PACKAGED SEWAGE LIFT STATION, WET WELL TYPE

1. GENERAL

1.1 Scope of Work

.1 The Work under this Section includes supply, delivery, installation, training, testing, and performance verification support for semi-positive displacement submersible grinder pump system, the package control panel, tankage connection to existing sanitary system and other ancillary items for a complete working pump station.

1.2 References

.1 Section 02315 – Excavation, Trenching and Backfilling

.2 The following is a list of standards that may be referenced in this Section:

.1 HIS

.2 Canadian Electrical Code, CSA C22.1

.3 NEMA

.4 ULC

.5 NFPA

1.3 Definitions

.1 Terminology pertaining to pumping unit performance and construction shall conform to ratings and nomenclature of HIS.

1.4 Submittals

.1 Shop Drawings, Refer to Section 01300 – Submittals:

.1 Make, model, weight, and horsepower of each equipment assembly.

.2 Complete catalogue information, descriptive literature, specifications, dimensions, and identification of materials of construction.

.3 Performance data curves showing head, capacity, horsepower demand, and pump efficiency over entire operating range of pump, from shutoff to maximum capacity. Indicate separately design points, head, capacity, horsepower demand, overall efficiency, and minimum submergence required at guarantee point.

.4 Power and control wiring diagrams, including terminals and numbers.

.5 Complete motor nameplate data, as defined by NEMA, from motor manufacturer.

.6 Factory finish system.

.7 Bearing life calculations.

.2 Quality Control Submittals:

.1 Manufacturer's warranty performance certificate: minimum twenty four (24) months.

.2 Factory and Field Performance Test Reports and Log.

.3 Manufacturer's Certification of Compliance that factory finish system meets requirements specified herein.

.4 Special shipping, storage and protection, and handling instructions.

.5 Manufacturer's printed installation instructions.

.6 Manufacturer's Certificate of Proper Installation.

.7 Suggested spare parts list to maintain equipment in service for period of one (1) year and five (5) years. Include list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

.8 List special tools, materials, and supplies furnished with equipment for use prior to and during start-up and for future maintenance.

.9 O&M manual.

.3 Other:

.1 Excavation plan for the existing sanitary storage tank.

.2 Condition inspection of existing sanitary tank, including tank material, dimensional drawings of all components, and any other observations related to the construction.

.3 Details of the anti-flotation concrete anchor, sealed by a Professional Engineer registered to APEGM.

.4 Details of the connections to the existing sanitary FRP tank, sealed by a Professional Engineer registered to APEGM.

.5 Safe work plan.

1.5 Extra Materials

.1 Supply one (1) spare grinder pump core, complete with all operational controls, level sensors, check valve, anti-siphon valve, pump/motor unit, and grinder.

1.6 Measurement and Payment

.1 Packaged sewage lift station shall be measured as a lump sum basis. The lump sum price shall be payment in full for all working and materials specified herein required for a complete and operational sewage lift station, and the supply and installation of electrical and control service from the pump control panel to the Deacon Booster Pump Station.

2. PRODUCTS

2.1 Operating Conditions

.1 The pumps shall be capable of delivering 1.0 L/s against a rated total dynamic head of 16 m and the maximum flow delivered shall not more than 1.9 L/s at any conditions. The pump(s) must also be capable of operating at negative total dynamic head without overloading the motor(s).

2.2 Supplements

.1 Pump datasheet and any other specific requirements are attached to this Section as supplements.

2.3 Components

.1 All components for the lift station shall be rated as Class I Division 2 Group D.

.2 Pumps and motors

.1 Pumps and motors shall meet the applicable discharge, head, power, and rpm requirements as specified. Pumps shall be capable of handling raw, unscreened sewage. They shall have a cast iron, brass or stainless steel impeller. The pumps shall be grinder pumps with double mechanical seals. An oil filled chamber shall be provided between the pump and the motor. A moisture probe shall be provided in the oil filled chamber. The motors shall be NEMA Design B, 575 volt, 3-phase, 60 hertz with a 1.15 service factor. A guide rail withdrawal system is required.

.2 The pumps shall be of the type that can be removed without entering the wet well. Complete weight of pump shall rest on the vertical pedestal plate.

.3 Each pump shall have a stainless steel nameplate indicating the kilowatts, amperes, volts, phase, rpm, service factor, insulation class, serial number, model number, L/s, TDH, and impeller number or size. A self-adhesive aluminum tag or laminated label shall be mounted inside the outer door of the control cabinet for each pump installed. The aluminum tag or label shall contain the same information as the stainless steel tag on the pump.

.4 The following spare parts and tools shall be furnished for each pump: One (1) set of mechanical seals, special impeller pullers, and special wrenches needed for breakdown of pump.

.5 The following items shall be furnished with each station: One stainless steel glycerin filled pressure gauge and diaphragm seal unit, one spare check valve flapper, flapper bolt, and hinge pin.

.6 Over-temperature conditions of the motor stator windings shall be sensed by two (2) bimetallic thermal switches contained in the motor. The leads for these switches shall be brought out through a waterproof connection such that the switches may be connected into the motor control circuit shown in the drawings. The motor's bi-metallic thermal switch shall automatically reset after the motor temperature falls below the reset switch reset temperature

.7 A seal failure in the pump shall be sensed by a moisture sensor contained in the oil chamber of the pump. The leads for this sensor shall be brought out through a waterproof connection such that the sensor may be connected to the sensor module located in the control cabinet.

.8 Motor and pump shall be capable of continuous operation without damage, submerged or dry. Motor shall be NEMA Class "F"-155° C insulation or better and certified as such by the vendor. The service factor of the motor shall not be used to achieve the operating performance of the pump. Additionally, the rated horsepower of the motor listed in the motor nameplate data shall not include horsepower available from the service factor rating of the motor. Motor shall be non-overloading for the full range of its operating curve.

.3 Discharge hose and slide face disconnect/valve: all discharge fittings and piping shall be constructed of 304 series stainless steel, polypropylene, EPDM or PVC. The discharge hose assembly shall include a shut-off valve rated for 1380 kPa WOG and a quick disconnect feature to simplify installation and pump removal.

.4 Electrical quick disconnect: the grinder pump unit shall include a single NEMA 6P electrical quick disconnect for all power and control functions. An integral tube shall allow venting of the control compartment to assure proper operation of the pressure switch level system. The grinder pump will be furnished with a length of 6 conductor, 14 gauge, type SJOW cable, pre-wired and watertight to meet UL requirements.

.5 Check valve: the pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral check valve built into the pump discharge. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Moving parts will be made of a 300 series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back pressure. The valve body shall be an injection molded part made of glass

filled PVC. Ball-type check valves are unacceptable due to their limited sealing capacity in slurry applications.

.6 Anti-siphon valve: the pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the stainless steel discharge piping. Moving parts will be made of 300 series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure. The valve body shall be injection-molded from a glass-filled thermoplastic resin. Holes or ports in the discharge piping are not acceptable anti-siphon devices, due to their tendency to clog from the solids in the slurry being pumped.

.7 Pump motor and sensor cables shall be suitable for submersible pump application and cable sizing shall conform to Canadian Electrical Code specifications for pump motors. Cable shall be of sufficient length to reach junction boxes without strain or splicing.

.8 Tank and Integral Accessway:

.1 Fibreglass-Reinforced Polyester Resin: The tank shall be custom moulded of fibreglass reinforced polyester resin. Tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to 150 percent maximum external soil and hydrostatic pressure.

.2 The accessway shall be an integral extension of the wet well assembly and include a lockable cover assembly providing low profile mounting and watertight capability. Accessway design and construction shall facilitate field adjustment of station height in increments of 75 mm without the use of any adhesives or sealants requiring cure time before installation can be completed.

.3 The station shall have all necessary penetrations moulded in and factory sealed. To ensure a leak-free installation, no field penetrations shall be acceptable.

.4 All discharge piping shall be constructed of 304 Series Stainless Steel and terminate outside the accessway bulkhead with a stainless steel, 32 mm female NPT fitting. The discharge piping shall include a stainless steel ball valve rated for 1380 kPa WOG; PVC ball valve will not be accepted. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.

.5 The accessway shall include a single NEMA 6P electrical quick disconnect (EQD) for all power and control functions, factory installed with accessway penetrations warranted by the manufacturer to be watertight. Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. The accessway shall also include a 50 mm PVC vent to prevent sewage gases from accumulating in the tank.

.6 Provide proper supports of the pumps

.9 Control Panel:

.1 All necessary controls, including motor and level controls, shall be located in the top housing of the core unit. The top housing will be attached with stainless steel fasteners.

.2 Non-fouling waste water level controls for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air column connected to a pressure switch. The level detection device shall have no moving parts in direct contact with the wastewater. High-level sensing will be accomplished in the manner detailed above by a separate air-bell sensor and pressure switch of the same type. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit. For increased reliability, pump ON/OFF and High-level alarm functions shall not be controlled by the same switch. Float switches of any kind, including float trees, will not be accepted due to the periodic need to maintain (rinsing, cleaning) such devices.

.3 To assure reliable operation of the differential pressure switches each core shall be equipped with a pressure equalization chamber. The equalization chamber shall continuously calibrate the level sensing pressure switches to fluctuations in barometric pressure and prevent fluid from entering the control compartment during high water level conditions. The equalization chamber shall be constructed from EPDM, High Impact Polystyrene and stainless steel and measure 300 mm in diameter by 150 mm high. The chamber shall be assembled by the core manufacturer and factory tested at the point of assembly to verify proper operation.

.4 The grinder pump will be furnished with 6 conductor 14 gauge, type SJOW cable, pre-wired and watertight to meet UL requirements with a factory installed NEMA 6P EQD half attached to it.

.5 Control panel shall include:

.1 Main circuit breaker disconnect interlocked with panel door.

.2 Combination circuit breaker type, NEMA rated motor starters.

.3 Fused control power transformer, 120 VAC.

.4 ON/OFF/CPU switches.

.5 Running lights.

.6 High level indication.

.7 Normally closed, dry, 5 A at 120 VAC contacts for future remote indication of:

.1 High level alarm.

.2 Pump failure (temperature or moisture alarm).

.8 Terminal strip for interfacing with external wiring.

.9 High temperature indication.

.10 Moisture alarm indication.

.11 Alarm (high temperature, moisture, or high level) beacon located on top of panel.

.12 Lightning protection.

.13 Alarm silence button.

.14 Document pocket located inside panel with pump and panel operation and maintenance manual and separate laminated pump curve.

.15 110 V, duplex GFI outlet, weather-protected, and accessible from outside of panel.

.16 Run hour meter.

.17 100 W minimum, condensation heater with thermostat.

.18 ULC labelled panel.

.6 Prewired and factory tested.

.7 Mount control switches, indicating lights, and switches on hinged front panel.

.8 Single feed: 120 V, 1 phase.

.10 Alarm panel: each grinder pump station shall include a NEMA 4X, UL-listed Alarm Panel suitable for wall or pole mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic polyester to ensure corrosion resistance. The enclosure shall include a hinged, lockable cover with padlock, preventing access to electrical components, and creating a secured safety front to allow access only to authorized personnel. The enclosure shall not exceed 267 W x 355 H x 178 D (mm), or 318 W x 356 H x 190 D (mm) if certain options are included.

.1 The alarm panel shall contain one (1) 15-amp, double-pole circuit breaker for the pump core's power circuit and one (1) 15-amp single-pole circuit breaker for the alarm circuit. The panel shall contain a push-to-run feature, an internal run indicator, and a complete alarm circuit. All circuit boards in the Alarm Panel are to be protected with a conformal coating and the AC power circuit shall include an auto resetting fuse.

.2 The alarm panel shall include the following features: external audible and visual alarm; push-to-run switch; and redundant pump start with high level alarm capability. The alarm sequence is to be as follows:

.1 When liquid level in the sewage wet well rises above the alarm level, audible and visual alarms are activated, the contacts on the alarm pressure switch close, and the redundant pump starting system is energized.

.2 The audible alarm may be silenced by means of the externally mounted, push-to-silence button.

.3 Visual alarm remains illuminated until the sewage level in the wet well drops below the "off" setting of the alarm pressure switch.

.3 The visual alarm lamp shall be inside a red, oblong lens at least 95 L x 60 W x 38 H (mm). Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain NEMA 4X rating. The audible alarm shall be externally mounted on the bottom of the enclosure, capable of 93 dB @ 0.6 m. The audible alarm shall be capable of being deactivated by depressing a push-type switch that is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure (push-to-silence button).

.4 The entire alarm panel, as manufactured and including any of the following options shall be listed by Underwriters Laboratories, Inc.

.5 All materials exposed to waste water shall have inherent corrosion protection.

.11 NEMA 12 painted steel enclosure, for outdoor duty. Refer to Divisions 16 and 17, Instruments and Panels Subsystem, for additional panel requirements.

2.4 Accessories

.1 Provide level control devices for:

.1 Low level – pump off. (from level transmitter)

.2 High level – pump on. (from level transmitter)

.3 High high level – alarm.

.2 In accordance with Divisions 16 and 17, Instruments and Panel Subsystems components.

.3 Interface to WTP control system MODBUS RS232 connection to Ethernet converter.

.4 Equipment Identification Plate: 16 gauge stainless steel with 6 mm die-stamped equipment tag number securely mounted in readily visible location.

2.5 Source Quality Control

.1 Control Panel:

.1 Factory Inspections: Inspect control panels for required construction, electrical connection, and intended function.

.2 Factory Tests and Adjustments: Test all control panels furnished.

.2 Pump:

.1 Factory Performance Test:

.1 In accordance with HIS 1.6, for centrifugal pump tests.

.2 Include test data sheets, curve test results, performance test logs.

.2 Conduct on each pump.

.3 Perform under actual or approved simulated operating conditions.

.1 Throttle discharge valve to obtain pump data points on curve at $^{2}/_{3}$, $^{1}/_{3}$, and shutoff conditions.

.3 Motor Functional Test: Perform Manufacturer's standard motor test. Submerge and run for thirty (30) minutes at pumping conditions corresponding to maximum motor load.

3. EXECUTION

3.1 Factory Test:

.1 Each grinder pump shall be submerged and operated for 5 minutes (minimum). Included in this procedure will be the testing of all ancillary components such as, the anti-siphon valve, check valve, discharge assembly and each unit's dedicated level and motor controls. All factory tests shall incorporate each of the above listed items. Actual appurtenances and controls which will be installed in the field, shall be particular to the tested pump only. A common set of appurtenances and controls for all pumps will not be acceptable. Certified test results shall be available upon request showing the operation of each grinder pump at two (2) different points on its curve, with the maximum pressure no less than 414 kPa. The Contract Administrator reserves the right to inspect such testing procedures with representatives of the City, at the grinder pump manufacturer's facility.

3.2 Delivery:

.1 All Grinder Pump units will be delivered to the job site, 100% completely assembled, including testing, ready for installation.

3.3 Installation:

.1 The electrical enclosure shall be furnished, installed and wired to the grinder pump station by the Contractor. An alarm device is required on every installation.

.2 The Contractor shall mount the alarm device in a conspicuous location, as per national and local codes. The Alarm Panel will be connected to the Grinder Pump Station by a length of six (6) conductor 12 gauge TC type cable as shown on the contract drawings. The power and alarm circuits must be on separate power circuits. The grinder pump station will be provided with a minimum of 9.75 m of useable electrical supply cable outside the station, to connect to the alarm panel. This cable shall be provided with a factory installed EQD half to connect to the mating EQD half on the core.

.3 The Contractor shall be responsible for handling ground water to provide a firm, dry subgrade for the structure, and shall guard against flotation or other damage resulting from general water or flooding.

.4 The grinder pump station shall not be set into the excavation until the installation procedures and excavation have been approved by the Contract Administrator.

.5 Installation shall be accomplished so that 25 mm to 100 mm of accessway, below the bottom of the lid, extends above the finished grade line. The finished grade shall slope away from the unit. The diameter of the excavated hole must be large enough to allow for the concrete anchor.

.6 A 150 mm (minimum) layer of naturally rounded aggregate, clean and free flowing, with particle size of not less than 3 mm or more than 20 mm shall be used as bedding material under each unit.

.7 A concrete anti-flotation collar, and sized according to the Manufacturer's instructions, shall be required and shall be pre-cast to the grinder pump or poured in place. Each grinder pump station with its pre-cast anti-flotation collar shall have a minimum of three (3) lifting eyes for loading and unloading purposes.

.8 If the concrete is poured in place, the unit shall be levelled, and filled with water, to the bottom of the inlet, to help prevent the unit from shifting while the concrete is being poured. The concrete must be manually vibrated to ensure there are no voids. If it is necessary to pour the concrete to a level higher than the inlet piping, a 200 mm sleeve is required over the inlet prior to the concrete being poured.

.9 Make connections to existing piping and tank as shown on the drawings.

3.4 Backfill Requirements:

.1 Backfill to 200 mm above the highest pipe connection with sand confirming to CW2030.

.2 Backfill the remaining excavation with Class 2 backfill as specified in CW2030.

.3 All restoration shall be the responsibility of the Contractor. The site shall be restored to its original condition, in all respects, including, but not limited to, curb and sidewalk replacement, landscaping, top soiling and seeding, and restoration of traveling ways, as directed by the Contractor Administrator.

3.5 Start-up and Field Testing:

.1 The Manufacturer shall provide the services of qualified factory trained technician(s) who shall inspect the placement and wiring of each station, perform field tests as specified herein, and instruct the City's personnel in the operation and maintenance of the equipment before the stations are accepted by the City.

.2 All equipment and materials necessary to perform testing shall be the responsibility of the Contractor.

.3 The services of a trained factory-authorized technician shall be provided at a rate of 2 days. Each day shall be ten (10) person hours in duration.

.4 Upon completion of the installation, the authorized factory technicians will perform the following test on each station:

.1 Make certain the discharge shut-off valve is fully open. Turn ON the alarm power circuit.

.2 Fill the wet well with water to a depth sufficient to verify the high level alarm is operating. Shut off water.

.3 Turn ON pump power circuit. Initiate pump operation to verify automatic "on/off" controls are operative. Pump should immediately turn ON. Within one (1) minute alarm light will turn OFF. Within three (3) minutes the pump will turn OFF.

.5 Upon completion of the start-up and testing, the manufacturer shall submit to the Contract Administrator the start-up authorization form describing the results of the tests performed for each Grinder Pump Station. Final acceptance of the system will not occur until authorization forms have been received for each pump station installed and any installation deficiencies corrected.

3.6 Field Finishing

.1 No field coating is allowed. Only field touch-up in accordance with the Manufacturer's recommendation is permitted.

3.7 Field Quality Control by Contractor

.1 Functional Tests: Conduct on each pump.

.1 Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.

.2 Vibration Test:

.1 Test with units installed and in normal operation, and discharging to the connected piping systems at rates between the low discharge head and high discharge head

conditions specified, and with the actual building structures and foundations provided shall not develop at any frequency or in any plane, peak-to-peak vibration amplitudes in excess of 0.1 mm or velocities in excess of 3 mm/sec.

.2 If units exhibit vibration in excess of the limits specified adjust or modify as necessary. Units that cannot be adjusted or modified to conform as specified shall be replaced.

.3 Flow Output: Measured by local instrumentation and storage volumes.

.4 Operating Temperatures: Monitor bearing areas on pump and motor for abnormally high temperatures.

.2 Performance Test: In accordance with HIS and/or more stringent requirements as described herein for operating conditions indicated in supplemental equipment data sheets.

3.8 Manufacturer's Representative Field Services

.1 Verify satisfactory delivery of the equipment by completing Form 100, illustrated in Section 01650 – Equipment Installation.

.2 Instruct Contractor in the methods and precautions to be followed in the installation of the equipment. Certify the Contractor's understanding by completing Form 101, illustrated in Section 01650 – Equipment Installation.

.3 Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the Manufacturer's recommended procedures.

.4 The minimum periods of Site attendance are identified in the following table along with the form to be completed on each of these trips.

.5 The total number of trips will depend on the Contractor's schedule. The cost of additional trips, to be determined by the Contract Administrator, will be borne by the Contractor. Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the Manufacturer's recommended procedures.

Item	Description	Total number of business days	Form
1	Equipment Delivery	As requested by Contractor	100
2	Installation Assistance	As requested by Contractor	101
3	Witnessing of Equipment Installation	1	102
4	Assistance in Equipment Performance Testing	1	103

3.9 Installation Witnessing

.1 The Contractor shall ensure that equipment is installed plumb, square, and true within tolerances specified by the Manufacturer's Representative and as indicated in the Contract Documents.

.2 The Manufacturer's Representative shall ensure the equipment is installed as required to provide satisfactory service.

.3 The Manufacturer's Representative and the Contractor are to cooperate to fulfill the requirements for a successful installation as documented by Form 102, illustrated in Section 01650 – Equipment Installation.

3.10 Equipment Performance Testing

.1 The Manufacturer's Representative shall ensure that each pump, including all component parts, operates as intended.

.2 The Manufacturer's Representative shall demonstrate satisfaction of requirements specified herein.

.3 The Manufacturer's Representative and the Contractor are to cooperate to fulfill the requirements for successful testing of the equipment as documented by Form 103, illustrated in Section 01650 – Equipment Installation.

3.11 Supplements

.1 Data Sheets:

.1 Sanitary Pumps: P-H540A, P-H541A.

SUPPLEMENT 1 – DEWATERING PUMPS

PARAMETER	VALUE
Tag No. (s)	P-H540A, P-H541A
Design Point Flow Capacity (L/sec)	1.0
Design Point TDH (m) (excludes losses internal to pump)	16
NPSH Required (Head (m) at Design Flow)	N/A
Flow Operating Range (cubic metres/day)	N/A
TDH Operating Range (m)	N/A
Fluid Temperature Operating Range (◦C)	0.5-25
Solids Concentration Operating Range (%)	N/A
Driver Maximum (kW)	1.5
Driver Voltage (V/phase/frequency)	575/1/60
Motor Suitable for VFD	N/A
Minimum Pump Efficiency at Design Point (%)	60
Acceptable Manufacturers	E-one
Design Standard	Model 2016-180 Package

N/A – not applicable.

END OF SECTION