

CHAPTER 10 SEWER PUMP STATIONS AND APPURTENANCES

10.1 **SCOPE**

This section is provided for the purpose of outlining items required in lift stations but is not intended to cover all special conditions or the ENGINEER'S special requirements.

10.2 **DESIGN CONSIDERATIONS**

A. General

1. The ENGINEER shall submit the following design considerations:
 - a) Loading calculations indicating pump station service area and build-out flows.
 - b) System hydraulic analysis with system curve for recommended pump.
 - c) Flotation calculation (weight of station without pumps vs. uplift).
 - d) Cycle time calculation shall provide for a maximum five (5) cycles/hour and a minimum run time of 1 minute at zero inflow.
 - e) Motor and control circuit shall be rated for 10 cycles/hour.
 - f) Calculations showing that system at full build-out shall have capacity for 24 hours hold time.
 - g) Control panel bottom shall be 6" above the 25 year flood elevation calculated at the pump station site.
2. Pump Station Classification

All pump stations shall be monitored. The extent of monitoring required will be determined by the discharge capacity of the pump station, and the designation will be assigned by BJWSA. See Chapter 12 for SCADA requirement for each classification. The pump station classifications are generally:

- a) Local Station: flows from gravity and discharges into a gravity system.
- b) Master Station: receives flow from other pump stations.
- c) Regional Station: discharges directly to a waster water treatment plant or is on a common force main.
3. Site Requirements
 - a) Site size: Minimum site dimensions shall be as follows:
 - i) 6' and 8' diameter wetwells - 40 feet by 40 feet.
 - ii) 10' diameter wetwells minimum of 50 feet by 50 feet.
 - iii) Stations with wetwells larger than 10' shall have sites proportionally larger. Actual sized will be determined on a case by case basis.
 - b) Yard hydrant, water meter, and sampling station shall be installed at each pump station. Yard hydrants are to have locking capability and have an approved vacuum breaker installed on outlet. Contractor shall install meter furnished by BJWSA. Yard hydrant is to be installed adjacent to wetwell.
4. Vehicular Access to Pump Station
 - a) Provide road access to pump station sufficient for a tandem axle truck with 250" wheel base.
 - b) Provide circular access or turn around area sufficient for delivery and removal of portable trailer-mounted generator, vacuum truck or 18-wheeler.

- c) All turning radii should be set at 60'.
- d) Site shall be serviced by an all weather road with top of site a minimum of 6" above adjacent paved road.

5. Design and Construction considerations:

- a) Wetwell (this section applies to submersible and above ground)
 - i) Concrete shall meet the requirements as specified in Chapter 9. Interior surface of the wet well and exterior of discharge piping shall be coated with hydrogen sulfide resistant coating. Refer to Interior Protective Coatings of Chapter 9.
 - ii) Bottom slab of the wet well shall be set on a minimum of 12" base made of crushed stone. All over-excavated area below the wet well bottom shall be filled with crushed stone or flowable fill as directed by the ENGINEER.
 - iii) Wet well bottom shall be constructed to provide a hopper or fillet bottom. Concrete bricks may be used as filler to form hopper bottom provided minimum of 6" grout cover over bricks is maintained.
 - iv) Top of wetwell shall be one foot (1') above adjacent paved road or surrounding grade. A Registered Land Surveyor shall confirm the difference and stamp the elevation on a 2" diameter Standard Brass Benchmark embedded into the wetwell top. Pump station site is to be higher than final grade within adjacent 10' of the pump station. Drainage across the pump station is not allowed.
 - v) Wet well hatches shall be of heavy gauge aluminum with aluminum or 316 stainless steel support bracing, accessories. Minimum clear opening size shall be 32" by 48" single door style. All hatches shall be equipped with a hinged safety grate. Refer to Chapter 13 for a list of approved manufacturers.
 - vi) Flush vent shall be a 4.75" square opening framed with 1/4"x1"x 1" angle and covered by 1"x 1" x 1" aluminum grating 6" square.
 - vii) Wet well level sensor hangers shall be hung on the edge of the safety grate hatch away from inlet piping and shall be supplied in accordance with the approved manufacturers in Chapter 13.
 - viii) All bolts, nuts, anchors, washers, and other hardware utilized in the wet well shall be 316 stainless steel.
- b) Influent pipe shall extend a minimum of 2" and a maximum of 3" inside the basin.
- c) The bypass suction leg (4" PVC) shall terminate in a MJ 90 anchored in fillet. It shall extend up through Wetwell top. The bypass piping shall turn 90 degrees and terminate with a male quick disconnect fitting with cap just under discharge piping.
- d) All piping in wet well shall be coated with hydrogen sulfide resistant coating. Refer to: Interior Protective Coatings of Chapter 9.
- e) Pump station location shall be optimized for both elevation and power supply.

6. Piping and Fittings

- a) Piping within wet well shall be flanged.
- b) All valves shall be resilient seat, plug type, and open left (counter-clockwise). Valves located above ground shall be hand-wheel operated.
- c) Discharge riser piping shall be C900 SDR 18
- d) Above ground pipes shall be supported with a 304 SS or HD Galvanized adjustable

pipe support. The Support base shall have screw adjustment range of not less than 12 inches, and 4 bolt holes with minimum diameter of 9/16 inches, and the saddle shall match the curvature of the pipe to be supported.

- e) The pump discharge shall be equipped with a pressure gauge plug in assembly:
 - i) All components are to be Stainless Steel
 - ii) Piping to owner gauge shall be 2" x 1" tee, 1" x 1" nipple, 1" ball valve, 1" make NPT Universal coupling, and Universal blank with securing nylon lanyard attached to piping. Universal coupling must be resistant to corrosion by sewer gasses (brass, SS, and HDG are acceptable)
- f) All above ground piping shall be coated with a minimum of three coats of Tnemec epoxy paint. The topcoat shall be color "Hunter Green". Total system minimum dry film thickness of 16 mils is to be achieved. Piping surface shall be prepared, primed, intermediate coated, and topcoated per manufacturer's instructions. See Chapter 13 for approved epoxy coatings.

B. Submersible Pump Station Site Requirements

- 1. All design considerations from 10.2.A apply to this section.
- 2. Site Requirements
 - a) A night area light and alarm light shall be installed a minimum of 12-FT above finished grade and mounted on a timber light pole treated to 2.5-LB CCA. Yard light shall be 120V 500W Quartz or Halogen floodlight pointed at the control panel. Light shall be controlled by a switch mounted in control panel, not the circuit breaker.
 - b) The motor control center shall be located outside and facing toward the wet well with an adequate distance from the wet well to avoid accidental fall.
 - c) Fencing of Lift Station Site is required.
 - i) Area to be fenced shall start 1.5' inside property line.
 - ii) Fence Materials
 - 1. All material shall be Class I Hot-dipped Galvanized Coated. Vinyl coated fencing may be installed for aesthetic purposes.
 - 2. Fabric shall be six (6) feet high, ends barbed, commercial grade nine (9) gauge, two inch (2") mesh installed between 1" and 3" above finished grade.
 - 3. End, corner, and pull post shall be 3" OD Schedule 40 steel pipe. Provide water tight closure caps on all posts.
 - 4. Line posts shall be 2-1/2" OD Schedule 40 steel pipe. Provide water tight closure caps on all post. Top posts shall be 1-5/8" OD Schedule 40 steel pipe.
 - 5. Bottom tension wire shall be 7-gauge spring coil wire.
 - 6. Gatepost shall be 3" OD Schedule 40 steel pipe. Provide water tight closure caps on all post.
 - 7. Gate shall be a pair of 8'-0" long (16' total width) 6 feet high sections constructed of 2 inch OD pipe. Gate shall be equipped with a prop post center latch and hasp assembly. A ground anchor cast in concrete shall be provided. Gates shall be factory fabricated, coated, and equipped with gate holders. Duckbill backstops shall be provided for swing side of both gate sections.

3. Design and Construction Considerations

a) Wet well Appurtenances

- i) Guide rails shall be 316 stainless steel. Guide rails shall be compatible with ABS guide rail system. All of the metal parts associated with the wetwell shall be 316 stainless steel, including guide rail top brackets and intermediate guide rail brackets. **No splices or welds are allowed in guide rails.**
- ii) Pump manufacturer shall specify minimum opening size required for wetwell hatch. Engineer is to size hatch opening 2" greater than required by manufacturer on each side. Larger size hatches shall be specified to support larger pumps, if an up grade is probable. All hatch support bracing should incorporate a self-locking hinge mechanism to lock in the open position. All hatches shall have a pad-lockable recessed locking mechanism.
- iii) Stainless Steel (316) support grips shall be provided on power cables for pumps 10 HP and larger.

4. Other Requirements

- a) The entire site shall be covered with MIRAFIX 600X filter fabric covered with 4" of crusher run stone, and 2" of #57 stone. Stone shall be clean with no soil or foreign material present.
- b) Fenced area of site is to be at an elevation not more than 2" below wetwell top.
- c) Site drainage shall be approved by BJWSA.
- d) A receiving manhole must be located in the fenced area of each pump station for by-pass pumping.

C. Above Ground Pump Station Site Requirements

1. All design considerations from 10.2.A apply to this section.
2. 6'x6' Above Ground Pump Stations

a) Enclosure Requirements

- i) Access panels must be on all sides of enclosure.
- ii) A vent in one access panel shall allow free air-flow for enclosure ventilation.
- iii) The complete station enclosure, less base, must be completely removable after disengaging reusable hardware.
- iv) Disassemble and removal of the enclosure shall take less than 15 minutes and no more than two people working without assistance of lifting equipment.
- v) A blower mounted in the station roof shall be sized to exchange station air volume at least once every two minutes.
- vi) Pump Station shall be provided with a 1300/1500 watt, 115 volt electric heater with cord and grounding plug.
- vii) Pump Station shall be provided with a 250/500 watt, 115 volt AC quartz halogen hand lamp with 12 feet of cord and grounding plug. Hand lamp shall be constructed of corrosion resistant materials and shall be equipped with a guard and an adjustable stand.

b) Other Requirements

- i) Yard light shall be 120V 500W Quartz or Halogen floodlight pointed at the control panel. Light shall be controlled by a switch mounted in control panel, not the circuit breaker.

3. Custom Built or Prefabricated buildings larger than 6'x6'

- a) Access to Pump Station
 - i) Layout site to allow
 1. Access of boom truck to double doors or rollup door.
 2. Access by vacuum truck or tanker with 40' trailer to within 15' of wetwell hatch.
 - ii) Pump Station enclosure is to be accessible with truck to side of building with rollup door and side of building with swing door.
- b) Enclosure Requirements
 - i) Enclosure shall have a minimum R-13 insulation factor and shall be capable of withstanding 125 mph wind loads.
 - ii) The pitch of the roof shall be sufficient for good moisture drainage.
 - iii) Enclosure shall be provided with one 3'-0" wide x 6'-8" entrance door.
 - iv) Enclosure shall be provided with one 8' wide x 6'-8" high rolling service door.
 - v) Enclosure shall have floor sloped to a drain.
 - vi) Lighting inside enclosure shall provide a minimum of two (2) watts illumination per square foot in most dimly lit area.
 - vii) Enclosure shall be provided with two (2), duplex, GFCI receptacles, internal and external, mounted 48" above finished floor. External receptacle shall be located adjacent to WW hatch.
 - viii) Enclosure shall have a thermostatically controlled, 120 VAC, exhaust fan with screen and weatherproof shutters installed in the wall approximately opposite a fresh air intake vent. The fan shall have a minimum capacity of 1600 CFM at free air and be capable of changing the air in the enclosure a minimum of six times per hour.
 - ix) Enclosure shall be provided with high capacity electric blower type heater for protection of the internal equipment. The heater shall maintain an inside/outside differential temperature of 30 degrees F.
 - x) Enclosure shall have engine assembly and space for one additional pump and motor to be added in the future. This space shall be shown as "future" on plans.
- c) Other Requirements
 - i) Concrete bollards shall be placed around buried fuel tank and generator.
 - ii) A receiving manhole must be located within 15' of wetwell and within vehicle access area.
 - iii) Provide a flow meter with transmitter inside of building.
 - iv) Provide a pressure transmitter inside of building.
 - v) Provide an external light on all side of the enclosure.

10.3 PUMPS AND MOTORS

A. General

1. Pump and motor shall be shipped with non-wicking electrical power cable, over-heat cable, and seal-failure cable, factory installed and tested. Cut ends are to be factory sealed and tagged for shipping. Each pump shall have only one cable.
2. Pump station system design shall require the selected motor to operate within 10

percentage points of its maximum efficiency

3. Acceptable manufacturers for lift station pumps are shown in Chapter 13.
4. Pump motors shall have a five- (5) year written manufacturer's warranty.
5. Pumps station system shall be designed to handle peak flow with the largest pump out of service. Minimum design peaking factor shall be 2.5.
6. Pump and motor shall have a minimum of 400 series stainless steel shaft on motors under 10 HP. On motors over 10 HP, the shaft may be chrome-plated steel.
7. Impeller shall be keyed to shaft and shall be the single vane non-clogging design. The impeller shall be gray cast iron capable of passing a 3" sphere. Impellers shall **not** be trimmed to meet the design flow and TDH; they shall be dynamically balanced to the manufacturers design specification for the pump supplied.
8. Pump volute shall have replaceable stainless steel wear rings or plates.
9. Seals shall be tungsten carbide to silicon carbide or tungsten carbide.
10. B-10 bearing life shall be a minimum of 50,000 hours.
11. Pump housing shall be equipped with moisture detection probe and have moisture detection lamp mounted on the control panel. Moisture detection shall cause the motor to shut down and activate the ALARM light.
12. Motor shall be a minimum of 4.6 HP and shall be equipped with overheat sensors activating an overheat lamp mounted on the control panel. Overheat detection shall shut down the motor and activate the ALARM light.
 - a) Electrical
 - i) Motors shall be non-overloading over entire pumping range and have a 1.15 service factor.
 - ii) Motors shall have Class F (155 degree C) insulation and withstand Class B (130 degree C) temperature rise with a service factor of 1.0.
 - iii) Motors shall not exceed 1800 RPM.
 - iv) Unbalanced voltages on motors under load shall not exceed 3.0% when measured at the motor disconnect terminals. Voltage measurements shall be read with an accurate digital voltmeter; and readings shall be recorded as part of the final inspection. Systems will not be accepted until unbalance has been corrected.
 - v) Systems that are metered with a KVA meter supplied by the power company shall have power factor correction to 95%.
13. Stand-by pumping systems will be required for the following:
 - a) Pump stations that have Type III SCADA.
 - b) Pump stations that are located in environmentally vulnerable areas.
 - c) Systems that have less than 24 hours holding time.
14. Pumps rated at 25 HP and above shall require solid state reduced voltage starters. Starters shall be ASTAT CD Plus manufactured by General Electric.

B. Submersible

1. All design considerations from 10.3.A apply to this section
2. Pumps
 - a) Stainless Steel Lifting cables shall be adequately sized and be of a length to reach the tip of station plus an additional 2 feet. Cables end loops shall be formed by Flemish eye splice secured by SS swaged sleeve.

Minimum requirement and size is as follows:

- i) Cable, 3/16" SS
- ii) Chain, 18" – 1/4" SS
- iii) Shackle, 5/16" SS screw pin
- iv) Thimble SS, and Nicro press sleeve to fit Grip Eye System by ABS

3. Pumps shall mount on single stainless steel guide rail system compatible to ABS pumps.
4. Wetwell

Depth of wetwell shall be set to accommodate all conditions set forth in Chapter 10.2 and the following Level Control System parameters:

- a) ALARM (Low): Set at the higher of 12" below OFF and 8" above the minimum submergence recommended by pump manufacturer.
- b) OFF: Set no lower than the lifting eye of the pump.
- c) LEAD ON: Minimum elevation determined by minimum run time allowed and OFF.
- d) LAG ON: Provide a minimum of one-foot (1') above LEAD ON
- e) ALARM (High): Set one-foot (1') minimum above the LAG ON.
- f) INFLUENT PIPE: Set a minimum of six inches (6") above the ALARM (high).

C. Above Ground

1. All design considerations from 10.3.A apply to this section
2. Pumps
 - a) Pumps shall be horizontal, self-priming sewage pumps, specifically designed for pumping raw, unscreened, domestic sanitary sewage.
3. Wet Well

Depth of wetwell shall be set to accommodate all conditions set forth in Chapter 10.2 and the following Level Control System parameters.

- a) ALARM (Low) Set at 2" above top of minimum cover required over suction pipe opening
- b) OFF: Minimum as specified by the pump manufacturer
- c) LEAD ON: Minimum as specified by the pump manufacturer
- d) LAG ON: 6" minimum above LEAD ON
- e) ALARM (High): Set one-foot (1') minimum above the LAG ON
- f) INFLUENT PIPE: Set a minimum of six inches (6") above the ALARM (high).

4. Drive Motors – Electric
 - a) General Description
 - i) Motor to be horizontal, totally enclosed, fan cooled (TEFC), induction type, with Class F insulation, normal starting torque and low starting current characteristics, NEMA Design B, 1.15 service factor.
 - ii) Motor shall not be overloaded at the design condition or at any head in the operating range as specified.
 - iii) Equip all motors intended for outdoor installation with 120-volt space heaters having leads terminating in the main terminal box.
 - iv) Provide motor in current NEMA design cast iron frame with copper windings,

and having a minimum efficiency rating of 90% and a minimum power factor rating of 85%.

- b) Drive transmission
 - i) Transmit power from motor to pump by means of V-belt drive assembly, using not less than 2 V-belts.
 - ii) Select drive assembly to establish proper pump speed to meet the specified pump operating conditions.

5. Auxiliary Drive Engine

- a) Provide standby engine, LP gas fueled with a continuous duty power rating suitable for the horsepower requirements of the pump.
- b) Furnish engine with integral water or forced air cooling system capable of maintaining safe engine operating temperature under the expected operating loads, and subject to the expected maximum ambient temperatures in the pump station enclosure.

D. Commercial Duplex Grinder Pump Station

- 1. Authorized Usage: If conditions arise where normal installation of the standard solids handling pump station cannot be implemented, the AUTHORITY'S Engineering Department will consider such installations. Commercial duplex grinder pumps stations will not be allowed if:
 - a) Loading on pump station is above 20 REU's.
 - b) Gravity can be extended to the property.
- 2. If approved, the following criteria shall be used:
 - a) Duplex station only, with full size 2" guide rails.
 - b) No motors smaller than 2 HP.
 - c) Motors 2 HP to 3 HP may be single phase conventional start.
 - d) Refer to Chapter 13 for approved manufacturers.
 - e) Separate box is required to house plug & check valves, pressure gauge, and unions as shown in Standard Detail Drawings. It must be sized to allow 12" working space between components and edge of box. Box shall be no more than 4' deep and drain the wet well. Access hatch opening shall weigh no more than 50#s and have a permanently attached lifting handle.
 - f) Wet well shall be pre-cast and designed as described in Chapter 9, Wet Well Design and Construction.
 - g) The Developer shall pay all fees and permits.
 - h) Control panel shall be as specified in Chapter 11.
 - i) Spare parts: Provide one- (1) additional grinder pumps with electrical cables for inventory.
- 3. Site Considerations: All site construction is to comply with Chapter 9 and design considerations are to comply with Chapter 10.

10.4 TESTING AND STARTUP

- A. Start up service shall be provided by the manufacturer's representative prior to acceptance of the pump station.
- B. Draw-down test shall be performed by the ENGINEER prior to final acceptance of the pump station. Specifications to include completion of pump station start-up procedures in

presence of an AUTHORITY representative and pump supplier.

- C. The ENGINEER shall provide a Certification that the work has been completed in accordance with approved plans, specifications, and good engineering practice. The CONTRACTOR shall provide a Certification that all material suppliers and Subcontractors have been paid and that no lien is in force against the work.
- D. CONTRACTOR shall supply a one (1) year written warranty on all work and material except pumps. Pumps shall be supplied with a five- (5) year manufacturer's warranty.

10.5 CLOSEOUT REQUIREMENTS

- A. CONTRACTOR shall furnish on or before final inspection each of the following:
 - 1. Deliver to designated BJWSA location:
 - a) For submersible stations: One (1) complete pump and motor.
 - b) For above ground stations
 - i) One (1) cover plate O-ring;
 - ii) One (1) rotating assembly;
 - iii) One (1) rotating assembly O-ring;
 - iv) One (1) mechanical seal;
 - v) One (1) set rotating assembly shims.
 - vi) Electrical spare parts listed in 10.5.A.3 below.
 - 2. The Contractor shall provide two (2) bound copies and one electronic copy of the following pump station documentation:
 - a) Pump Engineering Data Sheet
 - b) Certified Pump Curve – note a copy of this curve is also to be posted in the control panel
 - c) Pump Operation, Parts & Maintenance Manual
 - d) Operation & Maintenance sheet on each component (including but not limited to valves, check valves, air release valves, PLC, motor starters, breakers etc.) at pump station including detailed parts list.
 - e) Electrical one line diagram
 - f) Electronic schematics schematic.
 - g) Pump Station as-built drawings Plan & Profile
 - h) All certified test and inspection data.
 - i) A completed start-up report by the pump manufacturer.
 - 3. Electrical Spare Parts
 - a) One box (2 min) of fuses for each size that is in control panel.
 - b) One complete set of motor starter contactor kit.
 - c) One box (4 min) of spare bulbs of each size used in the control panel.
 - d) Motor starter coil.
 - e) One spare relay and timer for each type used.
 - f) One VFD or ASTAT if so equipped.

END OF SECTION