This specification outlines the general requirements for the supply and installation, or retrofit, of a fully functioning pre-fabricated or cast in place wastewater pumping station, including any/all storage tanks, piping, valves, access frames, pumps, control panels, enclosures, accessories and ancillary components necessary for reliable operation.

The requirements of this specification are a general guideline only, intended to establish some level of uniformity between stations, improve the reliability of stations, maximize operational safety and efficiency, and reduce overall life cycle costs. This specification does not purport to describe all details of the equipment to be furnished. Project specific requirements should be obtained from, and reviewed with, the Owner.

PART 1 REFERENCES

This specification refers to the following standards, specifications, or publications:

Government of Newfoundland and Labrador, Department of Environment and Climate Change

Guidelines for the Design, Construction and Operation of Water and Sewerage Systems

ASME International

B16.1	Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

ASTM International

A36/A36M	Standard Specification for Carbon Structural Steel
A48/A48M	Standard Specification for Gray Iron Castings
A181/A181M	Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
A536	Standard Specification for Ductile Iron Castings

American National Standards Institute (ANSI)/American Water Works Association (AWWA)

C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast
C509	Resilient-Seated Gate Valves for Water Supply Service
C606	Grooved and Shouldered Joints

CSA Group

B242	Groove- and Shoulder-type Mechanical Pipe Couplings
C22.1	Canadian Electrical Code, Part I, Safety Standard for Electrical Installations
C282	Emergency Electrical Power Supply for Buildings
Z11	Portable Ladders

Institute of Electrical and Electronics Engineers (IEEE)

112	Standard Test Procedure for Polyphase Induction Motors and Generators

National Fire Protection Association

NFPA 820	Standard for Fire Protection in Wastewater Treatment and Collection Facilities
NFPA 70	National Electrical Code (NEC)

Underwriters Laboratories of Canada

S701	Standard for Thermal Insulation. Polystyrene Boards and Pipe Covering

Others

Electrical Equipment Manufacturers Advisory Council (EEMAC)

International Organization for Standardization (ISO) 9001 Quality Management Systems - Requirements

National Electrical Manufacturers Association (NEMA)

American Iron and Steel Institute (AISI)

PART 2 GENERAL

2.1 SCHEDULING

.1 Schedule work to minimize interruptions to existing services.

.2 Maintain existing sewage flows during construction as per Section 01005 – General Instructions.

2.2 CODES AND STANDARDS

.1 Applicable standards established by ANSI, AISI, ASME, AWWA, ASTM, CSA, EEMAC, ISO and NEMA govern the materials and quality of the work employed in the manufacture of all equipment. Canadian standards take precedence over American standards in the case of duplication or conflicting requirements. Electrical motors and equipment must be built to EEMAC standards with Canadian Standard threads and bearings throughout.

.2 All work to conform to the Department of Environment and Climate Change Guidelines for the Design, Construction and Operation of Water and Sewerage Systems.

.3 New material and equipment, including factory assembled control panels and component assemblies, must be approved and certified by CSA and/or ULC. In the case of unavailability of CSA/ULC approved equipment, use equipment approved by special inspection of the Authorities Having Jurisdiction (AHJ) and the local power utility.

2.3 APPROVALS AND PERMITS

.1 The Contractor shall apply for, obtain and pay for permits required for the project, unless otherwise instructed by the Owner. Permits may include, but are not limited to:

.1 Building permit
.2 Permit to connect
.3 Waste disposal permit
.4 Plumbing permit
.5 Environmental Permit to Construct Drinking Water and Wastewater Infrastructure as required by the Newfoundland and Labrador Department of Environment and Climate Change
.6 Environment Permit for Alterations to a Body of Water, if applicable, by the Newfoundland and Labrador Department of Environment and Climate Change
.7 Electrical Permit
.8 Other permits as may be required.

.2 A complete list of the project specific permits required must be confirmed with the Owner prior to commencement of work.

.3 On completion of the work, all final certificates including proof of all required inspections must be submitted to the Owner.

2.4 SUBMITTALS

.1 The Contractor and/or their supplier must submit written confirmation that they will provide the required installation, commissioning, warranty repairs and follow up service as required. Subsequent submittals (e.g., shop drawings) will not be reviewed without this document and delays incurred because of the contractor not meeting this requirement may be grounds for termination of the contract. Any costs associated with such delays shall be borne solely by the contractor.

.2 Provide certification that pumps and controls have been factory tested and deficiencies rectified prior to delivery to site.

.3 Shop Drawings are required for all equipment and structures as specified in the Contract Documents. Shop Drawings will be reviewed by a representative of the Department and/or the Owner with comments provided.

.4 As soon as possible after receipt of an order, the contractor shall furnish the following, in accordance with Section 01340 – Shop Drawings, Samples and Submissions:

.1 General assembly drawings (plans, elevations, sections) which show:

.1 the location and necessary excavation required for the pumping station.

.2 general pumping station layout including but not necessarily limited to:

.1 intake connections
.2 discharge connections
.3 station equipment
.4 pumps
.5 control panel(s)
.6 liquid level regulators
.7 access frames

.3 Wiring diagrams for the complete station, including all power and control circuits.

.5 Submittals required ‘For Information Only’ include:

.1 Engineering reports and associated drawings.
.2 Test procedures, test results, installation certificates, instructions, etc.
.3 Staging and sequencing plans.
.4 Equipment lists.

.5 Spare parts lists.
.6 Equipment testing plans and reports.
.7 Electrical coordination reports.
.8 Arc Flash Study report (if required).
.9 Completed SCADA SAT (if required).

2.5 MAINTENANCE AND OPERATIONS MANUAL

.1 The contractor and/or their supplier(s) shall prepare and supply one (1) electronic copy of a maintenance and operations manual for each pumping station in accordance with Section 01720 – Closeout Submittals. At minimum, these manuals shall contain the following information:

.1 Record drawings, electrical schematics, and mechanical/process schematics for equipment as installed.
.2 Outline dimension drawings of the sewage pumping station as installed.
.3 Layout and wiring diagrams for the complete station, including all power and control circuits including interconnections with numbers and wire sizes.
.4 A schematic diagram of the control system, including Information on the level regulation system and components.
.5 Certified pump characteristic curves.
.6 Detailed start-up, operation, maintenance and safety instructions for all equipment including optional equipment and/or accessories.
.7 Parts list comprising complete schedule clearly identified to facilitate re-ordering.
.8 Start-up reports from the pump service technician.

2.6 WARRANTY

.1 From the date of commissioning a warranty of 60 months is applicable on all components of the station. This warranty shall be provided in writing by the Contractor and/or their supplier(s) and shall cover both parts and labour.

.2 Where any defect or fault is rectified and made good under this Warranty, said work shall be warranted for a further 24 months from the date that the correction is completed.

2.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 1600 – Material and Equipment and with manufacturer’s written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations and protect from nicks, scratches, and blemishes.

.2 Replace defective or damaged materials with new.

PART 3 PRODUCTS

3.1 GENERAL

.1 All supplied materials and equipment shall be new and designed by the manufacturer for use in municipal sewage lift station applications with a minimum design life of twenty-five (25) years.

3.2 WET WELL CHAMBER

.1 The chamber shall be of inside dimensions with size and height as detailed on the drawings to be able to contain all associated equipment. The station shall be cast-in-place concrete, pre-cast concrete, fibreglass reinforced plastic, or approved equal.

.2 The chamber shall have concrete benching in accordance with the pump supplier's recommendations to prevent sludge and debris settling in the chamber and to minimize the amount of liquid left in the chamber after pump down. Benching shall have a smooth finish to prevent debris from adhering to the surface.

.3 The unit shall be designed to prevent flotation under all conditions.

.4 Concrete chambers shall be constructed and tested in accordance with Section 02601 – Maintenance Holes and Catch Basin Structures. Top sections shall be flat slab top type with the opening offset for vertical ladder installation.

.5 Pre-cast chambers for pumping stations constructed of materials other than concrete shall be as specified by the manufacturer and approved by the Owner.

.6 All electrical equipment installed in wet wells and/or areas not isolated from wet wells shall be approved for installation in Zone 1 for Group D. Installation of all equipment, including forced air ventilation as required, shall be in accordance with Section 18 of the Canadian Electrical Code, Part I (CSA C22.1) and NFPA 820.

.7 Wet Well Ventilation

.1 The lift station shall be equipped with two (2) vent pipes. Each vent pipe shall be constructed from 100 mm schedule forty (40) hot dipped galvanized steel pipe. The top of the vent pipe shall utilize two (2) 90-degree elbows such that the vent opening will face downwards. The vent opening shall have a steel mesh screen welded over the opening to prevent birds from entering the vent pipe. Where the control panel is to be mounted at the lift station, the vent pipes may be utilized to form a mount for the control panel and junction box.

.2 Where the site layout drawings permit, vent pipes shall be supplied with a mounting plate to be cast in the chamber top. Mounting plates shall be provided with bolts firmly welded in place. Vent pipes shall be easily installed and removed from the mounting plate. Vent pipes cast directly into the chamber top are not acceptable.

.3 Where the vent pipes are used for control mounting, the mounting plate shall incorporate 50mm conduit nipples in quantities as listed in the control specification and drawings.

.4 All vent pipe components and fasteners are to be hot-dipped galvanized.

.5 Unless necessary, continuous positive pressure ventilation with fixed ventilation fans for supply and exhaust is not required.

.6 Wet well vent piping and control mounting assembly shall be mounted as shown on the drawings. A mounting plate with 50 mm conduit nipples shall be set in the concrete at the time of pour. Sufficient conduit nipples shall be provided for each pump circuit, the level regulation system, and other electrical systems as indicated on the project drawings. Both conduit and vent pipe base will be open at the bottom.

3.3 SUBMERSIBLE PUMPS

.1 Refer to Table 1 for submersible pump technical data.

.2 A minimum of two pumps are required, refer to contract drawings.

.3 Submersible pumps shall be suitable for continuous operation in a municipal sewage lift station application. The pump(s) shall be capable of handling raw, unscreened sewage, storm water and other similar solids-laden fluids without clogging.

.4 The pumps shall be installed in a manner that will allow easy removal from the station without the need for personnel to enter the well. Each unit shall be supplied complete with a mating discharge connection elbow permanently installed in the wet well with and connected to the discharge piping.

.5 The pump(s) shall be automatically and firmly connected to the discharge connection elbow when lowered into place, and shall be easily removed for inspection and service.

.6 No portion of the pump shall bear directly on the floor of the chamber. The pump, with its appurtenances and cable, shall be capable of continuous submergence under water, without loss of watertight integrity, to a depth of 20 m.

.7 Major pump components shall be grey cast iron, Class 30, with smooth surfaces, devoid of porosities, blowholes, and other irregularities.

.8 All exposed nuts and bolts shall be 316 Series SS construction. All surfaces coming into contact with sewage, other than SS or brass, shall be protected by an approved, factory applied sewage-resistant coating of zinc phosphate primer with a high solids two part epoxy paint finish coat. The pump exterior shall be finished with a non-toxic top coat. Chlorinated-rubber paint or other special epoxy primers and top coats shall be available when required to meet special or abnormal liquid considerations.

.9 The pump and motor assembly shall incorporate metal to metal contact between machined surfaces. Fittings shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces.

.10 All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile or fluoroelastomer (FKM) rubber O-rings. Sealing will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requiring a specific torque limit. No secondary sealing components, rectangular gaskets, elliptical O-rings, grease or other devices or materials shall be used.

.11 Pump and motor shall be of the close-coupled, integral design. Preference will be given to units employing motor and hydraulic units from the same manufacturer.

.12 A schedule 40, automatic discharge connection shall be provided for each pump to connect the pump to the discharge piping. The discharge connection shall be permanently fixed in position by four (4) SS anchor bolts attached to the bottom of the pump chamber. Discharge connections shall permit rapid and precise installation or removal of the pumps without entering the pump chamber.

.13 Lifting Equipment:

.1 All equipment shall be of adequate strength to safely remove the pumps from the station and be rated for overhead lifting.

.2 Where material of construction is steel, there units shall be hot-dipped galvanized. All fasteners shall be stainless steel.

.3 Each pump shall be fitted with a rigid handle of suitable strength to lift up to four (4) times the weight of the pump. The lifting handle shall provide a large open loop so that the handle can be easily hooked from the surface without the need for personnel to enter the wet well.

.4 Each pump will be fitted with galvanized Grade A8 chain or SS lifting cable, approved for overhead lifting and of adequate strength to permit raising and lowering of the pump.

.5 A lifting davit must be supplied to allow for easy removal of either pump. Davits shall have sufficient clearance to the top of the chamber for removal of the pump.

.6 A chain hoist or winch shall be attached to the davit. The chain hoist or winch shall be suitable for acceptance of the pump lifting chain / cable. This pump lifting arrangement will allow the pump to be lifted by its chain/cable, in a single lift, thus providing a simple method of removing the pump(s) for inspection and service. The chain hoist or winch shall have a minimum one (1) ton lifting capacity.

.14 Guide Bars

.1 There will be no requirement for personnel to enter the chamber. Sealing of the pumping unit to the discharge connection shall be accomplished by a simple linear downward motion of the pump.

.2 A sliding guide bracket shall be attached to the pump unit. Guide devices that are integral with the pump casing and systems utilizing guide cables will be unacceptable.

.3 Vertical guide bar(s) shall be provided with each pump to ensure correct alignment of the pump with the automatic discharge connection.

.4 The entire weight of the pumping unit shall be guided by rigid guide bar(s) and pressed tightly against the discharge connection elbow, providing a tight seal through either metal-to-metal contact or through an elastomer gasket.

.5 For each pump, the guide bar(s) shall consist of 316 SS Schedule 40 SS pipe, securely fixed at the lower end to the discharge connection by means of special bosses, provided. The guide bar(s) shall extend from the discharge connection toward ground level and shall be securely fixed by a galvanized or equivalent bracket (upper guide bar holder), anchored to the station roof. The bracket shall also be provided with special inserts to position the guide bars rigidly.

.15 Impellers and Pump Volute:

.1 The impeller shall be of grey cast iron, Class 30 or better and dynamically balanced to prevent undue vibration during operation.

.2 The impeller shall have an enclosed, non-clog or recessed design having a long through-let without acute turns.

.3 The impeller shall be capable of handling solids, fibrous material, heavy sludge, and other matter found in normal sewage applications.

.4 The backside of the impeller shall work in conjunction with the motor housing bottom to prevent fouling of the seal by materials in the pumped media which may cause premature seal failure.

.5 The impeller shall have a slip fit onto the motor shaft and be fastened to the shaft by a stainless-steel bolt. The impeller bolt shall be equipped with a suitable locking device to prevent loosening. The impeller shall be prevented from turning on the motor shaft by a key, conical collar, or other suitable locking mechanism.

.6 Semi-open impellers shall be equipped with a wear-plate containing a spiral groove on the impeller side to shred and move fibrous materials through the pump to the discharge. Semi-open impellers shall be adjustable to compensate for wear.

.7 The impeller shall be coated with an alkyd-resin primer.

.8 The volute shall be of a single part, grey cast iron, non-concentric design with centreline discharge. Passages shall be smooth, fluid, and large enough at all points on the volute to pass any size solids that can pass through the impeller.

.9 A wear ring system shall be installed to provide efficient sealing between the volute and impeller, and shall consist of a stationary ring of brass or cast iron, which is drive-fitted to the volute inlet.

.10 Grinder Pumps shall have hardened stainless shredding ring and grinder to reduce sewage to a small size for discharge through small diameter piping.

.11 The fit of the impeller into the volute / motor assembly shall be such that no stringy debris or other materials may enter the area of the outer mechanical seal.

.16 Cable Entry

.1 The cable entry, water-seal design shall preclude specific torque requirements to ensure an impermeable seal.

.2 The cable entry(s) shall be comprised of one (1) or more cylindrical elastomer grommet, each flanked by SS washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter, and compressed by the entry body, until it bottoms out on a shoulder, assuring controlled compression. Cable sealing systems that utilize mastic, adhesive, epoxy resin, or sealing

compounds as a primary seal shall be capable of preventing entry of moisture even through a damaged cable to a submerged depth of 20 m.

.3 The cable entry body contains a strain relief function, separate from the function of sealing the cable. The strain relief will be applied from the outer side of the cable entry assembly.

.17 Shaft and Seals

.1 The pump shaft shall be of AISI 400 series SS. This is a nickel-bearing chromium steel, heat-treated, designed to superior mechanical properties providing greater corrosion and abrasion-resistant characteristics. Each pump shall be provided with a tandem mechanical shaft seal system.

.2 The upper of the tandem set of seals shall contain one stationary ring and one positively-driven rotating ring functioning as an independent secondary barrier between the pumped liquid and the stator housing. The rings shall be constructed of either silicon-carbide or tungsten-carbide material.

.3 The lower of the tandem set of seals shall function as the primary barrier between the pumpage and the stator housing. This set shall consist of a stationary ring and a positively-driven rotating ring, both of which shall be constructed of silicon-carbide.

.4 For conventional double mechanical seals, each seal interface shall be held in place by its own spring system. Conventional double mechanical seals containing either a common single or double spring, acting between the upper and lower units, shall not be considered acceptable or equal to the dual, independent seal specified. A common spring is only acceptable where cartridge type seals are used that cannot be disassembled.

.5 The seals shall require neither maintenance nor adjustment but shall be easily inspected and replaced. Each pump shall be provided with a lubrication chamber for the shaft sealing system. The chamber shall be designed to assure that air is left in the chamber to absorb the expansion of the lubricant due to temperature variations.

.6 The pump shaft shall rotate on two independent bearings either permanently lubricated or run in lubricant. The support (upper) bearing shall be a single-row ball bearing, and the main (lower) bearing shall be a two-row angular contact ball bearing, sized to take all radial and shock loads.

.18 Submersible Motor

.1 The pump motor shall be of the squirrel-cage induction type design, housed in a watertight chamber of maximum efficiency and

durability. The motor shall be designed for continuous duty capable of sustaining a minimum of fifteen (15) starts per hour. At the design condition, the motor shall not draw more than the specified power at nominal voltage of utility supply quality at the specified maximum speed.

.2 The motor stator shall be directly shrink fitted into the stator housing. Preference will be given to pumps with cast iron stator housings. Bolts, pins, or other fastening devices shall not penetrate the stator housing. The stator winding and leads shall be insulated with moisture-resistant varnish capable of withstanding a temperature of 155 °C or the motors maximum temperature rise, whichever is greater. The stator shall be dipped and baked three (3) times in Class F varnish or better. Motors shall be inverter duty rated when the control system utilizes a variable frequency drive.

.3 The rotor bars and short-circuit rings shall be made of aluminum. Thermal sensors shall be used to monitor stator temperatures on all pumps. The stator shall be equipped with not less than two (2) thermal switches embedded in the end coils of the stator windings (one switch per phase to protect the motor against surcharges and high temperature). These shall be used in conjunction with, and supplemental to, external motor overload protection, and wired to the control panel.

.4 The pump shall be equipped with moisture/leaking detection system to detect any moisture or leaks into the pumping unit. The signals from the thermal switches and the moisture detector shall be wired to the control panel to shut down the pump in the event of a moisture or thermal fault.

.5 Where required by the pump manufacturer, the control of the moisture detector and the winding thermal switches shall be accomplished by using a control/indicator relay(s) that will be installed and wired inside the control panel to stop the pump unit upon a fault signal.

.19 Cooling System

.1 Pumps shall be designed such that adequate cooling is provided by the surrounding environment or pumped media without the danger of overheating during continuous operation in ambient temperatures up to 40 ˚C.

.2 Pumps shall not be dependent on an external cooling source.

.3 Pumps incorporating a cooling system utilizing the pumped media shall not have the cooling performance compromised by materials commonly found in sewage pumping applications nor shall they require maintenance to clear cooling ports or passages.

TABLE 1: SUBMERSIBLE PUMP TECHNICAL DATA

PROJECT TITLE: LOCATION: OWNER:	
Pump Type	☐ Non Clog - Semi-open Impeller
	☐ Non Clog - Closed Impeller
	☐ Non Clog - Vortex
	☐ Grinder
	☐ Other. Specify:_____
Impeller shall be capable of passing a sphere of size	_____ mm
Primary Duty Point	_____ L/s @ _____ metres
Primary Duty Point Efficiency	_____ % minimum
Secondary Duty Point	_____ L/s @ _____ metres
Secondary Duty Point Efficiency	_____ % minimum
Shut-off Head	_____ metres minimum
Static Lift	_____ metres minimum
Pump Discharge size	_____ mm
Rotational Speed	_____ rpm maximum
Power Rating	_____ kW _____ HP
Power Supply	☐ Single Phase - 230 Volt
	☐ Three Phase - 208 Volt
	☐ Three Phase - 230 Volt
	☐ Three Phase - 600 Volt
Cable Length	_____ metres
Lifting Chain / Cable Length	_____ metres
Internal Piping Size	_____ mm
Forcemain Connection Size	_____ mm
Valve Size	_____ mm

3.4 AUTO PRIMING PUMPS

.1 Auto priming pumps can be self-primed or vacuum primed.

.2 Refer to Table 2 for auto-priming pump operating conditions.

.3 Pumps shall be designed to handle raw, unscreened, domestic sanitary sewage.

.4 Pumps shall be auto-priming, either centrifugal type of either horizontal or vertical design. Pumps shall pass a minimum of a 63 mm spherical solid for 75 mm pump discharge size and a minimum of a 75 mm spherical solid for 100 mm pump discharge size and larger. Internal passages shall meet the minimum solids size to prevent maintenance or auto-priming issues.

.5 The manufacturer of the pumps shall have a quality management system in place and shall be ISO 9001 Certified.

.6 Pump casing

- .1 Shall be cast iron ASTM A48/A48M Class 30 and shall incorporate the following features:
- .2 Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.
- .3 A fill port cover plate shall be provided and incorporate a hand nut/clamp bar assembly for opening. Hand nut threads shall provide slow release of pressure with the clamp bar being retained by retention lugs. A polytetrafluoroethylene (PTFE) gasket shall prevent adhesion of the fill port cover to the casing.
- .4 A drain plug shall be provided to insure complete and rapid draining.

.7 Cover plate

- .1 Shall be included to allow for removal of pump blockages and servicing of the impeller, seal, wear plate or check valve without the need to remove piping.
- .2 Shall be constructed of cast iron ASTM A48/A48M Class 30; equipped with a replaceable wear plate; and a handle for positioning and removal.
- .3 Shall be retained by hand nuts for complete access to pump interior and equipped with pusher bolts to assist in removal of cover plate from the pump casing.
- .4 Shall be sealed to the pump casing via gaskets or O-rings and equipped with a pressure relief valve of rating to safely protect the pump system.

.8 Rotating Assembly

.1 Includes impeller, shaft, mechanical shaft seal, oil seals, bearings, seal plate, and bearing housing.

.2 Shall be removable as a single unit without disturbing the pump casing or piping.

.3 Seal plate and bearing housing shall be cast iron ASTM A48/A48M Class 30.

.4 Separate oil filled cavities, vented to atmosphere, shall be provided for the shaft seal and bearings. Pump designs that use the same oil to lubricate the bearings and shaft seal shall not be acceptable. Cavities shall be cooled by the liquid pumped. Seals shall be provided to prevent leakage of oil.

.5 The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.

.6 The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.

.7 Seals shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

.8 Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir.

.9 Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lock screw and conical washer.

.10 Adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by external means.

.1 Impeller face clearances shall be maintained by external shimless cover plate adjustment, utilizing collar and adjusting screw design for incremental adjustment of clearances by hand. Requirement of realignment of belts, couplings, etc., shall not be acceptable. Cover plate shall be capable of being removed without disturbing clearance settings.

.2 There shall be provisions for additional impeller face clearance adjustments if adjustment tolerances have been depleted from the cover plate side of the pump. The removal

of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above.

.3 Impeller face clearance adjustments that require movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

.11 Shaft shall be AISI 4140 alloy steel unless otherwise specified by the Owner, in which case AISI 17-4 PH stainless steel shall be supplied.

.12 Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten carbide. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring shall secure the stationary seat to the seal plate, and an internal O-ring shall hold the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be Viton. Cage and spring to be AISI 316 stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings.

.9 Vacuum-Primed Vertical Pump Specifics

.1 Pumps shall be of a vertical, centrifugal, non-clog design of heavy cast-iron construction and designed for use in sewage applications.

.2 The bearing closest to the impeller shall be designed for a combined thrust and radial load. This bearing shall be locked in place so that endplay is limited to the clearance within the bearing therefore minimizing seal wear caused by linear movement of the shaft. Seal wear shall be further limited by a minimum distance between the top of the impeller and the bearing.

.3 The upper bearing shall carry radial loads only and be free to move in a linear direction with thermal expansion of the pump shaft.

.4 The shaft shall be solid stainless steel through the mechanical seal to eliminate corrosion issues.

.5 Each pump shall be equipped with a dedicated vacuum priming system and the pump is to be primed from the lower pressure area behind the impeller to eliminate the possibility of solids entering and clogging the priming system. The priming system shall be capable of operating in a “Constant Prime” mode whereby the pumps are kept primed constantly or in an “On Demand” mode where priming only occurs when a pump is called on to run and if it is not already primed. The pump shall be equipped with a pump priming chamber that is monitored by the priming and control systems. To prevent

blockages in the priming system, no passageway through which liquid passes shall be smaller than 64 mm.

.6 The pump shall be equipped with a failure to pump sensor mounted on the discharge check valves thus indicating that the pump is operating based on opening of the check valve.

.7 The pump shall be arranged so that the rotating element can easily be removed from the pump casing without the need to disconnect the electrical wiring or disassembling the motor, impeller, back head, or seal in order to allow any blockages to be removed from the pump or suction line.

.8 Where semi-open impellers are used, adjustable and replaceable wear rings are to be installed.

.9 The pump shall be equipped with a mechanical seal constructed so that it automatically drains and primes each time the pump is drained and primed to prevent freezing and breakage of the seal during power outages in sub-freezing temperatures. The seal shall be of carbon and ceramic materials. The rotating ring shall be held in its mating position against the stationary ring by a stainless-steel spring. The seal assembly shall be held in place by a non-corroding seal housing.

.10 Auto-Priming Motors

.1 Pump motors shall be NEMA Design B with cast iron frame with copper windings, induction type, with Class F insulation and 1.15 Service Factor for normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any point in the operating range as specified. Motors shall be suitable for operation using the utility power available. Motors shall be at a minimum of open, drip-proof construction and be equipped with an integral fan for forced air circulation.

.2 Motors shall be tested in accordance with provisions of IEEE Standard. 112, Efficiency Test Method B.

.3 Pump drives to be enclosed on all sides by a guard constructed of fabricated steel or combination of materials including expanded, perforated, or solid sheet metal. No opening to a rotating member shall exceed one half (1/2) inch.

.4 Drive transmission pumps shall be either driven by a V-belt or close-coupled.

.5 Where V-belts are utilized, the sheave/belt combination shall provide the speed ratio needed to achieve the specified pump operating conditions and each drive assembly shall utilize at least two (2) V-belts providing a minimum combined safety factor of 1.5. Single belt drives or systems with a safety factor of less than 1.5

are not acceptable. Computation of safety factors shall be based on performance data published by the drive manufacturer.

TABLE 2: AUTO-PRIMING PUMP OPERATING CONDITIONS

PROJECT TITLE: _____

LOCATION: _____

OWNER: _____

Capacity	_____ l/s
Total Dynamic Head	_____ meters _____ meters
Total Dynamic Suction Lift	_____ meters
Maximum Repriming Lift	_____ meters _____ meters
Maximum Static Suction Lift	_____ meters
Total Discharge Static Head	_____ meters
Minimum Submergence Depth	_____ meters
Pump Suction Connection Size	_____ mm
Pump Discharge Connection Size	_____ mm
Pump Power Rating	_____ kW _____ HP
Pump Speed Rating	_____ RPM
Power Supply	☐ Single Phase - 230 Volt
	☐ Three Phase - 208 Volt
	☐ Three Phase - 230 Volt
	☐ Three Phase - 600 Volt

3.5 PIPING AND VALVES

.1 Pipe

.1 All station piping shall be in accordance Sections 02702 – Public Sanitary Sewerage Gravity Piping and 02724 – Sanitary Sewerage Force Main Piping, electric resistance weld steel pipe, schedule 40, and/or ductile iron in accordance with AWWA C151/A21.51, Class 53.

.2 All internal piping will be prefabricated and galvanized (hot-dip method) prior to installation. Stainless steel bolts and fasteners will be used to assemble all internal piping and valves. All grooved pipe & fittings to be galvanized prior to installation.

.3 The station header pipe shall be equipped with a clean-out port opposite the force main flange and of the same size as the header. The clean-out port will allow for cleaning of the force main and shall be covered by a galvanized blind flange.

.4 Influent and discharge lines shall terminate in a standard 1035kPa flange connection, or a standard grooved cap & rigid coupling in accordance with CSA B242, inside the lift station chamber.

.2 Fittings: Forged welding fittings shall be in accordance with ASTM A181/A181M; grooved standard rigid couplings shall be in accordance with CSA B242; ductile iron grooved fittings to ASTM A536.

.3 Flanges: In accordance with ASME B16.1, Class 125. Ductile iron grooved end flanges to ASTM A536.

.4 Wall Pieces: All wall pieces to have slip-on flanges, welded to the pipe and located in the centre of the wall. Exterior wall pieces to be cement-lined ductile iron, flanged inside and plain end outside. Exterior connections to force main to be by suitable dresser style coupling. Ductile iron shall be in accordance with AWWA C151/A21.51 with flexible cut grooves to AWWA C606 may be used. All mechanical joints shall be restrained from separation.

.5 Valves:

.1 Non-clog ball check valves and ball-centric plug valves shall be installed in each pump discharge line. Each valve shall have a throughway size equal to the pump discharge pipe size to ensure full, free-flow operation. Grooved end plug valves and grooved end check valves to AWWA C606. Laying length to AWWA C509.

.2 Where valves are installed external to the wet well, the following valve types may be used:

.1 Check Valve: Each pump shall be equipped with a full flow type check valve, capable of passing a 75 mm spherical solid, with flanged ends and be fitted with an external lever and spring. The valve seat shall be constructed of stainless steel and shall be replaceable. The valve body shall be cast iron and incorporate a 75 mm clean-out port. Valve clapper shall have a moulded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings, sealing busing shall have double O-rings. O-rings shall be easily replaceable without requiring access to interior of valve body. Valve shall be rated at 1200 kPa water working pressure and 2400 kPa PSI hydrostatic test pressure. Valves other than full flow type or

valves mounted in such a manner that prevents the passage of a 75 mm spherical solid shall not be acceptable.

.2 Plug Valve: A 3-way plug valve shall allow either or both pumps to be isolated from the force main. The plug valve shall be non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connections drilled to 860 kPa standard. The drip-tight shutoff plug shall be mounted in stainless steel bearings, and shall have a resilient facing bonded to the sealing surface. Valve shall be operated with a single lever actuator providing lift, turn, and reseat action. The lever shall have a locking device to hold the plug in the desired position.

.3 For submersible pump stations, install one (1) hydraulically operated flush valve on one (1) of the pumps, for each wet well. Stub and cap, threaded to Owner's fire hydrant standard, to be installed as detailed.

3.6 MISCELLANEOUS ITEMS

.1 Steel Splash Plate (where required). Fabricated from Steel ASTM A36/A36M, as detailed and painted with one coat of zinc-based paint meeting or exceeding the Society for Protective Coatings (SSPC) Paint 20, Type I and Master Painters Institute (MPI) #19 performance standards.

.2 Valve Chamber Drain (where required): Floor drain from valve chamber into wet well to be 50 mm diameter.

.3 Insulation (where required): Expanded polystyrene to ULC CAN/ULC-S701, 50mm.

.4 Ladders: A heavy duty portable non-conductive extension ladder shall be provided for each station and be of sufficient length to extend to sump depth plus 2 m. Ladders shall be CSA Z11 approved and be a minimum of Grade 1AA. Details to be submitted in accordance with Section 01340 – Shop Drawings, Samples and Submissions for Owner’s review and approval.

.5 Padlock: Padlocks shall have a laminated brass body with brass shackle suitable for use in a marine environment and in quantity as identified on the drawings. Padlocks shall be keyed to Master Lock No. 2081 c/w four keys.

3.7 PORTABLE DIESEL GENERATOR

.1 Supply and commission portable diesel generator to satisfy emergency power requirements outlined in the project documents.

.2 CSA C282 approved, diesel engine, alternator to be brushless type rated for full load, continuous duty; minimum 95 litre fuel tank with the requirement that the tank be upsized to achieve 24 hour run time under station load, with bottom tapered to a collection sump with drain cock, control panel with main breaker, 12 volt electric start with battery charging circuit, residential muffler. Engine and alternator to be close coupled and mounted on a sufficiently rated spring axel trailer with fenders, fender lights, wheels, and toe eye extension.

.3 Supply extension cable of length specified in project documents, with mating plug compatible with existing stations in the community or as specified on the project drawings.

3.8 ACCESS FRAME AND COVER

.1 The aluminum access frame shall be fabricated using an extrusion of 6351 aluminum.

.2 The top of the access frame shall be flush, the handle recessed. A padlock shall be installed within the recess to lock the cover in the closed position.

.3 Where applicable, each access frame shall be capable of supporting the full weight of any equipment that can be installed through its opening.

.4 The access frames shall be designed for embedding into the concrete top of a sewer station, the extrusion shall be shaped such as to provide good anchoring to the concrete. All surfaces in contact with the concrete shall be bitumastic coated.

.5 Where applicable, aluminum rail nuts shall be provided within the extrusions, permitting an upper guide bar holder, a level regulator hanger and a chain hook to be attached without any modifications required to the frame.

.6 Access frames shall be provided with a rigid fall-through safety grate that will allow access to level regulators for cleaning and adjusting as well as visual inspection of the chamber. The grating shall be painted in a high visibility colour, hinged, and provided with the ability to be locked closed.

.7 Where multiple frames are used, the frames shall be capable of being installed side-by-side by bolting them together using standardized bolting kits.

.8 The cover shall be fabricated using a plate of 5086 aluminum designed to withstand shear and deflect not more than one seventy ninth (1/79) of the maximum span for minimum specified loads of 7.2 kPa uniform load or 1100 kg point load.

.9 The cover shall rest on a rubber gasket and shall be hinged along one side with a continuous aluminum hinge. A cover stay shall be provided that allows the cover to be locked in the open position.

.10 A bilingual confined space warning label shall be clearly displayed on the underside of the cover.

3.9 LIQUID LEVEL CONTROL

.1 Liquid level regulators shall be provided to control the operation of the pumps in accordance with variations of sewage levels in the pump chamber.

.2 Float type level regulators shall consist of a switch enclosed in a watertight polypropylene casing and shall be suspended from the top of the pump chamber by means of a three conductor, SJOOW or PVC-jacketed cable and set at pre-determined elevations within the pump chamber.

.1 The centre of gravity of the float type level regulator being in a different position from the centre of buoyancy, results in the regulator tilting whenever the liquid level reaches it, thus activating the switch to energize or de-energize the control circuit.

.2 The float type level regulator shall be installed on a galvanized hanger fitted with non-metallic cable glands. Level regulator cables shall run directly to the control panel. Cable lengths shall be selected to suit site conditions without the need for splicing.

.3 The air bubbler level control system shall utilize an electronic pressure switch that shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump when the liquid level in the wet well rises to the “lead pump start level”. When the liquid is lowered to the “lead pump stop level”, the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second pump when the liquid reaches the “lag pump start level” so that both pumps are operating. These levels shall be full adjustable with a local LED status indicator.

.1 The electronic pressure switch shall include a DC power supply to convert 120VAC control power to 12VDC Enhanced Power Supply (EPS) power. The power supply shall be 500 mA (6 W) minimum and be UL listed Class II power limited power supply.

.2 The electronic pressure switch shall be equipped with an electronic comparator and solid state output relay to alert maintenance personnel to a high liquid level in the wet well. An indicator, visible on the front of the control panel, shall indicate that a high wet well

level exists. The alarm signal shall be maintained until the wet well level has been lowered and the circuit has been manually reset. High water alarm shall be furnished with a dry contact wired to terminal blocks.

.4 Ultrasonic level transmitters shall use non-contacting ultrasonic technology to provide effective monitoring for a range up to 15 meters. The beam-width of the ultrasonic level transmitter shall be sufficiently narrow as to avoid nuisance detections of station components such as pumps or piping, or shall incorporate programming to ignore these items. The level transmitter shall have a 4-20 mA output to provide level information to the pumping station controller.

.5 Submersible level transducers shall be designed for use in sewage applications and constructed of non-corroding materials. Cables shall be of sufficient length to reach control panel without splicing, be rated to suspend the level transducer without the support of other cables, and incorporate a vent tube equipped with user replaceable vent filter to prevent moisture from entering the level transducer electronics. The level transducer shall have a 4-20 mA output to provide level information to the pumping station controller. Scaling shall be for full station depth with an overpressure rating a minimum of two (2) times full scale. The level transducer shall be installed in a 100 mm diameter pipe inside the station to protect against fat build-up. The pipe shall be supported at top and bottom to the wall of the pump station via hot dip galvanized supports. Where more than one length of pipe is required, the joint shall be supported to the wall. The level transducer cable shall be supported from the top of the pipe via a non-metallic cable gland.

.6 Level sensing probes shall use the conductive properties of the sewage to complete a circuit to ground from a probe controller installed in the station control panel via metallic sensors mounted on the probe. The system shall consist of probe controller in the pump control panel, intrinsically safe barrier, and the sensing probe.

.1 The probe shall be constructed of non-conductive PVC with ten (10) pairs of sensors evenly spaced along its length. The sensors shall be constructed of stainless steel that will not corrode in a sewage environment and shall be of minimal projection to prevent materials from hanging up on them. The probe shall have a flexible cable suitable for sewage environments and capable of supported the weight of the probe without the need for other support. The cable shall be secured to the top of the probe with a compression fitting and the probe assembly shall be injected with an epoxy or urethane resin to fully encapsulate all internal components and connections into one unit. The cable shall contain a conductor for

each pair of sensors with each conductor uniquely marked for identification of the sensor pair. Markings shall be at regular intervals not exceeding 300 mm. The probe shall be equipped with a stainless-steel hanger for suspension from the top of the station in a turbulent part of the wet well. The hanger shall be equipped with a polyurethane squeegee through which the probe can be pulled to remove any deposits that may build up on the probe.

.2 The probe controller shall be mounted in the inner door of the pump control panel and shall monitor all the sensor pairs of the level probe and provide a visual indication of the submerged sensors thus providing a visual indication of the well level. The probe controller shall be equipped with ten (10) digital outputs, one for each sensor pair, and one (1) 4-20 mA analog output to provide level information to the pump controller. An intrinsically safe barrier shall be installed between the level probe and the probe controller.

3.10 SUBMERSIBLE PUMP CONTROL PANEL

.1 All parts shall be of the best industrial quality, designed for extended, reliable, and maintenance-free operation under extreme weather conditions. Electro-mechanical components shall normally be limited to a strict minimum.

.2 The enclosure shall be of heavy industrial quality, SS, and shall be weatherproof to NEMA 4x with a minimum of a 3-point closing mechanism activated by a single handle to provide reliable outdoor operation. Quarter turn fasteners or screws are not considered adequate means of securing the outer door against weather. The box shall be fitted with a heavy steel inner door. The exterior door shall be hinge-mounted with a 135-degree angle opening to allow easy access to the components.

.3 The control panel shall be equipped with a main disconnect switch, automatically interlocked with the inner door to electrically isolate the components of the control panel when the inner door is open. For ratings up to 100 A, the main disconnect switch shall be of the fusible type, with fuses rated at 100,000 A short-circuit capacity. For capacities above 100 A, the main disconnect switch shall be a thermal-magnetic circuit breaker having a fast response, with a high interrupting capacity approved by the Owner, and sealed contact chambers with clear covers for inspection.

.4 Each pump circuit shall be fitted with an adjustable 3-pole, thermal magnetic-circuit breaker or current-limiting motor protector and overload relay. The response time under short-circuit conditions shall be less than one-quarter of a cycle; the action shall open all poles, thus avoiding single-phase operation of three-phase pumps.

.5 The circuit breaker and overload relay shall exhibit stable operation under varying temperature conditions (from -25 °C up to 50 °C). The circuit breaker shall have a high interrupting capacity independent of the thermal setting.

.6 Each pump circuit shall be fitted with a 3-pole, fast-acting magnetic contactor, designed for a minimum of 20 years' service under normal operating conditions of sewage pumping stations. Under overload conditions, the circuit shall be designed to open the overload relay first and then the contactors.

.7 The control shall be equipped with not less than a 100-watt heating element integral with a thermostat and a protective shield around the heating element to prevent injuries.

.8 A manual line transfer switch, complete with a weatherproof, exterior-mounted receptacle, shall be installed.

.9 Phase failure and phase reversal protection shall be installed in three phase stations only.

.10 PLC / Micro Processor Controller Based:

.1 The pump manufacturer shall supply a completely assembled control panel based on a solid-state microprocessor or PLC controller with a fault diagnostic system and pump running time recorder, specially designed and programmed for the operation of two or more submersible pumps as specified in Table 1. Where specified by the Owner an electro-mechanical panel may be provided. This panel shall provide basically the same functions as the PLC based, except for the float fault function.

.2 Isolated handles for each motor protector shall be mounted on the inner door.

.3 A state-of-the-art, microprocessor-based or PLC control with fault diagnostics and display shall be used to provide failsafe operation of the sewage pumping station and shall fulfil, but not be limited to the following functions:

.1 The controller shall control the starting, stopping and alternation of the pumps and shall include a 15-second time delay between the consecutive start of either pump to prevent high inrush currents which would result if both pumps were started at the same time.

.2 The controller shall provide a visual indication showing which level regulator is activated. The controller shall monitor any failure in any of the level regulator circuits. If any of the level regulators are out of service, the next higher level regulator shall assume automatically the duties of the faulty regulator.

At the same time, a visual indicator shall identify the faulty level regulator.

.1 For example: if float 1 is faulty, float 2 will assume the duties of float 1; float 3; the duties of float 2, and float 4, the duties of float 3 and 4. Even in the event of fault occurrences in all the level regulator circuits the control shall at least send an alarm.

.3 The controller shall have a visual indicator showing the pump(s) in operation and/or a demand for a pump to operate.

.4 The controller shall monitor the pump heat sensor output(s) and shall shut off the overheating pump before high temperature damage to the insulation.

.5 The controller shall monitor any leakage of water into the stator housing and shall shut off the faulty pump and initiate the alarm.

.6 The controller shall start the back-up pump whenever a faulty condition stops the service pump.

.7 The controller shall identify the degree of urgency of all fault conditions and classify them as “malfunction” or “emergency”. An optional (as specified by the Owner) remote monitoring system shall transmit these conditions to a remote location through telemetry.

.8 High priority faults, identified as “emergency”, which require immediate intervention, are only alarmed when a definite risk of flooding exists.

.9 Low priority faults are identified as “malfunctions” and their correction may be scheduled during the regular maintenance activities of the following day.

.10 Upon inspection, the diagnostic display will identify any fault that has occurred since the last visit, even if the fault has self-corrected or no longer exists.

.11 An alarm silencing push button shall be included to stop the alarm from unnecessary operation once the station operator has taken notice of the fault.

.12 Physical MANUAL/OFF/AUTO switches shall be mounted on the inner door to allow manual pump operation.

.13 An alarm test button shall be incorporated for testing the alarm circuits.

.14 Visual indication of pump station operation and alarms shall be through either a LED panel or HMI.

.4 A duplex receptacle with ground-fault circuit interrupter at 120 V shall be installed for connection of a convenience lamp. An exterior-mounted, vandal-proof, shatter proof alarm light, two running-time recorders, and a two-pump, running-time recorder shall be installed. To prevent water leaks into the control enclosure, the alarm light shall not be mounted on the top of the control enclosure.

.5 The controller shall operate the pumps as per the following sequence:

.1 Float 1: stop both pumps and alternate pumps.
.2 Float 2: run duty pump.
.3 Float 3: run standby pump.
.4 Float 4: emergency alarm.

.11 PLC / RTU Controller Based:

.1 The pump manufacturer shall supply a completely assembled control panel based on a PLC/RTU controller complete with graphics touch screen operator interface and remote communications using modbus protocol or option modbus TCP/IP protocol via high-speed Internet access. The panel shall be designed and programmed for the operation of two or more submersible pumps as specified in Table 1. The panel shall provide space for a UHF or 900 MHz data radio.

.2 A PLC/RTU shall be used to provide fail safe operation of the sewage pumping station. All control system parameters required to implement the pumping station operation shall be entered using the touch screen. The system shall be designed to be 100 % user configurable to allow the operator to perform the initial start-up and any future adjustments to the parameters, set points, alarms set points, etc.

.3 The PLC/RTU shall control the starting, stopping and alternation of the pumps and shall include a user selectable time delay between the consecutive start of either pump to prevent high inrush currents which would result if both pumps were started at the same time.

.4 The PLC/RTU shall be interfaced to a minimum of a 125 mm, 256 color graphics touch screen for data entry and monitoring. The screen shall display a minimum of 320 trend points on the X-axis to permit on screen plotting of all data points. The range between points shall be user selectable, in seconds.

.1 The screen shall display active and current alarms and alarm history of the last 25 alarms.

.2 The following alarms shall be displayed:

.1 pump under current

.2 pump overload
.3 pump high temperature
.4 pump leakage
.5 transmitter fault
.6 high well level
.7 low well level
.8 voltage fault

.3 The screen shall have a graphical representation of the pumping station showing the following:

.1 pump hours
.2 pump starts
.3 pump amps
.4 pump status
.5 well level
.6 station inflow
.7 pump flow
.8 combined pump flow

.5 The PLC/RTU shall be programmed to log well level, pump starts, pump amps, pump hours and station inflow. The data logger shall have a minimum storage capacity of 10,000 records with user selectable logging rate. This data shall be stored to a removable memory storage device to upload to a computer for analysis. Where this data is stored in a proprietary format, the software package necessary to view this data shall be provided with the pump station.

.6 All operating parameters are to be entered from the touch screen through a series of configuration screens and include but is not limited to the following:

.1 Well Level Transmitter Span
.2 Well Level Transmitter Zero
.3 Float or Level Transmitter operation selection
.4 Float normally open or normally closed selection
.5 Hi and Lo alarm Set points
.6 Lead, Lag, and Standby pump start and stop set points
.7 Leak and thermal fault enabling and selection for each pump
.8 Pump 1, 2 & 3 Start delay time
.9 Pumps Maintenance selection/interval
.10 Wet well surface area
.11 Riser Area
.12 Bench Level
.13 Auto clean settings

.14 Data log settings
.15 External alarm light settings
.16 Pump auto status

.7 The PLC/RTU shall be equipped with flash type non-volatile type memory.

.8 The PLC/RTU shall have sufficient communication ports for communication with all equipment specified.

.9 The control panel and PLC/RTU shall operate the pumps as per the following sequence:

.1 Pump stop level set point
.2 Stop both pumps and alternate pumps
.3 Lead pump run set point
.4 Run duty pump
.5 Standby pump run set point
.6 Run standby pump

3.11 AUTO-PRIMING PUMP CONTROL PANEL

.1 The pump station control panel shall be tested as an integral unit by the pump station manufacturer. The control panel shall also be tested with the pump station as a complete working system at the pump station manufacturer's facility.

.2 Panel Enclosure

.1 Electrical control equipment shall be mounted within a common NEMA 1 stainless steel, dead front type control enclosures. Doors shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on removable steel back panels secured to enclosure with collar studs.

.2 All control devices and instruments shall be clearly labelled to indicate function.

.3 Branch Components

.1 Motor branch components to be of highest industrial quality, and securely fastened to the sub-plate.

.2 Circuit Breakers and Operating Mechanism

.1 A properly sized heavy duty circuit breaker shall be furnished for each pump motor. The circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering.

.2 An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A pad-lockable operator handle shall be secured on the exterior

surface. Interlocks shall prevent opening the door until circuit breakers are in “OFF” position.

.3 Motor Starters

.1 An open frame, across-the-line, NEMA rated magnetic starter with under-voltage release, and overload protection on all three phases, shall be furnished for each pump motor. Starters of NEMA size 1 and above shall allow addition of at least two auxiliary contacts. Starters rated “O”, “OO”, or fractional size are not acceptable. Power contacts to be double-break type made of cadmium oxide silver. Coils to be epoxy moulded for protection from moisture and corrosive atmospheres. Contacts and coils shall be easily replaceable without removing the starter from its mounted position. Each starter shall have a metal mounting plate for durability.

.4 Overload Relays

.1 Overload relays shall be solid-state block type, having visual trip indication with trip-free operation. Electrically resetting the overload will cause one (1) normally open and one (1) normally closed isolated alarm/control contact to reset, thus re-establishing a control circuit. Trip setting shall be governed by solid-state circuitry and adjustable current setting. Trip classes shall be 10, 15 and 20. Additional features to include phase loss protection, selectable jam/stall protection and selectable ground fault protection.

.2 A reset mounted through the control panel door, shall permit resetting the overload relays without opening the door.

.4 Control Circuit

.1 A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.

.2 Pump mode selector switches shall permit manual start or stop of each pump individually or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the motor overload relays. Selector switches to be oil-tight design with contacts rated NEMA A300 minimum.

.3 Pump alternator relay to be electro-mechanical industrial design. Relay contacts to be rated 10 amperes minimum at 120 volts non-inductive. A switch shall permit the station operator to select automatic alternation of pumps, to select pump number one to be “lead” for each pumping cycle, or to select pump number two to be “lead” pump for each pumping cycle.

.4 Six-digit elapsed time meter (non-reset type) shall be connected to each motor starter to indicate total running time of each pump in “hours” and “tenths of hours”. An integral pilot light shall be wired in parallel to indicate that the motor is energized and should be running.

.5 A high pump temperature protection circuit shall override the level control and shut down the pump motor(s) when required to protect the pump from excessive temperature. A thermostat shall be mounted on each pump casing and connected to a pump shutdown circuit. If casing temperature rises to a level sufficient to cause damage, the thermostat causes the shutdown circuit to interrupt power to the motor. A visible indicator, mounted through the control panel door shall indicate motor stopped due to high pump temperature. The motor shall remain locked out until the pump has cooled and circuit has been manually reset. Automatic reset of this circuit is not acceptable.

.6 A duplex ground fault receptacle providing 115 VAC, 60 Hz, single phase current, will be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15 A thermal-magnetic circuit breaker.

.7 Wiring

.1 The pump station, as furnished by the manufacturer, shall be completely wired, except for power feed lines to the branch circuit breakers and final connections to remote alarm devices.

.2 All wiring, work, and schematic wiring diagrams shall comply with applicable standards and specifications of the CEC.

.3 Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 16 gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.

.4 Motor branch and other power conductors shall not be loaded above 60 °C temperature rating, on circuits of 100 amperes or less, nor above 75 °C on circuits over 100 amperes. Wires shall be clearly numbered at each end in conformance with applicable standards. All wires on the sub-plate shall be bundled and tied. All wiring outside the panel shall be routed through conduit.

.5 Control wires connected to door mounted components shall be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door

to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices.

.8 Conduit

.1 Factory installed conduit shall conform to following requirements:

.1 All conduit and fittings to be CSA listed.

.2 Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.

.9 Grounding

.1 Station manufacturers shall ground all electrical equipment inside the pump station to the control panel back plate. All paint shall be removed from the grounding mounting surface before making final connection.

.5 Equipment Marking

.1 Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:

.1 Equipment serial number
.2 Supply voltage, phase and frequency
.3 Current rating of the minimum main conductor
.4 Electrical wiring diagram number
.5 Motor horsepower and full load current
.6 Motor overload heater element
.7 Motor circuit breaker trip current rating
.8 Name and location of equipment manufacturer

.2 Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.

.3 Switches, indicators, and instruments mounted through the control panel door shall be labelled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

3.12 ELECTRICAL WIRING

.1 Only equipment essential for the operation of the pump station shall be installed inside. Where possible, all fans, heaters, switches and junction boxes etc. shall be located outside to avoid corrosion or flood damage.

.2 All electrical wiring of the pump station shall be designed and supplied by the manufacturer in accordance with the Canadian Electrical Code.

.3 Pump power and level regulator cables shall be provided in sufficient length to run directly to the control panel via an external conduit without splicing. Conduit fittings and strain relief connectors shall be provided in sufficient number and size to permit installation of the conduit to the pumping station. All external conduits shall enter the control panel enclosure only through the bottom. Conduits from the wet well shall be sealed in accordance with the Canadian Electrical Code. Conduits shall be sealed with O-rings at entrances to control panels or junction boxes.

.4 The power and/or control cable(s) shall be suitable to reach the control panel without splicing. Power cables shall be sized and selected according to applicable NEC and CSA standards. The outer jacket of the cable shall be of an oil resistant and UV stable material suitable for long-term use in municipal wastewater.

.5 All wiring in the pump station shall be coded either by colour or a numbering system. Pump power and level regulator cables shall be provided with sufficient length to run directly (no splices) to the control panel (except where otherwise specified) and shall be pulled through external conduits.

.6 All conductors in power wiring shall be no less than No. 14 AWG. Control wiring conductors may be smaller in size, in accordance with the current requirements of the circuit involved and all applicable standards.

.7 Power cables and control cables shall not be run in the same conduit.

.8 Each pump cable shall be run in its own dedicated conduit.

3.13 LABELS

.1 Suitable nameplates shall be permanently affixed onto the pumps, control enclosure components, and other operating components to indicate the purpose of the component or operating routine and parameters applying to the component. The lift station pumps and control equipment are CSA approved and the CSA logo appears on the nameplates of these components.

PART 4 EXECUTION

4.1 PROVISION FOR POWER

.1 The designer and contractor shall make themselves aware of all existing electrical connections, existing service voltages, existing service capacities, and the electrical requirements for all equipment.

.2 Provide a 120 volt, GFCI convenience receptacle, rated at 15 amp. Provide a receptacle for connection of power cord to the lift station emergency receptacle. All receptacles to have weather protectors.

.3 The contractor is fully responsible to arrange, with the electric power utility, temporary power, as required at the site during construction.

.4 The contractor is fully responsible to schedule with the electric power utility the disconnection of existing electrical services and connection of new electrical services.

.5 The contractor is fully responsible for maintaining the operation of existing stations during any changeover of electrical services.

.6 The contractor is fully responsible to supply a power cable and use of a generator (if the generator is not included in the contract or available from the Owner) to test the auxiliary power for the lift station during commissioning. The cable will become the property of the Owner if a generator is included in the contract or if the Owner has a generator used during commissioning. The cable will remain the property of the contractor if the generator used is the contractors.

4.2 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sewage lift installation in accordance with manufacturer’s written instructions.

.1 Visually inspect substrate in presence of Owner.
.2 Inform Owner of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Owner.

4.3 EXCAVATION BACKFILLING AND COMPACTION

.1 Excavate, backfill and compact in accordance with Section 02223 – Excavating, Trenching and Backfilling.

4.4 CONCRETE

.1 Do concrete work in accordance with Sections 02601 – Maintenance Holes and Cath Basin Structures.

4.5 EQUIPMENT INSTALLATION

.1 Install equipment, piping and controls in accordance with manufacturers' recommendations.

4.6 FIELD QUALITY CONTROL

.1 Authorized personnel shall be made available to supervise the installation of the pumps and equipment as necessary to satisfy the manufacturers' requirements.

.2 The pump/motor assembly shall be CSA approved as one, integral unit, in accordance with CSA requirements. Proof of this approval shall be submitted by the pump manufacturer together with the approval drawings. An approval of the motor unit only shall not be acceptable.

.3 The pump cable shall be CSA approved, SOOW type, neoprene-jacketed, with a 90 °C rating. The pump cable end will be sealed with a high-quality protective covering to make it impervious to moisture and/or water seepage, prior to shipping to job site and electrical installation.

.4 Any equipment in the pumping station that may have been provided by another supplier shall have been tested by the original supplier.

.5 After completion of installation, demonstrate functional operation of systems, including sequence of operation, to approval of the Owner.

.6 Test in presence of the Owner, Owner's Representative, and representative from equipment supplier.

.7 Provide labour and ancillary equipment necessary to fulfil tests.

.8 Test to demonstrate that:

.1 Pumps and equipment run free from heating, or vibration.
.2 Operation meets requirements of these specifications.
.3 Pumps and pumping are free and clear of debris and obstructions.

.9 Replace equipment found defective.

.1 Repeat test until equipment is accepted by the Owner.

4.7 COMMISSIONING

.1 The Commissioning phase shall confirm that the equipment provided meets the design intent and function in accordance with the project documents, and defined operational requirements prior to system handover to the Owner.

.2 Commissioning occurs after successful completion of start-up and the provision of a full itemized list of equipment installations, verifications,

certifications as well as a list of any technical difficulties/resolutions. Once the prime Consultant has reviewed and accepted this information, they shall advise that the pumping station is ready for Commissioning and the Contractor shall then schedule Commissioning date(s) a minimum of two (2) weeks in advance, subject to availability of all parties.

.3 During Commissioning, the Contractor demonstrates that all equipment and systems function properly and in accordance with the project documents. It is fully expected that all equipment and systems have been previously started, operated and tested successfully. The Commissioning phase is not to be used for start-up or testing of systems. This ensures efficient use of resources during Commissioning activities. If it is determined that all equipment has not been started and does not operate properly during the first attempt at commissioning, the Commissioning process may be terminated.

.4 Should the commissioning process require termination and rescheduling due to failure of the contractor to complete prior start-up or testing of systems, the Owner will deduct the amount of compensation for rescheduled commissioning from payment to the contractor.

.5 Commissioning will include over-all system testing to ensure the entire system, consisting of many subsystems, performs as specified. Commissioning shall be carried using a holistic approach for the entire system. Commissioning shall be completed to bring the mechanical, electrical, and other systems and components from a state of “static completion” to a state of “dynamic operation” and to verify conformance to this Specification and the engineering design.

.6 The Contractor shall have the prime responsibility to coordinate the execution of commissioning activities. The Contractor will work closely with the Department and/or the Owner to plan and execute commissioning. The following personnel shall be present for commissioning activities:

.1 Appointed Commissioning Officer: A dedicated commissioning officer to lead the site commissioning process must be identified. It will be the commissioning officer’s task to create the commissioning plan, create site acceptance testing protocols, and lead/directing the Commissioning process.

.2 Contractor: The Contractor shall have an appropriate number of staff available on-site to operate all equipment as directed by the commissioning officer and in accordance with the commissioning plan and site acceptance testing protocols.

.3 Subcontractors (as required).

.4 Department and/or Owner and/or Owner’s Representative.

.5 Subconsultants (as required).

.6 Suppliers (as required).
.7 System Operators.

.7 At minimum, the Commissioning plan shall include an execution methodology complete with checklists, verification reports and sign-off sheets, and shall cover the following:

.1 Full Input / Output listing and their function e.g.:
.2 Confirm pump switches ON/OFF at desired levels.
.3 Simulate failures.
.4 Confirm correct operation of speed drives.
.5 Methodology to test the pumps over various operating conditions.
.6 Communication arrangements.
.7 Full list of equipment and system set points.
.8 Test or simulate all Input/Output.
.9 Check, verify and record all parameters of pump performance (including electrical parameters) under all possible operating configurations. These 'benchmark' values will be used to check performance throughout pump lifecycle.
.10 Test (or simulate) and verify functionality of all alarms and ensure that response is in accordance with PCN.
.11 Check and verify functionality of all mechanical systems (i.e., ventilation, pump lifts, heating, hatches and accessories, valving, etc.).
.12 Demonstrate removal and reinstallation of all removable/serviceable mechanical equipment (i.e., screening baskets, pumps, etc.).
.13 Confirm auxiliary power supply system functionality by:

.1 Simulating a power interruption at full demand, i.e., open the line power main disconnect switch and
.2 by conducting a load bank test – 100% load for 6 hours.

4.8 DEMONSTRATION AND TRAINING

.1 The contractor and/or their supplier must schedule and deliver an onsite demonstration of the station along with site training by qualified personnel for three (3) designated operating personnel prior to receiving a substantial completion certificate for the project.

.2 The demonstration and training plan must be approved in writing by the Department and/or the Owner.

.3 Training must include, at a minimum, all system safety precautions and safe procedures for routine maintenance procedures, minor repairs, replacement of consumable parts, and disassembly/assembly of major components.

.4 Demonstration and Training can be scheduled to occur at/around the same time as Commissioning, but is not part of the Commissioning.

4.9 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01710 – Reinstatement and Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01710 - Reinstatement and Cleaning.

.3 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 5 PAYMENT

5.1 MEASUREMENT FOR PAYMENT

.1 Unless specifically marked optional and not specified elsewhere all items shall be supplied and installed.

.2 For each sewage pumping station specified under the Project Specific Specification using the format outlined in this Section.

.3 For each portable diesel generator specified under the Project Specific Specification using the format outlined in this Section.

5.2 BASIS OF PAYMENT

.1 All costs associated with the work outlined in this specification shall be deemed to be included in the appropriate unit and lump sum prices quoted as outlined in the Measurement for Payment subsection of this section and as included in the MERX Schedule of Quantities and Prices.

.2 Outfalls for overflows from sewage lift stations shall be paid in accordance with Section 02704 – Sanitary Sewer Outfall Pipe.

.3 Excavation and backfilling for lift stations shall be paid for in accordance with Section 02223 – Excavation, Trenching and Backfilling. Measurement limits shall be the plan outside dimensions plus 2 m and shall be to the full depth of the structure from original ground to the bottom of the structure.

.4 Concrete chambers for lift stations shall be paid for in accordance with Section 02601 – Maintenance Holes and Catch Basin Structures?