SECTION 6

SANITARY LIFT STATIONS

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6.1 General

This section pertains to the requirement for sanitary lift stations constructed as part of a private development. The City shall review and approve the use of any lift station. The Owner must show that it is not physically possible or economically feasible to provide gravity service into a public sewer.

All stations shall be designed for and operate on three (3) phase power. All stations shall be submersible type, including a minimum of two (2) pumps with a minimum capacity of one hundred (100) GPM and a minimum four (4) inch force main. Voltage shall be two hundred eight (208) or two hundred forty (240), three (3) phase.

6.2 General Requirements

A. All of the mechanical and electrical equipment shall be an integral package supplied by the pump manufacturer with local representation so as to provide undivided responsibility. The package shall be furnished by Flygt Pump or approved equal.

B. The Contractor shall submit to the City for review and approval two (2) sets of shop drawings, detailed specifications, pump warranty and performance characteristics for all of the equipment and fixtures to be furnished and installed. The shop drawings and equipment data shall be submitted with a cover letter or Contractor's stamp of approval, indicating that he has reviewed, checked and approved the data submitted. The City and City Engineer will review the submittal and render a decision in writing as to the acceptability of the equipment.

C. Design plans for sanitary lift station shall include aesthetic details of all components, to be approved by the City on a case by case basis. Lift stations and associated appurtenances, such as control centers, must blend with the surrounding environment such that eyesore they don’t become an eyesore.

D. Any exceptions to this Standard or associated approved Plans shall be submitted in writing and clearly stated. The exceptions must be approved by the City Engineer and the City prior to proceeding with the work.

E. All components of the lift station that are exposed to weather shall be constructed of material that is resistant to corrosion and will not require surface protection throughout the expected life of the lift station. In general, these materials are stainless steel, aluminum, fiberglass reinforced polyester (FRP) and ultraviolet stabilized PVC.

F. All valves and piping coming in contact with sewage or installed in the pump or valve chambers shall be coated as follows:

1. Primer - Aromatic Urethane Zinc-Rich 2.5 - 3.5 mil

2. Field Coats - Aliphatic Acrylic Polyurethane 2 coats @ 2.0 - 4.0 mil per coat

6.3 Operating Conditions

Prior to installation the Contractor shall submit the following information for each pump to the City for review and approval:

A. Pump Capacity in Gallons Per Minute;

B. Total Dynamic Head (TDH) and Operating RPM;

C. Motor Horsepower;

D. Motor RPM;

E. Motor Voltage, Phase and Cycle;

F. Make and Model Number; and

G. Pump Curves for the Pumps to be Provided.

6.4 Pump Design

A. Pump Construction

Major pump components shall be of gray cast iron, ASTM A 48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. The lifting handle shall be of stainless steel. All exposed nuts or bolts shall be AISI Type 316 stainless steel or brass construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.

Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

B. Cooling System

Motors shall be sufficiently cooled by the surrounding environment or pumped media. A water-cooling jacket is not required.

C. Cable Entry Seal

The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

D. Motor

The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air or oil filled, watertight chamber, NEMA B type. The stator windings and stator leads shall be insulated with moisture resistant Class H insulation rated for 365°F (180°C). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least ninety-five (95) percent. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 104°F (40°C) and capable of no less than thirty (30) evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 260°F (125°C) shall be embedded in the stator end coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber containing the terminal board, shall be hermetically sealed from the motor by an elastomer compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanent affixed to a terminal board. Wire nuts or crimping type connection devices are not acceptable. The motor and pump shall be designed and assembled by the same manufacturer.

All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 125°C (260°F) the thermal switches shall open, stop the motor and activate an alarm.

The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus ten (10) percent. The motor shall be designed for operation up to 104°F (40°C) ambient and with a temperature rise not to exceed 176°F (80°C). A performance chart shall be provided showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on

starting and no-load characteristics.

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be chloroprene rubber. The motor and cable shall be capable of continuous submergence under water without loss of watertight integrity to a depth of sixty-five (65) feet.

The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

E. Bearings

The pump shaft shall rotate on two (2) bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two (2) row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.

F. Mechanical Seal

Each pump shall be provided with a tandem mechanical shaft seal system consisting of two (2) totally independent seal assemblies. The seals shall operate in an oil reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the oil chamber, shall contain one stationary and one positively driven rotating tungsten-carbide ring. The upper, secondary seal unit, located between the oil chamber and the motor housing, shall contain one stationary tungsten-carbide ring and one positively driven rotating carbon seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable.

The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. Cartridge type systems will not be acceptable. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

Each pump shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall be designed to prevent overfilling and to provide oil expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.

Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral

concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action. Seal lubricant shall be FDA approved, non-toxic, and non-hazardous.

G. Pump Shaft

Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be stainless steel – ASTM A479 S43100-T.

If a shaft material of lower quality than stainless steel – ASTM A479 S43100-T is used, a shaft sleeve of stainless steel – ASTM A479 S43100-T shall be used to protect the shaft material. However, shaft sleeves only protect the shaft around the lower mechanical seal. No protection is provided in the lubricant housing and above. Therefore, the use of stainless-steel sleeves shall not be considered equal to stainless steel shafts.

H. Impeller

The impeller(s) shall be of Hard-Iron TM (ASTM A-532 (Alloy III A) 25% chrome cast iron), semi-open, multi-vane, back-swept, non-clog design. The impeller vane leading edges shall be mechanically self-cleaned upon each rotation as they pass across a spiral groove located on a replaceable insert ring. The impeller shall have vanes hardened to RC 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of sludge and rag-laden wastewater.

The impeller shall be capable of momentarily moving axially upwards a distance of 15mm/0.6-in. to allow larger debris to pass through and immediately return to normal operating position.

I. Wear Rings

A wear ring system shall be used to provide efficient sealing between the volute and suction inlet of the impellers. Each pump shall be equipped with a brass, or nitrile rubber coated steel ring insert that is drive fitted to the volute inlet.

J. Volute

Pump volute(s) shall be single-piece grey cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be four (4) inches. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged grooves. The spiral grooves shall provide trash release pathways and sharp edges across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of Hard-Iron TM (ASTM A-532 (Alloy III A) 25% chrome cast iron) and provide effective sealing between the multi-vane semi-open impeller and the

volute housing.

K. Mixed Flush Valve

All pumps shall be capable of having a mixed flush valve installed on the pump volute. The mixed flush valve shall open when pumping starts allowing water from the pump to be forced through the valve as a powerful jet-flushing stream. After flushing for approximately thirty (30) seconds, the valve shall close, and the pump shall empty the station to the preset stop level. When required by the City, the mixed flush valve shall be installed upon the pump chosen by the Owner. The mixed flush valve shall be a Flygt Flush Valve 4901, or equal.

L. Rail/Removal System

The pump mounting base shall include adjustable guide rail supports and a discharge connection with a one hundred twenty-five (125) pound standard flange. The base and the discharge piping shall be permanently mounted in place. The base plates shall be anchored in place utilizing epoxy type anchors with stainless steel studs and nuts as manufactured by HILTI Fasteners, Inc. or equal.

A rail system shall be provided for easy removal of the pump and motor assembly for inspection and service. The system shall not require a man to enter the wet well to remove the pump and motor assembly. Two (2) rails of two (2) inch stainless steel pipe shall be provided for each pump. The guide rails shall be positioned and supported by the pump mounting base. The guide rails shall be aligned vertically and supported at the top by attachment to the access hatch frame. One (1) intermediate guide rail support is required for each fifteen (15) feet of guide rail length.

The pumps shall be equipped with sliding brackets or rail guides. To ensure easy removal of the pumps, the rail guides attached to each pump shall not encircle the rails. A stainless-steel lifting chain or manufacturer's pump removal system (similar to the Flygt Lift) of adequate length for the basin depth shall be provided for each pump. Each pump shall be equipped with a permanent, stationary lifting handle with a minimum clearance of twelve (12) inch between the top of pump and bottom of handle.

The rails and the rail guides shall function to allow the complete weight of the pumping unit to be lifted on dead center without binding and stressing the pump housing. The rail system shall function to automatically align the pumping unit to the discharge connection by a simple downward movement of the pump. No twisting or angle approach will be considered acceptable. The actual sealing of the discharge interface may be of the hydraulically sealing diaphragm type assembly with removable Buna-N diaphragm as supplied by Hydromatic Pump or may be of the metal-to-metal contact as provided by Flygt Pump.

M. Pump Warranty

Pump warranty shall be provided by the pump manufacturer and shall warrant the units being supplied to the Owner against defects in workmanship and materials for a period of five (5) years under normal use, operation, and service. The warranty shall be in printed form and apply to all similar units. A copy of the warranty statement shall be submitted with the approval drawings.

6.5 Protection

All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 260°F (125°C) the thermal switches shall open, stop the motor and activate an alarm.

A leakage sensor shall be provided to protect water in the stator chamber. The Float Leakage Sensor (FLS) shall be a small float switch to detect the presence of water in the stator chamber. When activated, the FLS shall stop the motor and send an alarm. **USE OF VOLTAGE SENSITIVE SOLID-STATE SENSORS AND TRIP TEMPERATURE ABOVE 260°F (125°C) SHALL NOT BE ALLOWED.**

The thermal switches and FLS shall be connected to a Mini CAS (Control and Status) monitoring unit. The Mini CAS shall be designed to be mounted in any control panel.

6.6 Wet Well and Valve Pit

A. General

The walls of the pump station and valve pit structures shall be constructed of reinforced concrete pipe which shall conform to the latest ASTM Specifications C-76, with a minimum compressive strength of concrete equal to four thousand (4000) psi. Reinforcement of the pipes shall be of the circular type. All of the pipe for the pump chambers and the access tubes shall be Class III and of the diameter shown on the Plans. Handling or lifting lugs and/or devices shall be provided in the pipe shells for ease of unloading and setting in place. All joints between pipes and between ends of pipes and concrete slabs shall be made watertight.

The pipes utilized for the pump station wet well or valve pit shall be jointed with a rubber O-ring type seal conforming to the ASTM Standard C-443 (latest revision). The joint shall be designed to provide a maximum infiltration/exfiltration limit of .158 gallons (200 gpd/in-mile). The interior and exterior joint spaces shall be grouted to a smooth surface using a sand-cement mixture mortar. The mortar-grout shall have one (1) part cement to two (2) parts sand mix ratio. The completed interior and exterior joints shall have a smooth troweled waterproof finish.

The top concrete slab of the pump station and valve pit shall have cast into it a socket for receiving the end of each concrete pipe. The joint shall be made watertight. An access ladder shall be provided with rungs spaced twelve (12) inches on center from top to bottom of the station and shall be of welded steel

construction, and hot-dipped galvanized after fabrication or aluminum. The vent shall be a four (4) inch PVC air vent with corrosion proof insect screen. In the valve vault the integral floor drain shall have a two (2) inch drainpipe and slope to the wet well with duckbill check valve.

Concrete for the foundation and roof slabs shall be made of Class A concrete. See Figure S-11 for additional details.

B. Access Hatches

The Contractor shall furnish and install for both the wet well and valve pit aluminum access doors complete with frames, hinged and hasp-equipped covers, upper guide holders, drain hole and cable holder. The frames shall be securely mounted above the pumps. The doors shall be torsion bar loaded for ease of lifting and shall have safety locking handles in the open position. The access doors shall be capable of withstanding a three hundred (300) pound live load per square foot. The lift station wet wells are to be provided with two (2) separate access hatches or a two (2) door hatch. The valve pit access hatches are to be single door type.

C. Pipe, Valves and Fittings

The suction and discharge pipe and fittings shall be ductile and cast-iron Class 150. Inside pipe and fittings shall be flanged. Bell end pipes or fittings with mechanical joints shall be provided at or near the outside face of the station well. Piping shall be supported independent of the sewage flanges. All inside plug valves shall be provided with handwheels. All check valves shall be rubber flapper type.

All metal piping other than cast or ductile iron and copper tubing shall be galvanized steel pipe.

6.7 Disconnect Switch

A. A single main fusible or breaker disconnect switch of adequate size to provide power for the "control center" and its related components shall be provided by the Contractor.

B. The disconnect switch shall be housed in a NEMA 4X stainless steel enclosure with an external operation handle capable of being locked in the ON position.

6.8 Control Center

A. The control center shall be built in a NEMA 4X stainless steel enclosure and shall be suitable for the specified horsepower and voltage for the pumping equipment. The outer door of the panel shall be hinged dead front with provisions for locking with a padlock. Inside shall be a separate hinged panel to protect all electrical components. H-O-A switches, run lights, circuit breakers, etc. shall be mounted such that only the faces protrude through the inside swing panel and no wiring is connected to the back side of the inside swing panel.

B. A circuit breaker and magnetic starter with three (3) leg overload protection and manual reset shall be provided for each pump. Starters shall have auxiliary contacts to operate both pumps on override condition. A separate circuit breaker shall be supplied for power to the control circuit. The control center shall include an extra circuit breaker of adequate size to provide one hundred fifteen (115) volt, single (1) phase power for a future remote monitor panel. The control center shall include a control voltage transformer to reduce supply voltage to one hundred fifteen (115) volt, single (1) phase to be used for all control functions except the level circuit and associated relays which shall be provided with twenty-four (24) volt control voltage. An alternating relay shall be provided to alternate pumps on each successive cycle of operation. A green run light and H-O-A switch shall be provided for each pump. A terminal strip shall be provided to make field connections of pump power leads, float switches, seal sensor leads, heat sensor leads, and remote monitor panel interconnections.

C. A time delay relay shall be provided to delay start of second pump should power outage occur.

D. The control system shall incorporate the level monitoring system.

E. The control center shall incorporate connections for heat sensors which are installed in the pumps. The connection shall disconnect the starter upon high temperature signal and will automatically reconnect when condition has been corrected.

F. The control center shall incorporate connections for seal failure sensors which are installed in the pumps. The panel will have a seal failure alarm light for each pump. This alarm indicates failure of the lower mechanical seal in the pump. This will be an alarm light only and will not shut down the pump.

G. The control center shall include an hour meter for each pump to register the elapsed operating time of each pump.

H. The control center shall have a high and low water alarm built into the main enclosure. The alarms shall consist of a flashing alarm light with red Lexan plastic cover or red glass globe with metal guard mounted on top of the enclosure such that it is visible from all directions. An alarm horn shall be mounted on the side of the enclosure. A push to test horn and light button as well as a push to silence horn button shall be provided and mounted on the side of the enclosure.

I. The control center shall include a condensate heater to protect against condensation inside the enclosure. The heater shall be placed so as not to damage any other component or wiring in the control center.

J. The control center shall include lightning protection and a phase monitor relay to shut down the control circuit and protect the equipment due to loss of phase or phase reversal. The three-phase sequence voltage relay shall be of the eight (8) pin connector type.

K. The control center shall incorporate an alternator selector switch to allow selection of automatic alternation or manual selection of the lead pump.

L. The control center shall include a GFI convenience outlet with twenty (20) amp breaker and suitable transformer or power supply to provide one hundred ten (110) volt single (1) phase power to the convenience outlet.

M. The control center shall have an exterior, lockable one hundred twenty (120) volt , twenty (20) amp, waterproof, receptacle for use with a City furnished portable mixer. Receptacle cover shall have a slot or opening to "lock" plug into receptacle.

N. The control center shall be suitable for connection to a remote monitor package. The main control must include the following interconnections:

1. Circuit breaker to power remote monitor panel.

2. Relay contacts to signal high and low water alarms.

3. Relay contact to signal tripping of the overload of any of the pumps.

4. Relay contact to transmit signal of seal failure or heat sensor trip of any of the pumps.

O. A minimum four (4) inch PVC Schedule 40 wall conduit shall be provided from the wet well basin to the control center which will allow the pump power cables, sensor cables and level monitoring cables to be pulled through without difficulty and allow the use of one (1) piece cables from the pumps and level system to the control center. The conduit shall be sealed at the control center to avoid entrance of sewer gases into the control panel.

P. The control center and associated components shall be mounted on a non-maintenance type pedestal or mounting stand constructed of aluminum or pressure treated wood. The control center shall be located so as to provide safe access to the panel while wet well hatch doors are opened and shall be positioned so as not to be between the access drive and the wet well.

Q. All components of the control center shall be available from local sources. In particular, items such as circuit breakers, overload protection, relays, etc. shall be available and in stock by local sources.

R. In order to maintain unit responsibility and warranty on the pumping equipment and control center, the control center must be furnished by the pump manufacturer as suitable for operation with the pumping equipment.

S. The City may require in specific cases, that a Series 500 Stow-Away panel be furnished and installed.

6.9 Level Monitoring System

A. Components

The wet well level shall be monitored by either:

1. Flexible bulb electrode type level controller by Warrick, or equal.
2. Electrode probe and controller by Multi Trode Model MTIPC 2.2, or equal.

A back-up high level mercury type float switch shall be provided for high level alarm.

B. System Operation

On sump level rise, the lower level one (1) shall first be energized, then the upper level 2 shall next energize and start the lead pump. With the lead pump operating, sump level shall lower to lowest switch and turn off the pump. The alternating relay in the control center shall index on stopping of the pump so that the lag pump will start on the next operation. If sump level continues to rise when lead pump is operating, the level three (3) shall energize and start the lag pump.

Both lead and lag pumps shall operate together until low level turns off both pumps. If level continues to rise when both pumps are operating, alarm level 4 shall energize and signal the alarm. If one pump should fail for any reason, the second pump shall operate on the override switch. All levels shall be adjustable for level setting from the control panel.

6.10 Remote Monitoring Panel

The Developer Contractor shall install one (1) remote monitoring telemetry panel to monitor the alarms listed in paragraph 6.08 "Control Center". The Contractor shall be responsible to install all power and control wiring between the pump control center and the remote monitoring panel. This panel shall be like to the City's existing panels, furnished by the City, and the Owner Contractor shall reimburse the City based on direct costs.

6.11 Operation and Maintenance Manuals

A. Two (2) operation and maintenance manuals shall be submitted to the City.

B. Manuals shall include, at a minimum:

1. Operation Instructions
2. Maintenance Instructions
3. Recommended Spare Parts List
4. Lubrication Schedules
5. Structural Diagrams

6. As-Built Wiring Diagrams

7. Bill of Materials

6.12 Spare Parts

A. The Contractor shall supply one set of spare parts for each station, including at a minimum the following:

1. Wear Rings

2. O-Rings and Gaskets (two [2] sets)

6.13 Design Requirements

A. Sizing of Wet Basin

1. The wet well storage below the lowest inlet shall be a minimum of five (5) feet and shall also meet the following criteria:

a. OFF level to be set at the pump manufacturer's recommended level but no less than one (1) foot from the bottom of the wet well.

b. The distance between the OFF level and the lead pump ON level shall be set to provide storage capacity equal to:

$$\frac{15 \times \text{Rated Pump GPM}}{4}$$

(i.e. 15-minute cycle minimum)

c. The lag pump ON level shall be set a minimum of six (6) inches above the lead pump ON level and a minimum of six (6) inches below the lowest inlet invert.

d. The high-water alarm float shall be set a minimum of six (6) inches above the lag pump ON level and a minimum of six (6) inches below the lowest inlet invert.

e. All levels shall be set below the lowest inlet invert.

B. Station Warranty

Station warranty shall be two (2) years from the date of acceptance per City maintenance bond requirements.

6.14 Residential Grinder Stations

A. General

Small diameter pressure sewer systems incorporating the use of individual home grinder pump units will be allowed on a case-by-case basis subject to the written approval of the City and the Indiana Department of Environmental Management

(IDEM). In general, these systems shall only be considered in areas where the surrounding areas are currently served by sanitary sewers and the site cannot be serviced by gravity sewers.

The maintenance of the grinder pump station and force main, from the grinder station to to the discharge location, shall be the responsibility of the homeowner. Grider pump station force mains must discharge to the nearest sanitary manhole. The City shall only be responsible for the maintenance of the sewer main.