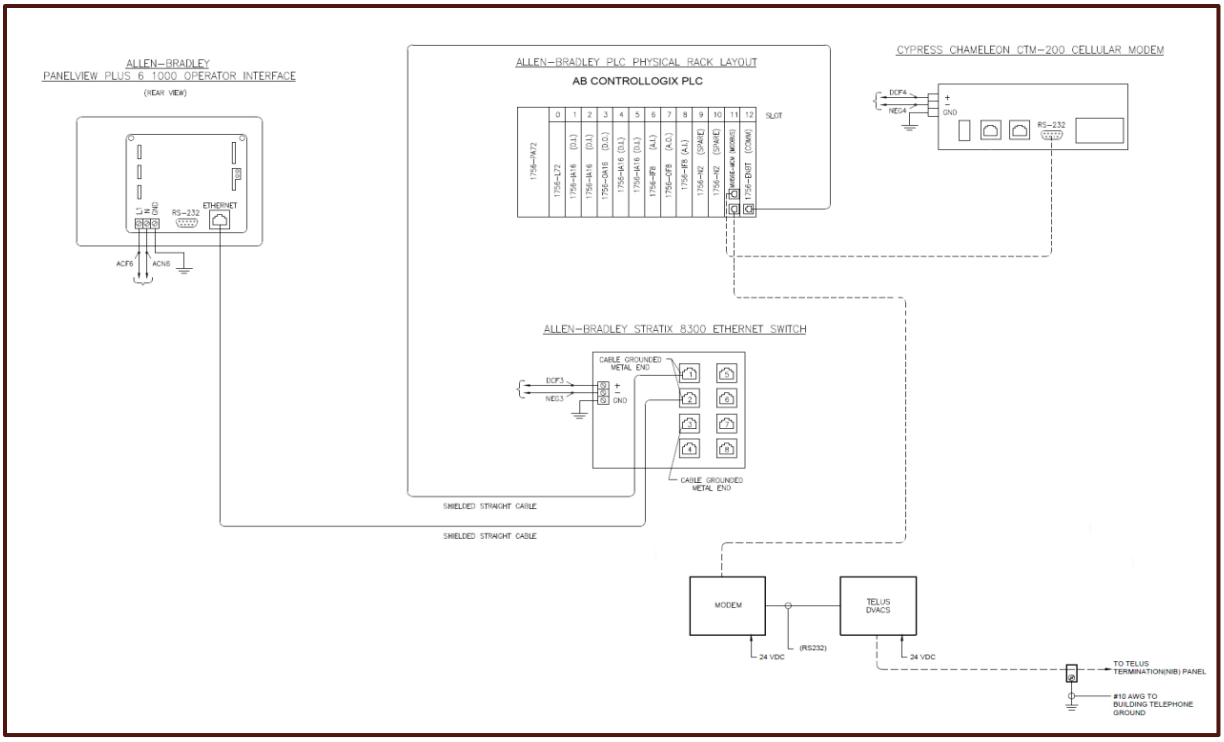


FIGURE 4

APPENDIX B
Functional Equipment Identification Code (P&ID)

Table 8 - FUNCTIONAL EQUIPMENT IDENTIFICATION (P&ID) CODE

Backlog Legend: E: Electrical (T-E) M: Mechanical (T-M) U: Utilities (T-U)
I: Instrumentation (T-I) D: C-DACS (T-D)

ALPHA PREFIX CODE				EQUIPMENT NAME	BACK LOG	EQUIPMENT DEFINITION
A	A			ALTERNATOR RELAY	E	AA:
A	B			AIR BLOWER	M	AB: Device intended to increase the flow volume of the air involved. Device should provide a pressure differential less than or equal to 35 psi. Includes control devices.
A	C	S		ACCESS CONTROL AND SECURITY	I	ACS: Card readers, electric locks, controllers, perimeter fences.
A	D			AIR DRYER	I	AD: Desiccant, refrigerated, adsorption types.
A	E			ANALYZER ELEMENT	I	AE: ISA Analyzer element
A	E	D		AUTOMATIC EXTERNAL DEFIBRILLATOR	I	AED: AED
A	F			AIR FILTER	M	AF: Air Filters in Air Handling Units, Filter Wheel, Filter Bank, Flat Filter, Rigid Filter, Roll Filter, Chemical Filter. IA's filters.
A	G			AIR LUBRICATOR	M	AG:
A	I	C		ANALYZER INDICATING CONTROLLER	I	AIC: ISA
A	I	T		ANALYZER INDICATING TRANSMITTER	I	AIT: ISA - Analyzer Indicating Transmitter
A	L	M		ALARMS	E	ALM: Alarms, Horn and Beacon alarms
A	N			ANNUNCIATOR	E	AN: Annunciator, alarm panel, BMS panel.
A	O			ACTUATOR	I	AO: Electrical, mechanical, or pneumatic. For gates, weirs, and valves.
A	P			STEAM CONDENSATE PUMP	M	AP:
A	S			AIR SEPARATOR	M	AS:
A	T			ANALYZER TRANSMITTER	I	AT: ISA - Analyzer Transmitter (Blind). Instrument with sensor heads for measuring density & volume

ALPHA PREFIX CODE				EQUIPMENT NAME	BACK LOG	EQUIPMENT DEFINITION
						of fluids.
A	U			AIR HANDLING UNIT	M	AU:
A	V			VENT	M	AV:
A	W			ADJUSTABLE WEIR	M	AW: Adjustable Weir. Look at P15A-Filtration. Asset Type Code: MISC.
B	A			BEACON ALARM	E	BA: Beacon Alarm; Flashing Alarm Beacon with colored lens
B	C			SLUDGE CENTRIFUGE	M	BC:
B	D			BUILDING	U	BD: Architectural, structural, roof, roofing, walls, windows, doors, ceiling, flooring, Loading Docks, Mezzanines, rooms, stories, basement, etc… Above ground building. Catwalks, stairs (including metal), platforms. *Note: Tunnels and Galleries are part of the building if the building itself is built up on top of Tunnel and/or Galleries.*
B	F			BACKFLOW PREVENTOR	M	BF:
B	G			BYPASS GATE	M	BG:
B	K			BREAKER	E	BK: Main frame only, others part of switchgear (components).
B	P			BLENDED SLUDGE PUMP	M	BP:
B	T	U		BIOREACTOR UNIT	M	BTU: Bioreactor as a whole, used as the FL1-UNIT
B	T			AERATION / COMPLETE MIX TANK	M	BT: PRE-ANOXIC CELL, ANAEROBIC CELL, ANOXIC CELL, AEROBIC CELL, SWING CELL.
B	U			BATTERY UNIT	E	BU:
B	V			BYPASS VALVE	M	BV:
B	W			FILTER BACKWASH PUMP	M	BW:
C	A			CAPACITOR	E	CA:
C	B			CONTROL PANEL	E	CB:
C	C			COOLING COIL	M	CC:
C	D			CENTRAL DISTRIBUTION PANEL	E	CD: 347, 480, and 600 volt panels.
C	E			CHLORINE EJECTOR	I	CE:

ALPHA PREFIX CODE				EQUIPMENT NAME	BACK LOG	EQUIPMENT DEFINITION
C	F			COOLING FAN	M	CF:
C	G			CONTROL GATE	M	CG:
C	H			CABINET HEATER	M	CH:
C	H	L		FLOW CHANNELS AND FLOW DUCTS	M	CHL: To deliver water at any of its stages (raw, influent, effluents, etc) across the wastewater treatment plant to be processed through the treatment process flow
C	I			CHILLER	M	CI: Chiller
C	K			EXHAUST STACK	M	CK:
C	L			CHLORINATOR	M	CL:
C	N			CATHODIC PROTECTION SYSTEM	E	CN:
C	O			CHLORINE REGULATOR	I	CO: Vacuum regulator
C	P			CHEMICAL PUMP	M	CP:
C	R			CHARGER	E	CR:
C	S			DRAIN SUMP	M	CS:
C	T			CHEMICAL TANK	M	CT:
C	U			CENTRAL PROCESSING UNIT	D	CU: CPU, Central Processing Unit
C	V			CHECK VALVE	M	CV:
C	W			CONTROL WEIR	M	CW:
D	B			DISTRIBUTION PANEL	E	DB: Distribution Panel
D	D			DIRECT CURRENT DRIVE	E	DD:
D	G			DIGESTER / SLUDGE TANK	M	DG:
D	P			DIGESTER DEWATERING PUMP	M	DP: Digester Dewatering Pump
D	S			DISCONNECT SWITCH	E	DS: For switchgear only. Small disconnect switches part of motor control device.
D	U			DCU CABINET	D	DU: DCU Cabinet; Distributed Control Unit
D	U	C		DUCTWORK	M	DUC: HVAC ductwork, exhausts air, supply air, return air, dryer exhaust.
D	V			DISCHARGE VALVE	M	DV:

ALPHA PREFIX CODE				EQUIPMENT NAME	BACK LOG	EQUIPMENT DEFINITION
D	X			DISPLAY CENTRE TERMINAL	D	DX: Computer work station
E	B			EYE BATH	M	EB: Single or double Eyewash Station with Polyethylene Bottles up to 32 oz. Normally a wall station. Color: Green, Yellow and sometimes Orange
E	C			SECONDARY SLUDGE COLLECTOR	M	EC: Mechanism of the Secondary Clarifier only.
E	C	U		SECONDARY CLARIFIER	M	ECU: Secondary Clarifier whole unit.
E	F			EXHAUST FAN	M	EF: Exhaust Fan, Kitchen range hood.
E	G			ENGINE	M	
E	H			ELECTRICAL HEATING	E	EH: For electric unit heaters use UH
E	J			EXPANSION JOINT	M	EJ:
E	L			TOOL INVENTORY LOCATION	M	EL: Delete - e.g. TRUCK, SHOPS
E	M			ELECTRIC MOTOR	E	EM: Includes all control devices e.g. starter, contactor, capacitor, disconnect switch, hand switch
E	P			EFFLUENT WATER PUMP	M	EP:
E	R			ELEVATOR	M	ER:
E	S			ELECTRIC STRAINER	M	ES:
E	T			VOLTAGE TRANSMITTER	M	ET: ISA – Voltage Transmitter
E	V			EMERGENCY RELIEF VALVE	M	EV:
E	W			EMERGENCY WASH STATION	M	EW: Eye Wash Station, Faucet Mount Eye Wash Station, Drench Shower Station, Horizontal Shower Station, Combination Shower and Eye Wash Station. *Note: Assets at Pine Creek include and alarm to the control room to warn of its using.*
E	X			EMERGENCY SHUTDOWN SWITCH	E	EX:
E	Y			EMERGENCY LIGHTING	E	EY: Includes battery, charger, rectifier, & lights
F	A			FLAME ARRESTOR	M	FA:
F	A	K		FIRST AID KIT	O	FAK: First Aid Kit
F	B			FIRE PANEL	E	FB:
F	C			FLOW CONTROLLER	I	FC: ISA – Flow Controller (Blind)

ALPHA PREFIX CODE				EQUIPMENT NAME	BACK LOG	EQUIPMENT DEFINITION
F	C	V		FLOW CONTROL VALVE	I	FCV: ISA. Activated Flow Control Valve
F	D			FIRE DETECTOR	E	FD:
F	E			FLOW ELEMENT	I	FE: ISA
F	E	X		FIRE EXTINGUISHER	M	FEX:
F	F			EFFLUENT FILTRATION	M	FF:
F	I	T		FLOW INDICATING TRANSMITTER	I	FIT: ISA
F	K			FIRE ALARM PULL STATION	E	FK:
F	P			FIRE PUMP	M	FP:
F	T			FLOW METER	M	FT: Flow Meter, Gas flow meter (turbine), Water flow meter (c/w transmitter)
F	T			FLOW TRANSMITTER	I	FT: Flow Transmitter (Blind) ISA. Flow Meter
F	U			FUSE	E	FU:
F	V			FLOW VALVE	M	FV: Usually it's a ¼ shut off valve. It's not actuated
F	W			FIRE SWITCH	E	FW: Sprinkler system type
G	A			GRIT AUGER	M	GA:
G	B			GAS BOOSTER	M	GB:
G	C			CONVEYOR	M	GC:
G	D			GAS DETECTOR	I	GD: ISA – Gas Detector; Portable Gas Detector
G	E			GENERAL	M	GE:
G	F			GAS FLARE	M	GF: Gas Flare, Thermal Oxidizer
G	N			GENERATOR	E	GN:
G	P			GLYCOL PUMP	M	GP:
G	Q			GROUND BUS	E	GQ:
G	R			GRIT CLASSIFIER / CYCLONE	M	GR: Includes rakes, classifiers, cyclones, and hydro-cyclones
G	R	D		GROUNDS	U	GRD: Lawns, roads, landscaping, trees, etc.
G	T			GAS CONDENSATE / SEDIMENT TRAP	M	GT: Gas Condensate; Condensate Sediment Trap; Sediment Trap.

ALPHA PREFIX CODE				EQUIPMENT NAME	BACK LOG	EQUIPMENT DEFINITION
G	V			GAS CONCENTRATION LEVEL HIGH VALVE	M	GV:
G	Y			GAS DRIP TRAP	M	GY: Gas Drip Trap, Moisture Accumulator Tank.
G	Z			GRIT BIN TROLLEY	M	GZ:
H	B			HEATING BOILER	M	HB:
H	C			HEATING COIL	M	HC:
H	E			HEAT EXCHANGER	M	HE: Open and closed types, tube and shell and plate types.
H	H			SOLIDS COMPACTOR / SCREEN WASTE COMPACTOR	M	HH: Helix press, Screenings Washer, Solids Compactor, Compactor.
H	M			HUMIDIFIER	M	HM: Gas Fired, and No Gas Fired
H	N			HORN / BELL	E	HN: Audio Alarm Horn
H	O			HOIST	M	HO:
H	P			HEATING / COOLING WATER PUMP	M	HP:
H	Q			HYDRAULIC CONTROL UNIT	M	HQ:
H	R			HEAT RECOVERY UNIT	M	HR:
H	S			HAND SWITCH	I	HS: ISA. Local/Off/Remote, Open/Stop/Close, Hand/Off/Auto Switch.
H	T			HYDRO-PNEUMATIC TANK	M	HT:
H	Y			FIRE HYDRANT	M	HY:
H	Z			HEAT TRACING	E	HZ:
I	C			PRIMARY SLUDGE COLLECTOR	M	IC: Mechanism of the Primary Clarifier. Cross Collector; Longitudinal Collector.
I	C	U		PRIMARY CLARIFIER	M	ICU: Primary Clarifier whole unit.
I	F			FLOW INDUCER	M	IF:
I	G			ISOLATION GATE	M	IG:
I	P			INFLUENT / SEWAGE PUMP	M	IP:
I	R	R		IRRIGATION	U	IRR: Ground irrigation, sprinklers, hose, controllers, etc.
I	S			PROCESS SCREEN	M	IS:

ALPHA PREFIX CODE				EQUIPMENT NAME	BACK LOG	EQUIPMENT DEFINITION
I	T			CURRENT TRANSMITTER	I	IT: ISA – Current Transmitter (Blind)
I	V			ISOLATING VALVE	M	IV:
J	B			JUNCTION BOX	E	JB:
J	P			OIL RECOVERY PUMP	M	JP:
K	B			LOCAL CONTROL PANEL	E	KB: Local Control Panel
K	C			COMPRESSOR	M	KC:
K	F			CONDENSER FAN	M	KF:
K	P			LUBE OIL COOLING WATER PUMP	M	KP:
K	T			TRAILER	M	KT:
K	V			FEED VALVE	M	KV:
L	A			LABORATORY EQUIPMENT	M	LA:
L	B			LIGHTING PANEL	E	LB:
L	C			LEVEL CONTROLLER	I	LC: Level Controller (Blind) ISA
L	D			LEAK DETECTION SYSTEM	E	LD:
L	E			LEVEL ELEMENT	I	LE: Level Primary Element, ISA
L	G			LOG GATE	M	LG:
L	I	T		LEVEL INDICATING TRANSMITTER	I	LIT: Level Indicating Transmitter, ISA
L	P			SEAL WATER PUMP	M	LP:
L	U			LAGOON CELL	M	LU:
L	V			LEVEL CONTROL VALVE	I	LV:
L	W			LOAD SHEDDING SWITCH	E	LW:
M	A			MANHOLE	M	MA:
M	B			MARSHALLING PANEL	E	MB:
M	C			MOTOR CONTROL CENTER	E	MC: MCC Motor Control Center
M	D			MOTORIZED DAMPER	M	MD:
M	E			MISCELLANEOUS EQUIPMENT	M	ME: Pre-action sprinkler station, pressure washer.
M	G			TRAFFIC GATE	M	MG:

ALPHA PREFIX CODE				EQUIPMENT NAME	BACK LOG	EQUIPMENT DEFINITION
M	H			MOTORIZED CRANE / MONORAIL	M	MH:
M	N			MONITOR	D	MN: Delete
M	P			MIXED LIQUOR PUMP	M	MP:
M	S			MANUAL STRAINER	M	MS:
M	T			MISCELLANEOUS TANK	M	MT: Air receiver, air saturation, expansion tank, Wet Wells at P40A, tank structure, LP gas holder, concrete, steel, fiberglass, plastic.
M	V			MECHANICAL CONTROL VALVE	M	MV:
M	X			MIXER	M	MX:
M	Z			CONTACTOR	E	MZ: Portable units only. Part of MCC.
N	P			GRIT PUMP	M	NP:
N	T			GRIT TANK	M	NT: Grit Tank, Vortex Tank
O	B			BIOFILTER	M	OB:
O	C			ODOUR CONTROL UNIT (CARBON)	M	OC: Odour Scrubber, Carbon Scrubber, Wet Scrubber; Carbon Canister
O	D			OVERHEAD DOOR	M	OD:
O	F			ODOUR CONTROL SYSTEM	M	OF:
O	F	S		ODOUR FOGGING SYSTEM		OFS: Pumps, Pipes, Nozzles, Motor, Shack, etc.
O	P			LUBE OIL PUMP	M	OP:
O	R			FIBRE OPTIC REPEATER	D	OR:
O	S			ODOUR SCRUBBER (WET)	M	OS:
O	V			OXYGEN VAPORIZER	M	OV:
P	A			PRESSURE SWING ADSORPTION (PSA) SKID	M	PA:
P	B			PERFORATEDBAFFLE	M	PB: Perforated Baffle, Perforated Baffle Plate
P	E			PRINTER	D	PE:
P	F	X		PLUMBING FIXTURE	M	PFX: Drinking Fountain: WF; Lavatory: L; Mop/Janitor Sink: MS; Shower: SH; Urinal: UR; Wash Fountain: WN; Water Closet: WC.
P	I			PRESSURE INDICATOR		PI:

ALPHA PREFIX CODE				EQUIPMENT NAME	BACK LOG	EQUIPMENT DEFINITION
P	I	P		PIPING		PIP: Process Piping, Mechanical System Piping, Plumbing Piping, Pipes, fittings, insulation, hangers, general valves, etc. Replaces 'SY'. Note: Toilettes are now within PFX.
P	I	T				PIT:
P	N			PART NUMBER	M	PN: Delete
P	P			PRIMARY / FERMENTER SLUDGE PUMP	M	PP: Primary Sludge Pump; Fermenter Sludge Pump
P	U			POLYMER MAKE-UP UNIT	M	PU:
P	C	V		PRESSURE CONTROL VALVE	I	PCV: PRESSURE/VACUUM CONTROL VALVE, ISA
P	V			PRESSURE VENT	M	PV: PRESSURE VENT; VACUUM RELIEF DAMPER (P02A)
P	W	L		POWER AND LIGHTING	E	PWL: Low voltage power (<300 V), wires, lights. Street lights, heat tracing.
Q	P			SUMP PUMP	M	QP:
Q	S			SANITARY SUMP	M	QS:
Q	T			GEAR BOX / SPEED REDUCER	M	QT:
Q	V			DRAIN VALVE	M	QV:
R	C			REFRIGERANT COIL	M	RC:
R	D			REFRIGERATION CONDENSING UNIT	M	RD:
R	F			RETURN FAN	M	RF:
R	G			RAIN GAUGE	E	RG
R	I			REMOTE I/O CABINET	D	RI:
R	P			RETURN ACTIVATED SLUDGE (RAS) PUMP	M	RP:
R	T			HOPPER	M	RT: Sludge, scum, screenings.
R	V			RELIEF VALVE	M	RV:
S	A			SAMPLER	I	SA: Sampler; Automatic Sampler; Grab Sampler; Composite Sampler. Chemscans
S	A	F		SAFETY	M	SAF: Safety Equipment.
S	D			SEWAGE DEGRITTOR	M	SD: Travelling grit extractor, queen.

ALPHA PREFIX CODE				EQUIPMENT NAME	BACK LOG	EQUIPMENT DEFINITION
S	F			SUPPLY FAN	M	SF:
S	G			SWITCHGEAR	E	SG:
S	J			SECURITY SYSTEM	E	SJ: See ACS
S	L			SILENCER	M	SL: Silencer
S	M			SLUDGE MACERATOR	M	SM: Sludge Macerator
S	P			DIGESTER SLUDGE RECIRCULATION PUMP	M	SP:
S	S			SLUDGE SKIMMER	M	SS: Mechanism only
S	S	U		DISSOLVED AIR FLOATATION TANK	M	SSU: DAF Tank whole unit.
S	T	R		STRUCTURE	U	STR: Structural components, conduits, sumps, tunnels, galleries, walls, etc. Below ground structures. Gratings. Not buildings. Not building components. Not Process Assets.
S	U			SLUDGE BLENDING TANK	M	SU:
S	V			SUCTION VALVE	M	SV:
S	W			SPLITTER BOX	M	SW:
T	B			TERMINAL BLOCK	E	TB:
T	C			TEMPERATURE CONTROLLER	I	TC: ISA – Temperature Controller (Blind)
T	C	V		TEMPERATURE CONTROL VALVE		TCV: ISA – Temperature Control Valve
T	E	L		TELEPHONE AND COMMUNICATIONS	E	TEL: TELCOM; Telephone and Data Communication ; Telephones; cell phones; pagers; etc.
T	M			THERMOSTAT	E	TM:
T	N			TELEPHONE SYSTEM	E	TN: See TEL
T	P			TRANSFER PUMP	M	TP:
T	T			TEMPERATURE TRANSMITTER	I	TT: ISA – Temperature Transmitter (Blind)
T	U			SLUDGE THICKENING UNIT	M	TU: Do not use. Delete see TW
T	W			FERMENTER/GRAVITY SLUDGE COLLECTOR	M	TW: Mechanism of the thickener only
T	W	U		FERMENTER/GRAVITY THICKENER	M	TWU: Thickener Unit - Fermenter thickener, gravity thickener

ALPHA PREFIX CODE				EQUIPMENT NAME	BACK LOG	EQUIPMENT DEFINITION
U	H			UNIT HEATER	M	UH: Includes electric motor and control devices.
U	K			SURGE PACK	E	UK:
U	P			HYDRAULIC PUMP	M	UP:
U	V			ULTRAVIOLET LAMP BANK	E	UV:
U	X			U.P.S. SYSTEM	E	UX: UPS System, UPS Panel
V	F			VARIABLE FREQUENCY DRIVE	E	VF:
V	I			VAR INDICATOR	E	VI:
V	P			WELLWATER PUMP	M	VP:
V	T			VIBRATION TRANSMITTER	I	VT: ISA – Vibration Transmitter (Blind)
V	V			PRESSURE REGULATING VALVE	M	VV:
W	C			WATER CONDITIONER	M	WC: Water softener.
W	E			WATER FEATURE	M	WE:
W	F			WATER COOLER	M	WF: Drinking fountain.
W	H			WATER HEATER	M	WH:
W	L			WELL	M	WL: Down hole wells. Hole drilled in the ground used to draw out material such as water well, oil well, gas well. Creosote Remediation Site has this kind of wells.
W	M			WIND MONITOR	M	WM: Includes data logger, recorder, software, wind socks.
W	P			WASTE ACTIVATED SLUDGE (WAS) PUMP	M	WP:
W	S			WEIGHT SCALE	M	WS:
W	T			SCUM TANK	M	WT:
X	A			TRANSFER SWITCH	E	WW: Auto Transfer Control
X	F			TRANSFORMER	E	XF: Stand alone transformers only. If mounted in MCC then part of MCC.
X	V			MISC. VALVE	M	XV:
Y	C			DUST COLLECTOR	M	YC:
Y	I			KVA INDICATOR	E	YI:

ALPHA PREFIX CODE				EQUIPMENT NAME	BACK LOG	EQUIPMENT DEFINITION
Y	P			SCUM PUMP	M	YP:
Y	S			SCUM SKIMMER	M	YS: Skimmer system C troughs
Y	V			AIR CONTROL VALVE	I	YV:
Z	C			POSITION CONTROLLER	I	ZC: ISA
Z	E			POSITION ELEMENT	I	ZE: ISA
Z	I	T		POSITION INDICATING TRANSMITTER	I	ZIT: ISA
Z	P			GROUNDWATER PUMP	M	ZP:
Z	S			POSITION SWITCH	I	ZS: ISA
Z	T			POSITION TRANSMITTER	I	ZT: ISA – Position Transmitter (Blind)

APPENDIX C
Checklists

Lift Station Design Guidelines
Preliminary Design Report Checklist

Project:

Developer:

YES	NO	
☐	☐	1. Site Details

- Site location indicated in lot map of development including roads and land-use designations
- Drawing of lift station lot and building outline with dimensions
- Drawing of topography of lift station lot and immediately surrounding area with directional arrows indicating drainage paths

☐ ☐ 2. Design Considerations

- Compliance of design with AENV Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems? If not, what are the deviations and why?

☐ ☐ 3. Phased Design Flow Rate Calculations – For each development phase and in final development

- Total Residential Population (Persons)
  - Single family units, persons/unit
  - Apartment units, persons/unit
  - Townhome units, persons/unit
  - Other units, persons/unit
- Residential Flow (per person) and Peaking Factor
- Institutional, Commercial and Industrial Population (persons) and Flow (per person)
- Catchment Area (hectares)
- Inflow and Infiltration (l/s/ha)

☐ ☐ 4. Forcemain Sizing and Hydraulic Grade Line Analysis

- For each forcemain
  - Pipe diameter (inches), pipe material, pipe pressure rating (psi), length (m), elevation differential (m), and draining flow rate (l/s).

☐ ☐ 5. Pumps and Wet Well

- Pump Data
  - Pump model, Power (kW), Voltage (volts), Amperage (amps)
  - Pump flow rate vs. pressure differential curve and FM performance curve (L/s vs. m of water)
- For each Wet Well cell
  - Dimensions (m)
  - Mixer model, Power (kW), Voltage (volts), Amperage (amps)
  - Macerator model, Power (kW), Voltage (volts), Amperage (amps)
- For each development phase and final development
  - Set individual pump, firm LS pumping, and maximum LS pumping flow rate (l/s), and cross-sectional forcemain velocities (m/s)
  - Above described operating points on Pump and Forcemain performance

curves (L/s vs. m of water)
    - Design average, minimum, maximum, and peak wet weather lift station influent flow (l/s)
    - Wet well cell(s) active and storage volume (m^3)
    - Residency time at design minimum influent flow at set individual pump flow rate (min)
    - Number of pump starts per hour (starts/hr) and storage volume used (m^3) at peak wet weather lift station flow plus forcemain draining flow rate, and set maximum LS pumping flow rate.

- Lift Station Overflow Data
    - If the lift station failed and overflowed, would it surcharge from the lift station, catchment area manhole(s), or both? If catchment area manhole(s) will surcharge, provide a map indicating the manhole location(s).

☐ ☐ 6. Lift Station Building

- Site Layout
    - Total building area, driveway area, and site area (m^2)
    - Fence height (m) and type

- HVAC Details
    - Wet Well Blower model, fan size (CFM), and heating power (kW)
    - Make-Up Air Unit model, fan size (CFM), and heating power or furnace size (kW)
    - Exhaust odour control type, fan size (CFM), and footprint (m^2)

☐ ☐ 7. Utility, Electrical & Controls Details

- Utilities
    - Main utility voltage (volts), main breaker size (amps), and total demand (kW)
    - Natural gas utility line diameter (mm), operating pressure (psi), supply capacity (SCFM), and total demand (SCFM)
- Standby Power
    - Standby power generator model, prime power rating (kW), voltage (volts), breaker size (amps), and standby power demand (kW)

- Pump Controls
    - Motor starters, soft starters, or VFDs?
    - Primary and secondary level sensing system types and models

☐ ☐ 8. Temporary Elements

- Propane Tank
    - Size (m^3), equivalent run time of standby generator (hrs) at total lift station demand
- Water Tank
    - Size (m^3), pump system flow rate (l/s) and pressure (psi)
- Access Road
    - Length (m), width (m), and material

☐ ☐ 9. Annual Operating Costs

- For each phase of development
    - Annual man-hour and material costs for wet well cleaning, building cleaning, regular operational reviews, standby power testing, standby power maintenance, valve maintenance, and odour control maintenance
    - Annual utility costs for water, electricity, and natural gas
    - Annual costs to refill temporary propane tank and water tank

Lift Station Design Guidelines
Technical Design Brief Report Checklist

Project:

Developer:

YES	NO	
☐	☐	1. Site Details

- Site location indicated in lot map of development including roads and land-use designations
- Drawing of lift station lot and accurate building and fence outline, driveway and pathways, boulevard and other roadway details, with dimensions
- Drawing of topography of lift station lot with and immediately surrounding area with profiles of existing vs. planned grades, and directional arrows indicating drainage paths through the site
- Attach Geotechnical Report for site with drawings of borehole locations and strata elevations

☐ ☐ 2. AENV Design Considerations

- Site Constraints
  - Is the site within the floodplain area during 1:25 or 1:100 year storm period?
  - If Yes, describe protective measure in the design
- Pumps
  - Number of lift station pumps including each pump's size and capacity
  - Maximum number of out of service lift station pumps possible without surcharging the lift station catchment area during Peak Wet Weather Flow conditions
- HVAC
  - Dry Well
    - Is the drywell continuously or intermittently ventilated? If intermittent, describe automatic and manual controls including any control overrides
    - How is the operation and air flow rate of the ventilation system verified?
    - Blower's maximum air flow capacity in terms of air changes per hour of the entire dry well volume
    - Is the dry well heated and dehumidified?
    - Distance between the lowest point in the dry well and the lowest fresh air ducting outlet
    - Number of fresh air ducting outlets, and exhaust ducting inlet, in the dry well
    - Fresh air intake fan, and exhaust fan, material
    - Gases monitored by built-in detection equipment in the dry well
  - Wet Well
    - Is the wet well continuously or intermittently ventilated? If intermittent, describe automatic and manual controls, and any control overrides.
    - How is the operation and air flow rate of the ventilation system verified?
    - Blower's maximum air flow capacity in terms of air changes per hour of the entire wet well volume
    - Is the wet well heated?
    - Distance between the high water level in the dry well and the lowest fresh air ducting outlet
    - Number of fresh air ducting outlets, and exhaust ducting inlet, in the dry well
    - Fresh air intake fan, and exhaust fan, material
    - Gases monitored by built-in detection equipment in the wet well
    - Is there odour control for the wet well exhaust?
    - Are the wet well and dry well ventilations systems interconnected?
    - Are there any unsealed wall penetrations between the wet well and dry well?

- Access
  - Is there an access between the ground level and the bottom of the drywell and wet well via stairways, ladders, both, or other? If other, describe means of access
- Potable Water
  - Describe potable water back flow prevention measures

☐ ☐ 3. Phased Design Flow Rate Calculations – For each development phase and in final development

- Total Residential Population (Persons)
  - Single family units, persons/unit
  - Apartment units, persons/unit
  - Townhome units, persons/unit
  - Other units, persons/unit
- Residential Flow (per person) and Peaking Factor
- Institutional, Commercial and Industrial Population (persons) and Flow (per person)
- Catchment Area (hectares)
- Inflow and Infiltration (l/s/ha)

☐ ☐ 4. Forcemain Sizing and Hydraulic Grade Line Analysis

- For each forcemain
  - Pipe diameter (inches), pipe material, pipe pressure rating (psi), length (m), elevation differential (m), and draining flow rate (l/s).
  - Drawing of forcemain plan and profiles, including locations of all crossing and adjacent utility lines
  - Drawing of layout of forcemain bypass lines, connections, and manhole locations

☐ ☐ 5. Pumps, Wet Well and Dry Well

- Pump, Pipes and other Wet Well Equipment Data
  - Pump model, Power (kW), Voltage (volts), Amperage (amps)
  - Pump flow rate vs. pressure differential curve and FM performance curve (L/s vs. m of water)
  - Mixer model, Power (kW), Voltage (volts), Amperage (amps)
  - Macerator model, Power (kW), Voltage (volts), Amperage (amps)
  - Single line diagram of all process piping, wet well instrumentation, with pump operation elevations for primary and secondary wet well liquid level monitoring systems
  - Full size Process Plans
- For Wet Well and Dry Well
  - Drawing of wet well and dry well layout, including the location of all hatches, stairways, ladders, catwalks, and any other access objects or structures, as well as openings between wet well cells
  - Drawing of wet well and dry well profiles with geodetic elevations of all floors and access structures, openings between wet well cells, the influent main, forcemain exit point, and pump operation elevations (e.g. lead pump start, pump stop)
- For each development phase and final development
  - Set individual pump, firm LS pumping, and maximum LS pumping flow rate (l/s), and cross-sectional forcemain velocities (m/s)
  - Above described operating points on Pump and Forcemain performance curves (L/s vs. m of water)
  - Design average, minimum, maximum, and peak wet weather lift station influent flow (l/s)
  - Wet well cell(s) active and storage volume (m^3)
  - Residency time at design minimum influent flow at set individual pump flow rate (min)
  - Number of pump starts per hour (starts/hr) and storage volume used (m^3) at peak wet weather lift station flow plus forcemain draining flow rate, and set maximum

LS pumping flow rate.

- Lift Station Overflow Data
  - If the lift station failed and overflowed, would it surcharge from the lift station, catchment area manhole(s), or both? If catchment area manhole(s) will surcharge, provide a map indicating the manhole location(s).
  - List on all of the potential functional lift station failure modes that could lead to surcharge and the individual systems that would be required to fail for each failure mode

☐ ☐ 6. Lift Station Building

- Site Layout
  - Total building area, driveway area, and site area (m^2)
  - Fence height (m) and type with architectural examples
  - Security considerations (e.g. fence type, exterior lighting placement)
  - Architectural rendering of the entire building, with fencing and landscaping features
  - Landscaping drawing of site with list identifying plants by their conventional and scientific names
  - Site drainage considerations, and Low Impact Development strategies
  - Full size Civil Plans
  - Full size Building Plans

- HVAC Details
  - Wet Well Blower model, fan size (CFM), and heating power (kW)
  - Make-up Air Unit model, fan size (CFM), and heating power or furnace size (kW)
  - Exhaust odour control type, fan size (CFM), and footprint (m^2)
  - Single line diagram of entire HVAC system, potable water system, and natural gas system
  - Full size Mechanical Plans

☐ ☐ 7. Utility, Electrical & Controls Details

- Utilities
  - Main utility voltage (volts), main breaker size (amps), total demand (kW) and locations of ENMAX transformer and utility line
  - Natural gas utility line diameter (mm), operating pressure (psi), supply capacity (SCFM), total demand (SCFM) and locations of ATCO meter and utility line
- Standby Power
  - Standby power generator model, prime power rating (kW), voltage (volts), breaker size (amps), and standby power demand (kW)
  - Automatic Transfer Switch model and size (amps)
  - Battery Charger model
- Main Electrical System
  - Power Quality Meter model
  - Transient Voltage Surge Suppressor model
  - Single line diagram of entire electrical system, including pump starters
  - Drawing of MCC layout
  - Full size Electrical Plans
  - Lighting Plans for building interior and exterior
- Pump Controls and Monitoring
  - Primary and secondary wet well liquid level monitoring system models and types
  - Primary pump control system PLC model
  - Secondary pump control system relay logic schematics for primary and secondary wet well liquid level monitoring systems
  - Lift Station monitoring system and network architecture

☐ ☐ 8. Temporary Elements

- Propane Tank
  - Size (m^3), equivalent run time of standby generator (hrs) at total lift station demand
- Water Tank
  - Size (m^3), pump system flow rate (l/s) and pressure (psi)
- Access Road
  - Length (m), width (m), and material

☐ ☐ 9. Annual Operating Costs

- For each phase of development
  - Annual man-hour and material costs for wet well cleaning, building cleaning, regular operational reviews, standby power testing, standby power maintenance, valve maintenance, and odour control maintenance
  - Annual utility costs for water, electricity, and natural gas
  - Annual costs to refill temporary propane tank and water tank

APPENDIX D
Acronyms

Acronym	Meaning
ASP	Area Structure Plan
ATS	Automatic Transfer Switch
CCC	Construction Completion Certificate
CFA	Construction Finance Agreement
ETAP	(Electrical Power System Software)
FAC	Final Acceptance Certificate
HMI	Human Machine Interface
HOA	Hand-Off-Auto
HVAC	Heating, Ventilation and Air Conditioning
IFC	Issued for Construction
LED	Light Emitting Diode
LEL	Lower Explosive Limit
LOC	Land Use, Outline Plan and Road Closure
MCC	Motor Control Centre
NOx	Nitrogen Oxides
NPSH	Net Positive Section Head
P&ID	Piping and Instrumentation Diagram
PLC	Programmable Logic Controller
SCADA	Supervisory Control and Data Acquisition
S-CRI	Special Purpose-City and Regional Infrastructure (Land-Use)
UPS	Uninterruptible Power Supply
VFD	Variable Frequency Drive