SANITARY SEWER PUMP STATION
REQUIREMENTS

2005

City of Oxford
Service Department
101 East High Street
Oxford, Ohio 45056
513-524-5206
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INTRODUCTION

This document has been developed to provide guidance to land developers, their consulting engineers, and contractors as to the requirements of the City of Oxford for design and technical specifications of sanitary sewer pump stations. These requirements are intended to supplement the requirements set forth by the Ohio Environmental Protection Agency (Ohio EPA) and in the following City of Oxford documents:

2. Sanitary Sewer Pump Station Policy
3. Pump Station Standard Drawings

There are several general requirements for all new and replacement sanitary sewer pump stations to be built in the City of Oxford. These include the following:

- All new and replacement sanitary sewer pump stations shall be fitted with submersible pumps.

- Typically, new pump stations will be duplex stations, where each of two pumps will be capable of meeting the station's design capacity. In some cases, larger capacity pump stations may be required, which shall be constructed with three or more pumps.

- Where possible, the requirements presented in this document have been developed to address both temporary and permanent installations; however, the City reserves the right to modify the requirements for individual projects as deemed necessary for the protection of public health and/or the environment.

- In general, ALL pump stations shall be considered to be permanent unless a project exists on the City of Oxford's 5-year Capital Improvements Plan that would eliminate the pump station or the Developer has specific plans for eliminating the pump station within approximately 5 years. However, each pump station will be reviewed at the inception of design by the Utility to determine whether the pump station will be considered permanent or temporary for design purposes. If a pump station is to be temporary (as determined by the Utility), certain requirements may be modified or omitted at the discretion of the Utility. In general these modifications and omissions will be as defined in Appendix A.

- The Utility will also evaluate options for the extension of gravity sewers to the site. The Contractor may be required to evaluate these options to determine feasibility and estimated costs for the gravity sewer extensions as well as the estimated cost of the proposed pump station and force main. These costs will be compared to assist in determining if a pump station will be allowed or a gravity sewer extension will be required.

Wherever the requirements specify "Contractor," they are intended to refer to land developers and their agents, who are typically contractors, and their consulting engineers. Nothing in these
requirements is intended to assign responsibility contradictory to legitimate contractual arrangements between those parties.

Where these specifications are included with Plans and Bidding Documents for a project publicly bid by the City of Oxford, the Plans and Detailed Specifications shall govern in the event of conflicts between them and this document.
1.0 SCOPE

The specifications herein given are general and subject to any special provision or requirements set forth in the sections of this document.

1.1 Scope of Work

A. The Contractor shall, unless otherwise notified, furnish all labor, materials, equipment, tools, and incidentals necessary to install, test, complete, and make ready for operation a submersible sanitary sewer pump station. This includes the furnishing and installation of all necessary and desirable accessory equipment and auxiliaries, whether specifically mentioned in these specifications or not, as required for an installation incorporating the highest standards for the types of service which this pump station is to perform.

B. These specifications are intended to give a general description of that which is required and do not purport to describe all details of the equipment to be furnished. Such details are considered to be either standard among all manufacturers or variable in accordance with specific equipment formulations, but resulting, in either case, in equipment equal in performance, long-term reliability, and life-cycle cost-effectiveness.

C. The Contractor shall be responsible for all excavation and removal of obstructions and restoration of all properties involved directly with the construction and/or installation of the pump station.

1.2 Land

A. A minimum of 6,000 square feet of property (excluding road right-of-way) shall be deeded to the City of Oxford for each sanitary sewer pump station. A larger area may be required, depending upon the configuration of the station, shape of the area, length of the driveway, terrain, and other factors. Enough space shall be provided for the proposed facilities as well as space for construction of a future replacement pump station.

B. The pump station must be located far enough from property lines, other utilities, etc. to permit excavation for the wet well and other structures and an adequate work area for construction. Generally, an area about 100 ft. x 100 ft. (centered around the wet well) is necessary for construction.

1.3 Capacity

A. The facility shall be sized to handle all flows from the total upstream watershed, except for the pumps and motors, which shall be sized to handle twice the design peak flow of the proposed participating development (but not less than the total of the proposed participating development plus any existing development in the watershed) or the total upstream watershed, whichever is less. However, the facility shall be designed to permit future installation of pumps sized to handle the peak flow of the upstream watershed.

B. The capacity of a pump station handling flow from existing gravity sewers shall be adequate to manage existing flows, including infiltration/inflow, as well as additional flows anticipated to be required for the proposed development.
1.4 Design

A. Design of pump stations shall be coordinated at all stages with City of Oxford. Complete construction drawings (including electrical and instrumentation) shall be submitted for review and approval along with the sewer construction drawings for the development requiring the pump station. The City of Oxford’s Standard Electrical Drawings shall be used to the extent possible. Plan review fees shall be paid according to standard departmental policies.

B. Plans shall indicate the elevation of the 100-year flood plain at the pump station site. The tops of the wet well, valve pit and all upstream manholes, as well as the generator and control panel pads, shall be at least one foot above the 100-year flood plain. The minimum service level of all buildings served by the pump station as well as the wet well top slab shall be at least one foot (1’) above the elevation of the lowest point of free overflow (manhole rim) upstream of the pump station. Buoyancy calculations and foundation design prepared by a Professional Engineer registered in the State of Ohio shall be submitted for all pump station structures to prevent flotation of the structures with water at the 100-year flood elevation and all structures empty. A safety factor of at least 1.5 shall be considered in this design.

C. See Section 2.1 for pump selection considerations.

D. See Section 3.1 for requirements related to the wet well, valve pit and other structures.

E. The design engineer shall review this entire document and incorporate all aspects of these requirements into the design of the pump station.

1.5 Inspection

Materials provided and work performed shall be subject to inspections by Utility representatives and/or by appointed agents of the Utility. Acceptance of the pump station shall be contingent on the condition that all materials, equipment, and workmanship provided pass set inspections, satisfactory completion of all work, and proper operation of the completed pump station.

1.6 Warranty

A. A minimum of a full twelve (12) month warranty shall be provided for the pump station. This warranty shall begin on the date the pump station is accepted by the Utility for operation. The warranty shall cover the following:

1. All equipment, parts, and labor.
2. Site materials, roadways, and fences.
3. Ground subsidence and settlement of valve chamber and wet well.

B. The pumps shall have at least an eighteen (18)-month full (all parts and labor) manufacturer’s warranty and 5-year prorated manufacturer’s warranty, which shall both begin no earlier than the date of shipment to the Contractor. In the event that the pump station is not accepted within six months of shipment of the pumps, the full warranty shall be extended to twelve months from the date the pump station is accepted by the Utility for operation.
1.7 Tools and Spare Parts

A. All special tools and recommended spare parts required for normal operation and maintenance shall be supplied for each piece of equipment furnished.

B. The following spare parts shall be furnished as a minimum:

1. One set of 1 upper and 1 lower mechanical seals for each pump and a seal tool
2. One set of upper and lower bearings for each pump
3. One set of gaskets, O-rings, grommets, and other sealing devices for each pump
4. One rotating wear ring (if so equipped) or a spare painted impeller for each pump, and one stationary wear ring (if so equipped) or a spare painted volute for each pump
5. One complete set of spare fuses for all electrical devices
6. Ten spare bulbs for each lamp type

C. All tools and spare parts shall be properly packed and protected for long storage and placed in containers clearly identified in indelible markings as to contents.

1.8 Submittals

A. The Contractor shall submit to the Utility, a minimum of five sets of plans, on City of Oxford standard size sheets (24"x36"), of the following for approval prior to ordering equipment and materials or initiating construction. Four sets will be kept by the Utility. The remaining sets will be returned to the Contractor with comments and/or approvals.

1. Certified shop and erection drawings and data regarding pumps, motors, characteristics, and performance. The data shall include guaranteed performance curves, based on actual shop tests of duplicate pumping units, which show that the units meet the specified requirements for head, capacity, efficiency, and input power. Curves shall be submitted in quadruplicate on 8-1/2-inch by 11-inch sheets. For pumping units of the same size and type, only curves for a single unit need be provided.
2. Literature and drawings describing the equipment and showing all important details of construction and dimensions
3. Complete data on motors, including schematic electrical wiring diagrams and other data as required
4. Complete schematic electrical wiring diagrams for pump station, control panel, and SCADA
5. Conduit routing and wire-pulling schedules
6. Complete grounding scheme

B. Submittals shall be provided for each of the items listed in Appendix B of this document.

1.9 Operation and Maintenance Manuals

A. Four complete sets of installation, operation, and maintenance instructions shall be provided for all equipment and electrical components. The manuals shall be prepared specifically for the installation to which they pertain and shall include all available installation manuals, operation manuals, maintenance manuals, catalog cuts, drawings, wiring diagrams, equipment and parts lists, list of spare parts provided, warranties, product descriptions, etc. All four sets of manuals for major equipment shall be original
manufacturer's manuals-copies will not be acceptable. Only one set of original manufacturer's literature is required for miscellaneous components; copies of this literature will be acceptable for the other three O&M manuals.

All manuals shall be furnished to the Utility no later than the date of acceptance.

B. The manual for each piece of equipment shall be a separate document with the following specific requirements:

1. Contents:
   a. Table of contents and index
   b. Brief description of each system and its components
   c. Starting and stopping procedures
   d. Special operating instructions
   e. Routine maintenance procedures
   f. Manufacturer's printed operating and maintenance instructions, parts list, illustrations, and diagrams
   g. Instrumentation data sheets with calibration data and specifications
   h. One copy of each wiring diagram
   i. Conduit routing and wire-pulling schedules
   j. One copy of each approved shop drawing and each Contractor's coordination and layout drawing
   k. List of spare parts, manufacturer's price, and recommended quantity
   l. Name, address, and telephone numbers of local service representatives

2. Material:
   a. Loose leaf, on 24-pound punched paper
   b. Holes reinforced with plastic, cloth, or metal
   c. Page size, 8-1/2 inches by 11 inches
   d. Diagrams, illustrations, and attached foldouts as required, of original quality, reproduced by dry-copy method
   e. Covers of oil-, moisture-, and wear-resistant material, 9-1/2-inches by 12-inches in size

1.10 Record Drawings

A. The Record Drawings shall consist of the Contract Drawings revised per as-built conditions and the approved Shop Drawings. As-built revisions to the Contract Drawings shall be professionally drafted. The Record Drawings shall be submitted to the Utility in reproducible form (i.e., 3-mil Mylar) upon completion of the construction.

B. Contract Drawings shall be legibly marked to record actual construction, including:

1. All deviations in location or elevation of any underground installation from that shown on the Contract Drawings—including gravity sewers, force main, valves, electrical conduits, grounding, etc.
2. Actual pipe elevations (inverts of gravity sewers, tops of exposed force main piping and tops of buried valve operators); bottom elevations of wet well, valve pit, and manholes; slab elevations (wet well, valve pit and manhole tops; generator slab,
control panel slab, and driveway slab)
3. Any significant changes in above-ground installations from the approved Shop
   Drawings or Contract Drawings—including locations of wet well, valve pit,
   manholes, air release installations, generator, control panel, antenna pole, electrical
   transformer, driveway, fencing, etc.
4. Indication of the Utility's approval of any such deviations or changes from the
   Contract Drawings or approved Shop Drawings

C. Specifications and addenda shall be legibly marked to record:
   1. Manufacturer, trade name, catalog number, and supplier of each product and item of
      equipment actually installed
   2. Changes made by change order or field order
   3. Other matters not originally specified

D. Shop Drawings shall be legibly annotated to record changes made after review.

E. Reproducible Record Drawings shall be submitted within seven calendar days after the date
   of acceptance.

1.11 Additional Items

A. Each installation shall be individually assessed as to the need for equipment, structures,
   procedures and other items not named or described in these specifications. Some examples
   of possible additional items are odor control systems, electrical control buildings, variable
   frequency drives, electric valve actuators, sewage grinders, dual wet wells, potable water
   service, retaining walls, drainage improvements, etc. Installation of these items may be
   required at the discretion of the Utility.

B. Any variations from the specifications provided in this document must be approved through
   the Utility representative or the appointed agent of the Utility.

C. These specifications are subject to change or revision without notification. All developers,
   engineers and contractors shall ensure they have the most recent version of these
   specifications prior to commencing work on a new pump station project.
2.0 SUBMERSIBLE PUMPS

The pumps used in all submersible sanitary sewer pump stations shall meet the following specifications.

2.1 Pump Selection

A. Pump selection shall be made by the design Engineer, subject to review and approval by the Utility. The Engineer should confirm pump selection(s) with the pump supplier/manufacturer. The Utility may reject a pump selection for failure to comply with the following considerations or in preference of a pump selection that better meets the required conditions.

B. The Engineer shall evaluate the following factors to determine the most appropriate pump selection(s).

1. Coordinate force main size, pump station piping size, and pump selection to maintain at least 2 feet per second force main velocity, minimize head losses, minimize overall life-cycle costs (installation costs, electric and other operating costs, and maintenance costs), and provide the best overall system.
2. Consider possible advantages of triplex vs. duplex pump configuration. For triplex stations, ensure that duty points for both one pump and two pumps running are satisfactory.
3. Static head shall be calculated based on a wet well water level at the top of the pump volute or the manufacturer's minimum allowable water level. However, the selected pump must also operate at an acceptable duty point when the wet well is full. A larger motor may be necessary in some cases to prevent overloading of the pump motor when pumping from a full wet well.
4. Friction head loss calculations shall be based on the Hazen-Williams formula utilizing a C-value between 100 and 120. Regardless of the C-value used for system design, the Engineer shall verify that the pump will operate satisfactorily with a C-value anywhere in the range of 100 to 140 to account for varying conditions.
5. The available surplus capacity in the receiving gravity sewer shall be determined assuming ultimate peak flows at complete build-out of the drainage area. Only this available surplus capacity will be available for a proposed pump station. The maximum pump station pumping rate (calculated at a full wet well and C value of 140) shall not exceed the available surplus capacity of the receiving sewer.
6. When practicable, pump motors should be non-overloading throughout the entire range of the pump curve from shut-off head to runout. Pump motors shall at least be non-overloading at all duty points considered in the pump selection as discussed herein.
7. Pump shall be selected to minimize net positive suction head required (NPSHRe) at the design duty point(s). In general, NPSHRe shall not exceed 24 feet at the design duty point(s). In no case shall the NPSHRe exceed 30 feet at any point in the expected operating range of the pump (i.e. C-values from 100 to 140).
8. Pump shall be selected to maximize efficiency to the extent practicable. An attempt shall be made to select a pump that will operate near its peak efficiency at the design duty point.
9. When the initial pump selection is not sized to pump the design peak flow from the total upstream watershed, the initial and future pump selections shall be coordinated
to facilitate the future pump replacement. The following options should be considered:

a. Install ultimate pump and motor with smaller impeller, initially. Requires that only the impeller be changed in the future.
b. Install ultimate pump with smaller motor and impeller, initially. Requires that only the motor and impeller must be changed in the future.
c. Whenever possible, the initial pump shall utilize the same size guide rails and discharge connection as the ultimate pump.

2.2 Pumps, Motors, and Installation

A. Pumps shall be ITT Flygt CP/NP or equal, shall be capable of passing solids at least three inches in diameter (except NP series), shall have a maximum ambient operating temperature of at least 104° F, and shall be capable of withstanding corrosive materials normally found in domestic and industrial waste. Other characteristics shall include:

1. The pumps shall be centrifugal, non-clog submersible in design capable of running dry while pumping raw, unscreened sewage. The design shall be such that the pump unit will be mounted in the wet pit and piped to the valve pit as shown on the drawings.
2. The pump, with its appurtenances, shall be capable of continuous submergence under water without loss of water-tight integrity to a depth of 65 feet.
3. The motor cooling system plus the design of the mechanized seals shall enable the unit to operate at any load or completely dry without damage. In addition, the motor cooling system shall allow the pump to be operated down to 30 percent of the nameplate speed without undue effects from heat generation.

B. Pump motors shall be 460/480 volt AC, 3-phase, 60 Hz.

C. A nameplate of 316 stainless steel shall be attached to each pump, giving the name of the manufacturer, rated capacity, head, speed, model number, serial number, and all other pertinent data.

D. All anchor bolts shall be of 316 stainless steel. All stainless steel bolt threads shall be coated with an anti-seize product. Anchor bolts shall use an appropriate Hilti chemical anchoring system or approved equal.

E. Each pump shall be provided with a sufficiently long power cable to suit its installation without splicing. The power cable shall be Type SPC cable, chloroprene rubber-jacketed, suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards and shall also meet with P-MSHA approval. Each power cable shall be installed in a separate conduit to the control panel.

F. A 316 stainless steel lifting chain shall be provided for each pump, of sufficient length to reach from the pump attachment to a chain holder, furnished by the equipment manufacturer and installed near the upper guide rail support for that pump. The chain shall be of sufficient strength to allow the raising and lowering of the pump with a safety factor of at least 2 above the chain’s working load, but in no case less than 1/4-inch chain links. (Note: Safety factor shall be applied to the safe working load of the chain—not the test load or breaking load.) An ITT Flygt Corp. “Grip-eye” or equal sized for the pump lifting
chains shall be provided for each pump station.

G. The pump shall be supplied with a mating cast-iron discharge connection elbow, which shall be properly anchored and grouted in place. The discharge connection elbow shall be permanently installed in the wet well along with the discharge piping. The pump shall be automatically connected to the discharge connection elbow when lowered into place and shall be easily removed for inspection or service. There shall be no need for personnel to enter the wet well to install, remove, or maintain the pumps.

H. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pump unit shall be guided by no less than two guide bars and shall be pressed tightly against the discharge connection elbow with metal-to-metal contact. Sealing of the devices by any other means shall not be acceptable. No portion of the pump shall bear directly on the floor of the wet well, and the minimum clearance specified by the manufacturer shall be maintained with at least 4" in all cases. The pump, with its appurtenances and cable, shall be capable of continuous submergence under water to a depth of 65 feet without loss of watertight integrity.

I. Major pump components shall be of gray cast iron, with smooth surfaces devoid of blow holes and other irregularities. All exposed nuts and bolts shall be of AISI-type 304 stainless steel or brass construction. All surfaces which will come into contact with sewage, other than stainless steel or brass, shall be protected by an approved sewage-resistant coating. The impeller shall be factory-coated with acrylic dispersion zinc phosphate primer. The pump exterior shall be protected by a factory-applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish.

J. All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This shall result in controlled compression of the O-rings without the requirement of a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease, or other devices shall be used.

K. The design of the cable-entry water seal shall insure a watertight and submersible seal. A single cable entry to the pump housing shall contain all leads. The cable entry shall be comprised of a single cylindrical elastomer grommet, flanked by stainless steel washers, all having a close-tolerance fit against the outside diameter of the cable and compressed by the entry body containing a strain-relief function, separate from the function of sealing the cable. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall protect the interior of the motor from foreign material which might gain access through the top of the pump. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable. The pump supplier shall provide a watertight connector, equal to a Crouse Hinds type CGB with a neoprene gland to terminate the cable in the pump disconnect.

L. The pump motor shall be designed and manufactured by the same manufacturer as the pump. The pump motor shall be of a squirrel-cage, induction, shell-type design, housed in an air-filled, watertight chamber. The stator winding and stator leads shall be insulated with moisture-resistant Class F insulation which shall resist a temperature of 155° C. The stator shall be dipped and baked three times in Class F varnish and shall be fitted into the stator housing by heat-shrinking. The use of bolts, pins, or other fastening devices
requiring penetration of the stator housing shall not be acceptable. The motor shall be
designed for continuous duty, capable of sustaining a minimum of ten starts per hour with
the liquid surface located at the top of the pump's volute but below the motor casing, with a
temperature rise not exceeding 40°C above ambient temperature.

M. The junction chamber, containing the terminal board, shall be sealed from the motor by an
elastomer compression seal (O-ring). Connection between the cable conductors and stator
leads shall be made with threaded, compressed-type binding posts permanently affixed to a
terminal board.

N. Each motor 20 horsepower or larger shall be provided with an adequately designed cooling
system, consisting of a water jacket encircling the stator housing. The water jacket shall be
provided with a separate circulation of the pumped liquid. Cooling media channels and
ports shall be non-clogging by virtue of their dimensions. Systems that utilize a closed
loop cooling system such as ethylene or propylene glycol or oil shall not be acceptable.

O. Each pump shaft shall be of either stainless steel or carbon steel C1035 and shall be
completely isolated from the pumped liquid.

P. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two
totally independent seal assemblies. The upper of the tandem set of seals shall operate in
an oil chamber located just below the stator housing. This set shall contain one stationary
tungsten carbide ring and one positively driven rotating tungsten carbide ring and shall
function as an independent secondary barrier between the pumped liquid and the stator
housing. The lower of the tandem set of seals shall function as the primary barrier between
the pumped liquid and the stator housing. This set shall consist of a stationary ring and a
positively driven rotating ring, both of which shall be of tungsten carbide. Each interface
shall be held in contact by its own spring system. The seals shall require neither
maintenance nor adjustment, but shall be easily inspected and replaceable. The following
seal types shall not be considered acceptable nor equal to the dual independent seals
specified:

1. Shaft seals without positively driven rotating members
2. Conventional double mechanical seals containing either a common or double spring
   acting between the upper and lower units (this conventional system requires a
   pressure differential to offset external pressure and effect sealing).

Q. The only functions of the oil chamber shall be as a secondary barrier between the pumped
liquid and as a seal lubricant. It shall be designed to compensate for oil expansion that can
occur due to temperature variations. Drain and inspection plugs, with positive sealing,
shall be easily accessible from the outside.

R. The pump shaft shall rotate on two permanently lubricated bearings. The upper bearing,
providing for radial thrust, shall be a single-row roller bearing. The lower bearing shall be
a two-row angular-contact bearing to compensate for axial thrust and radial thrust.

S. The impeller shall be of a gray cast-iron, dynamically balanced, double-shrouded, non-
clogging design having a long throughput without acute turns. The impeller shall be
capable of handling grit, solids, fibrous materials, heavy sludge, and other matter found in
normal sewage applications. The pump manufacturer shall furnish data on mass moment of
inertia for the proposed impeller. The fit between the impeller and the shaft shall be a
sliding fit with one key, and the fastening of the impeller to the shaft shall be made by a locking assembly which is sealed from the liquid by a protective rubber cap and a bolt threaded to the shaft terminal.

T. The volute shall be of a single-piece, non-concentric design and shall have smooth fluid passages large enough at all points to pass any solids which can pass through the impeller. The volute bottom shall be of a suction-bell design. A replaceable wear-ring system shall be installed to provide efficient sealing between the volute inlet and the impeller skirt. The wear rings shall consist of a stationary brass wear ring in the volute. Pumps 14 horsepower or larger shall also have a rotating stainless steel wear ring on the impeller skirt.

U. Cable support shall be provided for the pump power cable and shall consist of a stainless steel braided wire sleeve with attachment tails for connection to stainless steel J-hooks (e.g. cable support brackets) installed at the access hatch(es) within reach of operators, as approved by the Engineer.

V. A mix-flush system shall be provided for each pump. The mix-flush system shall be an ITT FLYGT 4901 flush valve or approved equal. The valve shall use the ejector principle, in which water exiting the valve shall violently agitate the liquid in the sump, thereby redissolving any accumulation of sludge. The flushing period of the valve shall be adjustable. The direction of discharge from the mix-flush system shall be adjustable in 360-degrees to any part of the wet well.

W. Pumps shall be accessible for removal by the Utility standard truck-mounted hoists.

2.3 Mounting Hardware

All slide rails shall be made of 316 stainless steel and shall be of tubular design. Upper guide bar brackets, middle support brackets, and float hangers shall also be made of 316 stainless steel. All other hardware (bolts, nuts, etc.) shall similarly be made of 316 stainless steel. All stainless steel bolt threads shall be coated with an anti-seize product.

2.4 Protection

A. Thermal sensors shall be used to monitor stator temperatures on all pumps. The stator shall be equipped with three (3) normally closed thermal switches, embedded in the end coils of the stator winding (one switch in each stator phase). Should high temperature occur, the thermal switches shall open, stop the motor and activate an alarm.

B. A lower bearing temperature sensor shall be provided on larger pump motors. The sensor shall directly contact the outer face of the thrust bearing providing for accurate temperature monitoring. Coordinate requirements with the Utility.

C. All pumps shall be equipped with seal leak detectors in the stator chamber to detect the presence of water, so as to give adequate warning if the lower seal unit should fail. Use of voltage sensitive solid state sensors shall not be allowed.

D. The thermal switches, leakage sensor and the lower bearing temperature monitor (where required) shall be connected to a CAS (Control and Status) or MiniCAS monitoring unit. The unit shall be a Flygt CAS/MiniCAS module or approved equal.
2.5 Shop Testing of Pumps

A. All pumps of 35 horsepower capacity or greater shall undergo certified testing at the factory for capacity, power requirements, and efficiency at specified extremes for rated head, shutoff head, and operating head, and at as many other points as necessary for accurate plotting of performance curves, with the completely assembled pump and motor that will be furnished.

B. All tests and test reports shall be made in conformity with the requirements and recommendations of the Hydraulic Institute Standards.

C. Copies of the test logs, a description of the test piping, equipment, and set-up, and a discussion of the test procedure shall accompany certified test performance curves and shall be submitted to the Utility. The curves shall include head, bhp, overall (wire-to-water) efficiency, rpm, and test NPSHRe plotted against capacity. The curves shall be easily read and plotted to scales consistent with performance requirements.

2.6 Field Acceptance Tests

A. After installation of the pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer’s representative, each pump shall be given a running test in the presence of the Utility during which it shall determine the pump’s ability to operate without vibration or overheating, and to deliver its rated capacity under the specified conditions.

B. During the drawdown and field tests, observations shall be made of head, capacity, and motor input. All defects or defective equipment revealed by or noted during the tests shall be corrected or replaced promptly at the expense of the Contractor, and if necessary, the tests shall be repeated until results acceptable to the Utility are obtained. The Contractor shall furnish all labor, piping, equipment, water and materials necessary for conducting the tests.

C. The field verification and/or drawdown tests shall include measuring or determining the following items:

1. Flow rate.
2. Total head on the pump.
3. Power input.
4. Static head on the pump.
5. Correct pump rotation.

D. On those pumps or set of pumps that have a flowmeter in the discharge line, the flowmeter may be used to determine the flow rate once its accuracy has been verified in the field.
3.0 STRUCTURES, BACKFILL AND EMBANKMENT

Structures shall be constructed as required, in accordance with the following specifications:

3.1 Wet Well and Valve Pit Design and Construction

A. Wet wells and valve pits shall be constructed using either precast concrete sections or poured-in-place concrete. If precast construction is used, each section shall be set and sealed with the proper gasket and joint sealing compound approved by the Utility. If the pump station will be constructed of poured-in-place concrete, the concrete shall be reinforced with reinforcement rod in accordance with acceptable engineering design practice and shall be certified by a Professional Engineer registered in the State of Ohio.

B. Either type of construction shall have a foundation designed so as to adequately support the station. At least one subsurface test boring shall be made at the pump station site to at least five feet below the proposed bottom of the wet well. A complete soil analysis including ground water level shall be submitted with the plans. Soil analysis shall include at least Standard Penetration Tests (ASTM D 1586); classification of soils' textures and consistencies; tests for natural moisture content; engineering classification of predominant soil horizons (including sieve and hydrometer analysis (ASTM D 422), Atterberg limits (ASTM D 4318), and specific gravity (ASTM D 854)); and determination of Rock Quality Designation values. This analysis shall be used by the design engineer to verify that adequate ground support exists for the station as well as to design the structure to prevent flotation. This design shall be certified by a Professional Engineer registered in the State of Ohio. See also Section 1.4 B. for additional foundation requirements.

C. Top slabs of wet well, valve pit and other below-ground structures shall be elevated six to twelve inches (6" - 12") above surrounding grade to prevent vehicles from driving onto them. If necessary to meet the flood-protection requirements listed in Section 1.4 B., the structures may extend higher; however, handrails with kickplates shall be provided around any structures more than 30" above grade. Stairs shall be provided for any structures more than 18" above grade. Top slab of any below-ground structure located within the driveway or other traffic areas shall be approximately one inch (1") above grade and shall be designed for H-20 traffic loading.

D. Design shall be such that a 30-minute cycle time for each pump (i.e. 15-minute overall cycle time for duplex stations; 10-minute overall cycle time for triplex stations) shall be obtained at average design flow. The wet well shall also incorporate a design sufficient to provide an emergency storage volume equal to at least two hours at ultimate design average flow. This emergency storage volume shall be calculated from the high water alarm elevation to the invert of the influent sewer. In no case shall this distance be less than six feet. In some instances (especially for large pump stations), the Utility may permit the emergency storage volume to be calculated from the high water alarm elevation to the lowest point of free overflow upstream of the pump station.

E. No more than one influent sewer shall enter the wet well, and it shall be located opposite the pumps (or as close as possible). The influent flow shall not discharge directly onto a pump.

F. Wet wells shall have a minimum inside diameter of six feet. Valve pits shall have a
minimum inside dimension in all directions of six feet. Excessively deep valve pits will not be permitted.

G. A grout fillet shall be properly designed and constructed around the full circumference of the wet well’s bottom to direct grit and other solids to the pumps. The slope of this fillet shall be at least 1:1. The inner diameter of this “grout circle” shall be as recommended by the pump manufacturer for the specified pump (or future pump) and approved by the Utility, but in general should be as small as possible without creating a vortex condition around the pumps. The inner “grout circle” shall be centered around the pumps. Either of the following mixes will be acceptable for this fillet, but the final mix design and slump shall be determined by the Contractor and approved by the Utility:

1. Sand-cement grout consisting of one part Portland cement, two parts fine aggregate and a maximum of 4.5 gallons of water per sack (cubic foot) of cement. Portland cement shall be Type III conforming to ASTM C 150. Fine aggregate shall be natural siliceous sand, consisting of hard, clean, sharp, dense, durable and uncoated particles, free from organic material and injurious amounts of deleterious substances. 100% of fine aggregate shall pass a Size No. 4 sieve.

2. 4,000 psi concrete mix, with 5-7 percent air content and 3/4”-1” slump. Mix shall include 510 lbs. Type I cement conforming to ASTM C 150; 90 lbs. Class F fly ash conforming to ASTM C 618; 1,315 lbs. sand conforming to ASTM C 33, ODOT 703.02; 1,651 lbs. AASHTO M-43 Size No. 8 aggregate; 200 lbs. water; and 2-4 oz./100 lbs. Type A or D water reducer conforming to ASTM C 494.

H. Each valve pit shall be fitted with a drainage system such that any liquid entering the valve pit will be drained back to the wet well. Drainage of the valve pit shall be ensured by a 1-degree slope to the floor of the valve chamber draining to the invert of a drain line or to an approved cast iron floor drain. The drain line shall be minimum 2” diameter constructed of schedule 80 PVC. The check valve shall be as specified in Section 4.4. The check valve shall be attached to the drain pipe with a NPT threaded joint. The pipe shall extend at least 12” into the wet well but shall not interfere with pump removal.

I. Each valve pit shall also be furnished with a valved connection to the force main beyond the pump isolation valves for emergency pumping. This connection shall be sized to equal the discharge piping from the pumps, unless otherwise directed by the Utility, and shall have a minimum diameter of six inches. This connection shall be equipped with a galvanized steel Bauer fitting for ease of hose connection. Equivalent quick-connect fittings are not acceptable. Bauer fitting and accessories shall be as follows, with one discharge connection, one rubber sealing ring, and one end cap.
<table>
<thead>
<tr>
<th>Size &amp; Type</th>
<th>Discharge Connection</th>
<th>Lever Ring</th>
<th>HK Rubber Sealing Ring</th>
<th>End Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>6&quot; Flanged</td>
<td>100-7005</td>
<td>included</td>
<td>107-0140</td>
<td>107-0201</td>
</tr>
<tr>
<td>6&quot; Threaded</td>
<td>107-0811</td>
<td>106-0134</td>
<td>107-0140</td>
<td>107-0201</td>
</tr>
<tr>
<td>8&quot; Flanged</td>
<td>100-7003</td>
<td>included</td>
<td>108-0140</td>
<td>108-0201</td>
</tr>
</tbody>
</table>

J. All pipe and conduit penetrations through the wet well and valve pit structures shall be sealed watertight with Dura-seal rubber compression gaskets, rubber Link Seal sleeves with stainless steel components, or approved equal products.

K. The wet well shall be provided with at least one “gooseneck” inverted vent pipe. The piping shall be made of epoxy-coated ductile iron, aluminum, or stainless steel and shall be at least as large as the largest pump discharge piping (minimum 4"). Black iron pipe will not be allowed. Also, PVC or other plastic pipe will not be allowed. The exterior end of the pipe shall be covered with a stainless steel screen.

L. Adequate water-proofing of the wet well and valve pit shall be included in the design and performed by the Contractor. A leakage test shall be performed on the entire wet well and valve pit prior to backfilling (see Section 3.2). The Contractor/Developer shall be responsible for properly repairing any leaks or correcting any other problems discovered during this test.

M. All valve pits shall be fitted with an aluminum ladder for access. Ladder shall be Halliday Products Series L1D or equal. An aluminum ladder safety extension post (Bilco Ladder-Up, Halliday Products Series L1E, or equal) shall be provided as well.

3.2 Sluice Gate Manhole

A. A separate manhole with a slab top shall be installed on the influent sewer within 15 feet of the wet well within the fence. Polypropylene manhole steps shall be installed in the manhole per City of Oxford Standard Specifications.

B. A zinc-plated steel anchor bolt and safety D-ring assembly shall be provided on the top slab of the manhole for personnel fall protection. The exact location shall be coordinated with the Owner in the field. This safety D-ring assembly and anchor bolt shall be rated for one person, 310 pound capacity. D-ring system shall be DBI Sala Model 2104560 or approved equal.

C. A 24" x 24" (minimum) aluminum hatch shall be provided in the top slab of this manhole above the manhole steps and shall open away from the manhole steps.

D. A sluice gate shall be installed at the outlet side of the manhole. The gate shall be the same size as the sewer (minimum 8"). The sluice gate wall pipe shall be installed level in the
manhole. Ductile iron pipe shall be installed between this manhole and the wet well at the slope indicated on the drawings; an appropriate fitting shall be provided, if necessary, to transition from the sluice gate wall pipe to the sewer pipe.

E. A cast iron floor box with lid shall be installed in the top slab of the manhole directly above the sluice gate operator to permit operation of the valve with a T-wrench.

3.3 Flow Meter Manhole (When Required—See Section 7.10)

A. The magnetic flow meter shall be installed in a five foot (5') diameter (minimum) manhole with slab top and a 30" x 30" (minimum) aluminum access hatch.

B. The flow meter manhole shall be watertight (except for the aluminum access hatch) and shall not be fitted with any drainage system.

3.4 Wet Well, Valve Pit and Sluice Gate Manhole Lids and Accessories

A. Wet well, valve pit and sluice gate manhole lids shall be composed of 0.25-inch-thick aluminum rated at 150 pounds per square foot minimum (H-20 load rating in traffic bearing situations or if top of structures are not elevated at least 6" above grade). Lids shall be affixed with stainless steel hinges and hardware. A retractable handle constructed of stainless steel shall be furnished with each lid—such that when the lid is closed, there shall be no protrusions above the lid level.

B. The channel frame shall be 1/4 inch minimum aluminum with anchor flange around the perimeter with a drain into the wet well.

C. Factory finish shall be mill-finish with bituminous coating applied to the exterior of the frame.

D. Each lid shall be furnished with a stainless steel padlock tab for securing the lid, a stainless steel snap lock with gasketed, threaded cover plug and removable key wrench, and a stainless steel hold-open arm with release handle for securing the lid in a 90° open position. Also, compression-spring operators enclosed in telescopic tubes shall be provided for smooth, easy and controlled door operation throughout the entire arc of opening and closing.

E. Pump access lids shall be sized according to the pump manufacturer’s recommendation. Access hatch(es) on the valve pit shall be large enough to permit easy installation and removal of the check valves and gate valves, as well as permit access to the Bauer connection. Every structure shall have at least one access lid with a minimum size of 30" x 30" (except that the hatch on the sluice gate manhole may be 24" x 24"). When selecting equipment hatch sizes, care shall be taken to ensure that the actual clear opening (or effective size) is large enough for installation and removal of the intended equipment. For example, on some hatches (esp. H-20 rated hatches), the lower portion of the open hatch lid overhangs the hatch opening, thereby reducing the effective size of the opening.

F. Access lids over the pumps in the wet well shall lift away from the pump guide rails (e.g. toward the influent sewer).

G. Access to the control panels (e.g. clearance between panels and hatches) shall meet
National Electric Code (NEC) conditions with the lids in the 90° open position.

H. Aluminum access lids shall be as manufactured by Bilco or approved equal.

I. The Contractor shall post the following signs on every aluminum hatch door frame: 5" x 7" 
   **DANGER: CONFINED SPACE: ENTER BY: "PERMIT ONLY" and 5" x 7" "FALL 
   PROTECTION REQUIRED". Signs shall be according to State and Federal OSHA 
   requirements. Signs shall be heavy gauge 0.063" aluminum with rounded corners and 1/4" 
   I.D. corner eyelets for mounting. Paint or ink shall be weather-resistant, and the face of the 
   sign shall be covered with a clear mylar topcoat. Signs shall be mounted on the hatch 
   frames so they are visible with the hatches open or closed. Signs shall be attached with 
   stainless steel self-tapping screws or other appropriate aluminum or stainless steel 
   fasteners. Signs shall be mounted such that they do not present a tripping hazard.

J. A zinc-plated steel anchor bolt and safety D-ring assembly shall be provided on the top slab 
   at each hatch on the wet well for personnel fall protection. The exact location(s) shall be 
   coordinated with the Owner in the field. This safety D-ring assembly and anchor bolt shall 
   be rated for one person, 310 pound capacity. D-ring system shall be DBI Sala Model 
   2104560 or approved equal.

3.5 Leakage Testing of Wet Well, Valve Pit, Sluice Gate Manhole and Flow Meter Manhole

Wet well, valve pit, sluice gate manhole and flow meter manhole shall be tested for leakage 
before backfilling as follows: structures shall be filled with water and allowed to remain 
for 24 hours. Any visible leaks shall be repaired immediately (prior to backfilling). If the 
water level in the structures drops substantially (generally, more than 3") during the leakage 
test, the Contractor may be required to investigate for additional leaks and another test may 
be required. It shall be noted that this testing method is not an acceptable test for a 
structure that has already been backfilled.

3.6 Backfill and Embankment

A. The Contractor shall provide all labor, materials, tools, equipment, and incidental required 
to place the compacted backfill or embankment where shown on the plans or where 
directed by the Engineer and as specified herein.

B. Compacted backfill and embankment shall consist of suitable excavated material approved 
by the Engineer or Granular Backfill meeting City of Oxford Specifications for Water 
and Sanitary Sewer Construction. This material may be obtained from suitable excavated 
material elsewhere on the project, if available. Use of frozen material, wood, rocks, or 
rubbish for backfill or embankment will not be permitted. If suitable material cannot be 
obtained from the excavated material, the Contractor shall furnish the material.

C. No fill shall be placed covering other work until such work has been inspected and 
approved by the Utility. Where fill is required on both sides of a foundation or wall, the fill 
shall be placed simultaneously on each side. Fill against building walls shall not be placed 
until the first floor slab has been poured and set, unless otherwise approved by the Utility. 
Fill against other work shall be in a manner and at such time as not to endanger the stability 
of or damage the work. No fill shall be placed against water bearing walls until they have 
been inspected, tested, and approved by the Utility. No fill shall be placed over snow or 
frozen material.
D. All fill shall be compacted as specified herein, unless otherwise shown.

1. **Backfill.** Backfill shall be placed in 6" loose layers and each layer compacted to not less than 95% of maximum dry density; the moisture content shall be not greater than 3 percentage points above optimum as determined by ASTM D698. Compaction shall be accomplished with a **vibratory double-drum steel wheel roller no less than 2.0 Tons and no greater than 3.0 Tons** or by other means approved in writing by the Engineer. Flushing with water before compacting is also encouraged if satisfactory drainage is provided for the free water. The method of compaction within road rights-of-way shall be per City of Oxford Water & Sanitary Sewer Improvement Specifications Manual.

2. **Embankments.** Embankment areas shall be constructed in accordance with this specification. Embankment fill shall be placed in 6" loose layers and each layer compacted to not less than the percent of maximum dry density specified herein; the moisture content shall be not less than optimum and not greater than 3 percentage points above optimum. For material which displays pronounced elasticity or deformation under action of compaction equipment, the moisture content shall be reduced and proper stability obtained. Moisture density shall be as determined by ASTM D698.

<table>
<thead>
<tr>
<th>Maximum Dry Density (lbs/cu ft)</th>
<th>Compaction Percent Maximum Dry Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>90-104.9</td>
<td>102</td>
</tr>
<tr>
<td>105-119.9</td>
<td>100</td>
</tr>
<tr>
<td>120 and more</td>
<td>98</td>
</tr>
</tbody>
</table>

3. **Subgrade.** All pavement subgrades for new pavement shall be compacted to a depth of 12". Subgrade soils with a maximum dry density of less than 100 pounds per cubic foot are considered unsuitable for use where subgrade compaction for a depth of 12" is required, and when encountered in the upper 12" of the subgrade shall be replaced with suitable soil or granular material. Soil subgrade with maximum dry density of 100 to 105 pounds per cubic foot shall be compacted to not less than 102% of maximum dry density. All other soil subgrade shall be compacted to not less than 100% of maximum dry density; the moisture content shall be not greater than 3 percentage points above optimum as determined by ASTM D698.

E. The Contractor shall obtain up to three (3) soil samples where directed by the Engineer and transport the samples to an approved testing agency for Standard Proctor dry density testing (ASTM D-698). In addition, the Contractor shall cause a trained and experienced soil technician from an approved testing agency to be onsite during all backfill and embankment placement and to conduct at least two field density tests for every vertical foot of backfill or embankment placed. The Engineer shall review and approve the field density test reports at least every ten (10) vertical feet of embankment, and placement of embankment may not continue without this approval.
4.0 PIPES AND VALVES

All pipes and related equipment shall conform to the following specifications:

4.1 Pipes

A. The force main and other piping at the pump station shall be a minimum of four inches (4") in diameter. Pipes shall be of Class 53 ductile iron meeting ANSI/WWA C111/A21.11 and shall be installed in accordance with ANSI/WWA C600. All pipes shall have either cement-lining per ANSI/AWWA C104/A21.4 standards with asphaltic seal coating or other special lining on the interior as required on the Drawings or in the City of Oxford’s Standard Specifications. Exterior of buried piping shall be coated with standard asphaltic coating.

B. Force main piping shall have standard push-on bell and spigot joints meeting ANSI/AWWA C111/A21.11 and shall be installed in accordance with ANSI/AWWA C600. Ring gaskets shall be of approved composition suitable for the required service. Fittings shall be ductile iron conforming to ANSI/AWWA C153/A21.53 or C110/A21.10. Piping at all bends and at both ends of the force main shall be restrained for sufficient lengths to withstand the higher of: a) the test pressure, or b) the operating pressure plus a reasonable surge allowance. Substitution of concrete thrust-blocks in accordance with AWWA and City of Oxford standards in lieu of restrained joint pipe is permitted in some cases—refer to the City of Oxford’s Standard Specifications for further requirements.

C. Force mains shall have a minimum cover of 4.0 feet and a maximum cover of 12.0 feet. High points in the force main should be minimized by the use of deeper cuts through small hills and rolling topography along the alignment. Storm sewer design (where applicable) should consider force main alignment, with storm sewers running under (not over) the force main wherever possible. The force main shall discharge into a separate terminal manhole having no upstream gravity sewer connections (existing or future) at an elevation not more than 2 feet above the invert of the receiving sewer. A ductile iron drop of the force main (per City of Oxford Standard Details) may be allowed in some cases, especially when it will eliminate the need for an air release valve. A smooth uniform invert shall be poured in the manhole from the force main discharge to the gravity sewer.

D. All mating ends in the pump station and valve pit shall be Class 125 flanged meeting ANSI/AWWA C110/A21.10 and C115/A21.15, with a gasket no larger than 0.125 inch between flanges. Restrained flange adapters shall be installed only where approved by the Utility—typically one on each pump discharge line immediately prior to the check valve and one after the flow meter (where applicable). Flange adapters shall be Meg-a-Flange or approved equal. Union Flange and other similar adapters will not be allowed. All flanges shall be ductile iron, not gray iron. All flange bolts shall be 316 stainless steel. All stainless steel bolt threads shall be coated with an anti-seize product.

E. Only one joint or fitting will be permitted on each pipe between the wet well and the valve pit. This shall be a restrained flexible coupling appropriate for buried service capable of providing both expansion and deflection. Flexible coupling shall be Flex-Tend or equal with stainless steel hardware. No flanged joints will be permitted outside the wet well and valve pit.
4.2 Isolation Plug Valves

A. Each pump discharge line shall be furnished with an individual isolation plug valve. Isolation plug valves shall also be furnished for the Bauer connection and on the common force main beyond the flow meter (outside the valve pit, if no flow meter is provided). An isolation plug valve shall also be installed on the force main side of the surge relief valve, if applicable.

B. Plug valves shall be eccentric style with valve bodies manufactured of ASTM A-126 cast iron, Class B. Plug valves shall have corrosion resistant non-lubricating heavy duty bearings and bolted one-piece bonnet.

C. Plug valves shall have resilient plug facings suitable for raw sewage applications providing dead-tight shutoff without the use of sealing lubricants. Even if small solids are trapped between the plug and seat, the resilient facing shall provide tight shutoff without seat damage. Seats shall be welded-in solid nickel.

D. Exposed valve ends shall be ANSI B16.1 Class 125 standard flanged with face-to-face dimensions in accordance with ANSI B16.1 and flanges in accordance with ANSI B16.10. Buried valve ends shall be AWWA C111/ANSI A21.11 mechanical joint.

E. Valve stem seals shall use multiple v-ring packing rings to provide a reliable long-life seal.

F. Valve body shall be rated for minimum 175 psi working pressure, tight shut-off with line pressure in either direction.

G. All bonnet and packing gland bolts shall be steel, electro-plated with either zinc or cadmium; packing gland bolts shall have stainless steel nuts.

H. Provide gear reducer actuator for valves 8-inch and larger. Exposed valves 6-inch and smaller shall have lever actuator, and exposed valves larger than 6-inches shall have handwheel actuator. Valves in exposed locations shall have position indicator. Buried valve actuator shall be square nut with adapters and valve box for tee-wrench actuation. Provide stem extension for buried valves as necessary to extend square nut within four feet from top of valve box.

I. All valves shall be marked in accordance with AWWA standards, including the name of the manufacturer, valve size, working pressure, and year of manufacture.

J. Valves shall open counter-clockwise and close clockwise. Permanent labels shall be provided for each valve, showing both the "Open" position and indicating arrows.

K. Plug valves shall be coated, interior, exterior, and valve bonnet, with Tnemec epoxy paint or approved equal suitable for the intended application.

L. All plug valves shall be installed in the proper orientation as directed by the manufacturer.

M. Plug valves shall be DeZurik or approved equal.
4.3 Check Valves

A. Check valves for ductile iron pipelines shall be swing-type and shall meet the material requirements of AWWA specification C508 swing-check valves for ordinary waterworks service. The valves shall be of cast-iron body, bronze-mounted, single-disc, non-shock, and hydrostatically tested at twice the working pressure. Valve ends shall be 125-pound ANSI B16.1 flanges. Interior and exterior of valve body shall be coated with fusion-bonded epoxy in accordance with AWWA C-550. Valves shall be designed for working pressure as follows:

<table>
<thead>
<tr>
<th>Valve Size (diameter)</th>
<th>Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 to 12 inches</td>
<td>175 psi</td>
</tr>
<tr>
<td>14 to 24 inches</td>
<td>150 psi</td>
</tr>
<tr>
<td>30 inches and larger</td>
<td>120 psi</td>
</tr>
</tbody>
</table>

B. When there is no flow through the line, the disc shall hang lightly against its seat in a vertical position. When open, the disc shall swing clear of the waterway.

C. Check valves shall have bronze seat and body rings, extended bronze hinge pins, and bronze nuts on the bolts of bolted covers.

D. Valves shall be fitted with an extended hinge arm with outside lever and weights. Valves shall be so constructed that disc and body seat may be easily removed and replaced without removing the valve from the line. Check valves shall thus be installed with enough clearance between the valves and the walls of the valve pit to permit removal of the shaft for maintenance purposes.

E. Pump stations designed with a total dynamic head above 100 feet or force main velocity above 4 feet per second shall be evaluated to determine the need for hydraulic cushion check valves. If indicated, check valves shall be equipped with a hydraulic cushion to dampen the last ten percent of the valve closing action. The hydraulic-cushion chamber shall be arranged so that the valve closing speed is adjustable to meet the service requirements. Air-cushioned check valves are not allowed.

F. All check valve shafts shall be designed to accept a hydraulic cushion in case future modification is desired.

G. Check valves shall be Golden-Anderson Model 250DOC, APCO Series 6000B or approved equal.

H. PVC check valves for valve pit drain piping shall be Red Valve Series 2633, Tide Flex TF-2 or approved equal.

4.4 Sluice Gate

The gate shall be cast iron with an appropriate operator. An operating stem with 2" square operating nut shall be included on the sluice gate and shall extend to about 6" below the bottom of the manhole’s top slab in line with a floor box. All components and hardware shall be stainless steel or other corrosion-resistant materials approved by the Utility. The gate shall conform to the AWWA Standard for sluice gates (C501-80) and shall be manufactured by the Rodney-Hunt Co., Waterman Industries, Inc., Hydro-Gate Corp., or approved equal.
4.5 Surge Relief Valves

A. Pump stations designed for a total dynamic head greater than 100 feet and/or force main velocity greater than 4 feet per second shall be evaluated to determine the need for a surge relief valve. The surge relief valve shall be designed to prevent damage to any piping, valves, or other equipment in the event of a power failure during operation of all pumps in the station.

B. Any surge relief valve shall be installed in the valve pit with discharge into the wet well.

C. The surge relief valve shall meet the same material and pressure-rating requirements as the check valves.

D. Surge relief valve design and construction shall be approved by the Utility. Surge relief valves shall have a hydraulic cylinder and externally-adjustable spring. Surge relief valves shall be APCO Angle-style Surge Relief Valve (Drawing No. S-3000) or approved equal.

4.6 Air Release Valves

Automatic air release valves (ARVs) shall be installed per the City of Oxford Standard Specifications and Details at each high point on the force main and at other appropriate locations. Air release valves shall not be installed in the valve pit.

4.7 Pressure Determination

A. Each pump discharge line shall have a ½” NPT tap with a lever-operated ball valve installed in the valve pit between the wall and the check valve to permit installation of a pressure gauge (by the Utility).

B. A full-size flanged pressure sensor (minimum 4”) as manufactured by Red Valve (Series 40) or approved equal shall be installed on the common force main between the individual pump isolation valves and the valve on the common force main. A stainless steel, glycerin-filled diaphragm gauge suitable for raw sewage service shall be provided on this pressure sensor. The gauge shall have at least a 4 ½-inch face with a polycarbonate window and a full scale pressure of approximately twice the shut-off head of the pump.

C. Piping and connections shall be NPT stainless steel or brass with a minimum pressure rating of 200 psi.

D. Ball valves shall be lever operated stainless steel with vinyl grip handles and NPT connections. Valves shall be rated for at least 350 psi working pressure. Hydrostatic tests shall be performed with ball valves turned off.

4.8 Painting - General

All piping inside the wet well, valve pit, and otherwise exposed to air or sewage shall be provided with an epoxy primer on the exterior—NOT the standard asphaltic coating. These pipes shall be field-painted with epoxy-based paint per the below specification.
4.9 Painting - Products

A. All painting materials shall be by the Tnemec Company, Inc.; equals by Ameron (VyGuard); DuPont or equal. The painting schedule has been prepared on the basis of Tnemec products (unless otherwise noted) and Tnemec recommendations for application. These specifications are not intended to override the paint manufacturer’s recommendations for application.

B. All painting materials shall be delivered to the mixing room in unbroken packages, bearing the manufacturer's brand and name. They shall be used without adulteration and mixed, thinned and applied in strict accordance with manufacturer's directions for the applicable materials and surface and with the Engineer's approval before using.

C. Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with the finish paints to be used.

D. No paint containing lead will be allowed.

E. Work areas will be designated by the Engineer for storage and mixing of all painting materials. Materials shall be in full compliance with the requirements of pertinent codes and fire regulations. Proper containers outside of the buildings shall be provided and used for painting wastes and no plumbing fixture shall be used for this purpose.

4.10 Painting – Preparation of Surfaces

A. All surfaces to be painted shall be prepared as specified herein and shall be dry and clean before painting. Special care shall be given to thoroughly clean surfaces to receive polyamide cured epoxy paint of all marks before application of finish.

B. All metal welds, blisters, etc., shall be ground and sanded smooth. All pits and dents shall be filled and all imperfections shall be corrected so as to provide a smooth surface for painting. All rust, loose scale, oil, tar and asphalt bearing coatings, grease and dirt shall be removed by use of approved solvents, wire brushing, grinding or sanding.

C. All PVC pipe and other plastic matrix surfaces to be painted shall be lightly sanded and cleaned of residue before painting.

D. Galvanized, aluminum and copper surfaces shall have all oxidation and foreign material removed before painting by SSPC SP1, using an approved V.O.C. compliant method. Galvanized and, when ordered, the other metal surfaces specified above shall be hand tool cleaned to SSPC SP2 standards to provide a uniform 1 mil surface profile.

4.11 Painting – Painting Schedule

A. All colors will be selected by the Utility.

B. The following types of paints by Tnemec Co. have been used as a basis for the paint schedule:

1. Hi-build Epoxoline (Series 66) - polyamide cured epoxy
2. Envirofil (No. 130-6602 off-white color) - waterborne cementitious acrylic
3. Endura-Shield III - semi-gloss (Series 73) - high-build acrylic polyurethane enamel.
4. Silicone Aluminum (No. 39-661) - high heat silicone aluminum (to 600 degrees F).
5. FC Typoxy (Series N27) - tie coat, low VOC, polyamide epoxy.
6. PVA Sealer (No. 51-792) - vinyl acrylic primer.

C. The following surfaces shall have the types of paint scheduled below applied at the dry film thickness (DFT) in mils per coat noted:

1. Exterior ferrous metals (except first coat-hollow metal-pressed metal work).
   a. 1 coat No. 66 (white in color) on properly prepared unprimed metal or for touch-up (2.0-3.0 DFT)
   b. 1 coat Series 66 (4.0 DFT), 1 coat Series 73 (3.0 DFT)
2. Interior ferrous metals (except first coat-hollow metal-pressed metal work).
   a. 1 coat No. 66 (white in color) on properly prepared unprimed metal or for touch-up (2.0-3.0 DFT)
   b. 2 coats Series 66 (3.0 DFT)
3. Plastic piping and, where scheduled to be painted, plastic components
   a. 2 coats Series 66 (3.0 DFT)
4. Previously painted metal surfaces and hollow metal-pressed metal work - first coat on substrates prepared as approved and replacing first coat of above-specified systems. Complete painting with remainder of specified system for each type of substrate.
   a. First Coat - FC Typoxy Series N27 (5 DFT)

4.12 Painting – Workmanship

A. General

1. Protection of movable objects, equipment, fittings and accessories shall be provided throughout the painting operation. Canopies of lighting fixtures shall be loosened and removed from contact with surface, covered and protected and reset upon completion. Remove all electric plates, surface hardware, etc, before painting, protect and replace when completed. Mask all machinery nameplates and all machined parts not receiving a paint finish. Dripped or spattered paint shall be promptly removed. Lay drop cloths in all areas where painting is being done to adequately protect flooring and other work from all damage during the operation and until the finished job is accepted.

2. On metal surfaces apply each coat of paint at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. One gallon of paint as originally furnished by the manufacturer shall not cover a greater area when applied by spray gun than when applied unthinned by brush. Deficiencies in film thickness shall be corrected by the application of an additional coat(s).

3. Upon completion, remove all paint where it has been spilled, splashed, or sputtered on all surfaces, including floors, fixtures, equipment, furniture, etc, leaving the work ready for inspection.
B. Field Priming

1. Steel members, metal castings, mechanical and electrical equipment and other metals which are shop primed before delivery at the site will not require a prime coat on the job. All piping and other bare metals to be painted shall receive one coat of primer before exposure to the weather, and this prime coat shall be the first coat as specified in the painting schedule. Surface preparation of bare metal shall be the responsibility of the Contractor.

2. Equipment which is specified to receive a baked-on enamel finish or other factory finish shall not be field painted unless the finish has been damaged in transit or during installation. Surfaces that have been shop painted and have been damaged or where the shop coat or coats of paint have deteriorated, shall be properly cleaned and retouched before any successive painting is done on them in the field. All such field painting shall match as nearly as possible the original finish. Preparation and painting shall be provided by the Contractor.

3. Equipment shipped with a protective shop painting coat or coats shall be touched up to the satisfaction of the Owner with primers as recommended by the manufacturer of the finish paint. Preparation and painting shall be provided by the Contractor.

C. Field Painting

1. All painting at the site shall be under the strict inspection of the Owner. Only skilled painters and, where dictated by special conditions or systems and so ordered, specialist painters shall be used on the work.

2. All paint shall be at room temperature before applying, and no painting shall be done when the temperature is below 60 degrees F, in dust-laden air, when rain or snow is falling, or until all traces of moisture have completely disappeared from the surface to be painted.

3. Successive coats of paint shall be different shades (from paint manufacturer's stock or shop mixed paint) of the required colors so as to make each coat easily distinguishable from each other with the final undercoat the approximate shade of the finished coat to ensure no show-through as approved.

4. Finish surfaces shall not show brush marks or other irregularities. Undercoats shall be thoroughly and uniformly sanded with the type paper appropriate for the undercoats to remove defects and provide a smooth even surface.

5. Painting shall be continuous and shall be accomplished in an orderly manner so as to facilitate inspection. Materials subject to weather shall be primed coated as quickly as possible. Surfaces of exposed members that will be inaccessible after erection shall be cleaned and painted before erection.

6. All painting shall be performed by approved methods with number of coats modified as required to obtain the total dry film thickness specified. Spray painting shall be performed specifically by methods submitted and as approved by the Owner.

7. All surfaces to be painted as well as the atmosphere in which painting is to be done shall be kept warm and dry by heating and ventilation, if necessary, until each coat of paint has hardened. Any defective paint shall be removed and repainted in accordance with the Owner's directions.

8. Before final acceptance of the work, all damaged surfaces of paint shall be cleaned and repainted as directed by the Owner.
5.0 ELECTRICAL

All electrical equipment and components shall conform to the following specifications:

5.1 General Requirements

A. All electrical components shall meet NEMA standards, and shall comply with the most current version of NEC and UL as applicable to construction and installation of wiring and components. The electrical system inside the wet well shall comply with the National Electric Code for Hazardous Locations, Class I, Division 1, Group D.

B. All enclosures, panels, etc. (including the motor control panel) shall be UL-listed and shall be fabricated by a UL certified and registered manufacturer of electrical panels in accordance with NFPA 79 Electrical Standards for Industrial Machinery. Manufacturer must produce documentation demonstrating that they are UL certified and registered before shop drawings for the panel(s) will be reviewed. Firms pre-qualified to fabricate the panels are:

1. Adgo, Inc.
   3988 McMann Road
   Cincinnati, Ohio 45245

2. Panelmatic Cincinnati, Inc.
   258 Donald Drive
   Fairfield, Ohio 45018

3. Panel FAB, Inc.
   10520 Taconic Terrace
   Cincinnati, Ohio 45215

C. An enclosure complete with all electrical equipment and appurtenances shall be supplied with each sanitary sewer pump station as described in this section and outlined on the Drawings. The enclosure shall be located on a separate reinforced concrete pad adjacent to the wet well as close to the wet well as safely and practically possible. The pad shall be of sufficient size to support the enclosure and provide access in accordance with NEC requirements.

D. The utility company electric meter, utility company CT enclosure, service entrance-rated main breaker or fusible disconnect, and automatic transfer switch enclosure shall be mounted on a structure of 3" stainless steel strut (square tubing and U-channel) to one side of the main motor control panel enclosure on the same concrete pad (see detail on Drawing). The control transformer shall be mounted either on the stainless steel strut or on the side or back of the main control panel enclosure.

E. Approved Drawings shall be stamped and signed by a licensed professional engineer in the State of Ohio.

F. All electrical devices, conduit, wiring and grounding must be installed and connected by a licensed Electrical Contractor. The Electrical Contractor will be responsible for obtaining all necessary permits and inspections.

G. Equipment, materials, and installation shall comply with the requirements of all federal,
5.2 Enclosures

A. The main enclosure shall contain both the motor control panel and the Supervisory Control and Data Acquisition (SCADA) equipment. The SCADA equipment shall be separated from the motor control panel as shown on the Drawings. Refer to Section 7 for requirements of the SCADA system. Hardwire controls must be kept away from the RTU to prevent electrical noise interference.

B. Enclosures supplied with each station shall be freestanding, double-door Hoffman # A-74H7224SSLP or equal (or appropriately sized equivalent) and shall be rated NEMA Type 4X. The enclosure shall be large enough to provide an unused space equal to at least 30% of the space required. This space shall be reserved for installation of future equipment by the Utility, and no wiring or controls shall intrude into this reserved space. The construction shall be of 12-gauge 304 stainless steel, in accordance with ASTM A-167, and shall include a continuous hinge on each door and smooth seamless sides. All bolts, screws, pins, and other fasteners used in the enclosure shall be stainless steel.

C. The enclosure shall include add-on kits equal to the Hoffman kits listed by catalog number below:
   1. Two A-DSTOPK Door Stop Kits.
   2. Two A-LF16M18 Lights with remote switch.
   3. Two Design-air Electric Heaters, 115 volt, with built-in thermostat, Model D-AH4001B or other Hoffman model sized properly to ensure proper air transfer and heating of entire enclosure (provide 20°F temperature rise above ambient).
   4. Hoffman Model A-CSHELF18 (18"x18") Folding Shelf Kit bolted to inside of enclosure’s inner door.
   5. A-DP2 Data Pocket mounted inside the enclosure.
   6. A-DK72SS6 stainless steel Drip Shield Kit.

D. Each enclosure shall have a door-in-door arrangement with interior swing-out panels on each side. The alternating on-off switch, circuit breakers, control switches, pilot lights, etc., shall be accessible to the operator from the inner panel without opening the inner doors. The outer panel shall be void of control devices.

E. The outer panel doors of the enclosure shall be secured as follows: Both the right-hand and left-hand doors shall be secured with pad-lockable Hoffman latch, Cat. # A-L1CR.

F. The subpanel in the back of the main enclosure shall be steel painted with white ceramic paint (Hoffman A-72P72 or equal). All other components of the enclosure shall be stainless steel.

G. An outline drawing of the control panel shall be provided, showing panel elevation, dimensions, and weight. Interconnecting/one-line wiring diagrams shall be provided, which show all electrical connections within the control panel as well as between field-installed equipment and the control panel. Schematic control wiring diagrams shall be provided, showing all control components, switches, pilot lights, relays, etc. The wiring diagrams shall indicate wire and terminal numbers using the standard numbering system. Each component shall be uniquely labeled. A copy of all as-built electrical/control/instrumentation drawings shall be laminated (or otherwise sealed in
plastic) and permanently located in the main control panel enclosure.

H. The Contractor shall provide for the Utility to inspect the motor control panel during fabrication and testing when the panel is substantially complete, but before it has been shipped from the site of assembly. This inspection shall be by one of the following methods at the discretion of the Utility: either employees of the Utility will travel (at the Utility’s expense) to the site of assembly, or the Contractor shall provide to the Utility sufficient digital photographs in a format acceptable to the Utility clearly showing all portions and details of the control panel to the Utility’s satisfaction. The control panel shall not be shipped without the approval of the Utility.

I. A 24”x24”x8” (minimum) stainless steel NEMA 4X junction box with stainless steel drip shield shall be mounted over the wet well over a 4” (minimum) sleeve through the wet well top slab (See detail on Drawing). The door of this junction box shall open in a direction away from any access hatches in the wet well, and the door shall be padlockable. All wires entering the wet well or other hazardous area (pump power and control wires, float wire, etc.) shall extend through at least 24” of open air below the junction box and shall be connected to terminal blocks inside this junction box with corresponding wires extending to the main control panel. Terminals shall be labeled as “Pump 1,” “Pump 2,” etc. Cord grip connectors with stainless steel braided wire sleeves (as shown on the Drawings) shall be used at the bottom of this junction box for all wires entering the wet well to seal the opening and provide strain relief for the wires. The Contractor shall post the following sign on the exterior surface of the junction box:

DANGER
HIGH VOLTAGE
ENERGIZED BY MULTIPLE POWER SOURCES
DISCONNECT BEFORE SERVICING

5.3 Circuit Breakers

A. All circuit breakers shall be of the thermal magnetic type, with molded case breakers. Breakers shall be UL-listed and CSA-certified, and shall meet Federal Specification W-C-375B/GEN.

B. Three-pole breakers shall be manufactured by Square D and shall have a short-circuit rating equal to 125% of the available fault current. Regardless of the available fault rating, circuit breakers shall not be less than Style FA for applications under 100 amps, or Style KA for applications from 100 to 250 amps.

C. Single-pole breakers shall be Square D QOU series and shall be used for control circuitry and peripheral devices.

D. A main circuit breaker shall be provided inside the main enclosure for the control panel (on the load side of the automatic transfer switch), with separate circuit breakers for each motor and transformer primary, as well as single-pole circuit breakers for control circuitry, RTU, lighting, flow meter, generator block heater, generator battery charger, receptacles, etc. Another 100-amp (minimum) service-entrance-rated circuit breaker or fusible disconnect shall be provided in a NEMA 4X stainless steel enclosure outside the main enclosure on the line side of the automatic transfer switch, lightning arrester, etc. Each breaker shall be fully coordinated with its upstream breaker to ensure the appropriate breaker trips under fault
conditions.

E. Circuit breakers for the main, pumps, 3-phase voltage monitor and control transformer shall be accessible by opening the inner door. The main breaker shall have an external handle mounted on the inner door. All other circuit breakers shall be accessible to the operator through the inner panel door, once the outer door is open, without having to come in contact with open wiring. The motor branch circuit breakers shall be provided with an attachment that allows the operator to lock-out the circuit in the “Off” position.

F. A minimum of two spare 120-volt AC, 20-amp circuit breakers shall be provided and mounted on the panel.

5.4 Starters

A. Motor starters shall be electronic overload starters with adjustable trip phase loss, ground fault, and phase reversal protection. They shall be equipped with three poles and shall be provided with auxiliary contacts for use in the control circuit for overload alarm and for run status inputs to the SCADA system. Starters shall be Allen Bradley Bulletin 509 type with SMP-2 adjustable overload relay; Square D Class 8536 full voltage NEMA starters with optional solid state motor logic overload relay (Class 9065 if ordered separately); Furnas ESP 100 series, Class 14 with Class 20 trip overload, with solid state adjustable thermal overloads; or Cutler Hammer A200 Freedom line starter with equivalent features. No other starters will be considered equal or allowed.

B. Starters shall conform to all NEMA ratings. The minimum size starter shall be NEMA 1.

C. Electronic soft-start starters shall be supplied for all motors 30 horsepower or larger or where otherwise required by a local power company or the Utility. Soft-start starters shall be Allen Bradley SMC Flex or approved equal. The basic features shall include:

1. Soft Start that gradually increase the voltage over a programmable time period
2. Soft Stop that gradually decreases the voltage over a programmable time period
3. Pump Control to minimize surges
4. Motor Protection
5. Metering
6. LCD Display
7. Keypad programming
8. Auxiliary contacts for remote interface
9. Undervoltage/Overvoltage/Unbalance protection
10. Ethernet communications (20-COMM-E)

5.5 Control Transformers

A. Control transformers shall be dry type, stainless steel enclosed (NEMA 3R), mounted external to the main control panel. Primary voltage shall be 480 volt AC (same as main power supply) and secondary voltage shall be 120 volt AC. Transformer case must be grounded.

B. The transformer shall be 10 KVA and shall be protected by circuit breakers on the primary and secondary sides. The transformer shall be Square-D Model 10S40FSS, Cutler Hammer S20N11S10 or approved equal.
C. Control transformers for 24-volt control shall be 120-24V, 100VA mounted inside the control panel. Transformer to be ACME Model TA-2-81143 or approved equal.

5.6 Control Relays

A. All control relays shall be of the 8- or 11-pin octal plug-in type, Allen Bradley 700-HA32A1 or equivalent. Relays may be either direct panel-mounted or DIN rail-mounted. Control relays shall be of at least DPDT configuration.

B. An intrinsically safe relay (Warrick Series 27A1D0 Intrinsic Barrier or approved equal) shall be provided for operation with the float switch. Wiring associated with the intrinsically safe relay shall adhere to UL requirements for intrinsically safe wiring and shall be segregated from other power and control wiring.

5.7 Lead Pump Selection/Alternation

A. Alternation of the lead pump will be accomplished by the SCADA programming.

B. A lead pump selection switch shall be provided in the control panel to allow for selection of any pump as lead pump or auto-alternating. Selector switch shall be Allen Bradley 800T Series or approved equal.

5.8 Switches and Pilot Lamps

A. All lamps shall be of the transformer type.

B. Switches and pilot lamps shall be oil-tight and shall meet NEMA standards for A600 heavy-duty contacts. Each pump shall have a separate selector switch with the following settings: HAND -- OFF -- AUTO. Each pump shall also have a green pilot lamp connected to auxiliary contacts on the starter to indicate when the pump is running. These switches and lights should be located inside the control panel.

C. All HOA switches and pilot lamps shall be Allen-Bradley 800T series or approved equal. Switches and pilot lamps shall be oil-tight and shall meet NEMA standards for A600 heavy-duty contacts. All pilot lamps shall have the push-to-test feature.

5.9 Voltage Monitors

A. A voltage monitor shall be supplied to monitor the incoming voltage. This unit shall be manufactured by SSAC, Model No. WVM911AL (480 volt) or approved equal. The monitor shall be rated at 480 volt AC, consistent with the incoming voltage source. The restart delay shall be adjustable from 0.25 to 64 seconds. Voltage monitor shall monitor all incoming phases. Protection of the voltage monitor, on the incoming voltage, shall be through 2-amp fast-blow fuses (Bussman KTK-R2 or equal).

B. When a power alarm condition occurs, an alarm shall be sent via the SCADA system after an adjustable time delay.

5.10 Wiring and Cable

A. All wiring and cable installation shall conform to NEC regulations and shall comply with
local codes. All conductors shall be copper. Wiring shall not be operated above 75° C.

B. For electrical equipment feeders (motor control centers, motor branch circuits, etc.), located below grade or for exterior control and motor circuits, wiring shall be NEC Type THHN through #2 AWG and NEC Type RHH for larger than #2 AWG.

C. For branch circuits for lighting and receptacles, wiring shall be NEC Type THHN in conduit. For branch circuits for interior control, wiring shall be NEC Type MTW.

D. Power wiring shall be 12 AWG minimum, and control wiring shall be 14 AWG minimum.

E. For instrumentation (i.e. 4-20 mA signals), cables shall be 16 AWG copper, NEC-Type TC rated at 600 volts (Belden No. 1118A or equal) individually shielded twisted pair cable. All digital signal wires may be of the type of wire specified above.

F. All SCADA and signal wires shall be in conduit separate from any AC power lines. All motor circuits must be in separate conduits apart from any lighting, receptacle, or control wiring.

G. All conductors shall be sized such that voltage drop does not exceed three percent for branch circuits or five percent for feeder branch circuit combinations.

H. The use of pulling compound shall be required in all installations of wire pulled in conduit as needed. All conduits shall be sized in accordance with NEC regulations and/or local codes.

I. All terminal blocks shall be Allen Bradley terminals Model # 1492-CA1 for wire sizes #22 - #8 with mounting channel Model # 1492-N1, end barriers Model # 1492-N16, and end anchors Model # 1492-N23, or approved equal. At least 10% spare terminals shall be provided on all terminal strips. Bare wire ends shall be connected into the recessed terminals. No fork-tongue compression terminals shall be used unless approved by the Owner for specific applications. No more than two wires may be connected to any individual terminal. A UL-listed anti-oxidation compound shall be used on any wires connected with wire nuts.

J. All wiring and components shall be tag-numbered and clearly marked at each termination in accordance with the drawings and as directed by the Engineer. Wire tags shall be heat shrink type wire markers with permanent legible machine printed markings and numbers. Adhesive or taped-on tags are not acceptable.

5.11 Raceways and Conduit

A. All conduits shall be of one of the following types:

1. Rigid aluminum, which shall comply with NEC and local codes. Rigid aluminum conduit shall be used for all above-grade installations and shall not be used for buried conduits.
2. PVC plastic, which shall be Schedule 80. All PVC conduit shall comply with NEC and local codes and have glued joints. PVC conduit shall not be used for interior conduits or above-grade exterior conduits, but shall be used for all buried conduits.
3. Liquid-tight, shall be flexible non-metallic conduit with fused PVC jacket. This
conduit shall have a smooth non-wrinkling PVC jacket that will not pull away from fittings. Flexible conduit shall be installed with appropriate non-metallic fittings. This conduit shall be Carflex liquid-tight Type LFNC-B as manufactured by Carlon or approved equal. Liquid-tight conduit shall be used for any final runs into instrumentation equipment, and shall not exceed 18 inches in length.

B. Conduits between the wet well and control panel shall have a minimum size of 2" and shall be as follows, unless otherwise noted or approved by the Utility:

1 conduit for each pump power wiring
1 conduit for miscellaneous pump wiring (use for both pumps)
1 conduit for future mixer or influent grinder (spare)
1 conduit for high level float to sluice gate manhole via wet well junction box (this conduit also used for future MultiTrode level sensor)
1 conduit for yard light (1" conduit)–to yard light, not wet well.
1 conduit for telephone – to telephone service, not wet well
2 conduits for radar level sensor power/signal (each conduit to be 1")

C. All conduits shall be tagged and identified with brass tags held on by copper wire at both ends.

D. Conduit routing and wire-pulling schedules shall be submitted with shop drawings. The Utility shall inspect and approve conduit installation prior to backfilling.

E. Conduits for three phase wires between the main transformer and the transfer switch, as well as between the generator and the transfer switch, shall be encased in a minimum of three inches of concrete on all sides. Other conduits shall be encased in concrete when shown on the plans. Other buried conduits may be encased at the discretion of the Contractor. Concrete encasement shall be colored as required by electrical codes. Buried conduits shall be backfilled with gravel, sand or dirt (no rocks). Provide caution tape in trench.

F. Plastic conduit spacers shall be used for all buried conduits, whether encased in concrete or not.

G. Where underground PVC conduit turns to go above ground, provide an Aluminum-to-PVC transition fitting below grade. For the portion of aluminum conduit that is below grade, coat the conduit with Scotchwrap primer (or approved equal) and wrap it with 10 mil corrosion tape. Tape to be 3M Scotchwrap 50 or approved equal.

H. Exposed conduit ends shall be sealed with Liquid Nails expanding foam sealant or equal.

5.12 Grounding

A. All submitted site plans shall show a grounding scheme. Grounding shall comply with NEC requirements. All equipment, reinforcing steel and SCADA antenna shall be grounded as required by NEC.

B. Ground rods shall be driven vertically into the earth not more than one foot below finished grade. Multiple ground rods shall be connected in a triad configuration. All connections made below grade shall be exothermic.
C. The grounding system shall be tested using the fall-of-potential method at the point where
the grounding electrode conductor connects to the main power distribution equipment.
The test shall not be performed within 48 hours after a rainfall event. The resistance value
of the main grounding conductor measured between the main and a good earth ground
shall not exceed five ohms. Results of the test shall be submitted to the Utility in a written
report, which shall include:

1. Type of instrument used
2. Ground resistance readings obtained at various test distances
3. Ground resistant/distance curve
4. Value of grounding electrode resistance at knew of curve
5. Sketch showing setup of instrumentation and location of grounding electrode(s) and
test probes
6. Proposed method to achieve the specified resistance, should an unacceptable reading
be obtained
7. Ground resistance readings obtained after incorporating modifications (if
applicable).

5.13 Security System Devices

A. Security system devices shall be furnished and installed as described below.

B. For pump stations with a building, a limit switch shall be mounted on each exterior door
such that the switch opens when the door is opened. All such switches shall be connected
in series to the Site Entry input point on the SCADA RTU.

C. The control panel shall have a limit switch mounted at each exterior door such that the
switch opens when the door is opened. All such switches shall be connected in series to
the Site Entry input point on the SCADA RTU.

D. A limit switch shall also be mounted at the control panel subpanel door that covers the
SCADA RTU, radio, modules, etc. such that the switch closes when this subpanel door is
opened. This limit switch shall be connected to the Tamper Switch input point on the
SCADA RTU.

E. Limit switches at building doors shall be Allen Bradley Model BUL802M-AY5 (or
approved equal) with lever arm. Conduit shall be continuous to the limit switch or the
Contractor shall install heavy duty, moisture proof cable Type ST00W-A 16 AWG 4C by
AIW Corp. or equal from the limit switch to the conduit grip end.

F. An Allen Bradley Model 800T-H33A key switch shall be used for the operator
("Entry/Depart") switch.

G. Limit switches on panel doors shall be Allen Bradley Model 802M-AY5 or approved
equal.

5.14 Nameplates

A. Engraved nameplates shall be provided for every circuit breaker, control switch, pilot
light, etc. Nameplates shall be white-faced tags with engraved black letters. Letters shall
be at least 3/16-inch in height.

B. Nameplates shall be attached to the panel by means of stainless steel machine screws or stainless steel rivets.

5.15 Line-Surge Protection

A. A lightning arrester and line-surge capacitor shall be provided on the incoming power lines. The lightning arrester shall be of the 650-volt, 3-phase, "Transquell" type, as manufactured by General Electric Co., Cat. No. 9L15ECC001, Square D Model SDSA3650, or approved equal. Line-surge capacitors shall be 650-volt, 3-phase, non-toxic liquid-insulated, as manufactured by General Electric Co., Cat. No. 9L18BBB301, or approved equal. The lightning arrester and line-surge capacitor shall be mounted outside the control panel.

5.16 Elapsed-Time Meters

A. An elapsed-time meter connected to auxiliary contacts on the pump starter shall be furnished for each pump.

B. Elapsed-time meters shall have an increment of 1/100 hour.

C. Elapsed-time meters shall be non-resettable.

D. An elapsed-time meter shall be furnished that indicates when two pumps run simultaneously. It shall be connected to auxiliary contacts from each pump starter connected in series.

E. Elapsed-time meters shall be Grasslin Model FWZ72-120V or approved equal.

5.17 Site Lighting

A 1,500 watt Quartz flood light shall be mounted on a wooden pole at least 15 feet above the ground. For installations where the antenna is installed on a wooden pole, the light may be installed on the same pole below the antenna. The light shall be Model QF1500 by Rab Electric Manufacturing Co., Hubbel, General Electric, or approved equal, with appropriate lamp. Conduit shall be extended continuously up the pole to the light. A two-position switch shall be mounted on the interior door of the main control panel to control this light. A photoelectric cell shall not be installed.

5.18 Telephone Service

A. Telephone service shall be provided for any pump station that utilizes a dialer.

B. All underground phone cable shall be Type C5 with gel-filled coating, approved for underground use, whether direct-buried or installed in conduit.

5.19 Receptacles

Duplex receptacles shall be furnished where shown on the Drawings. Receptacles shall be 20 Amp, 120 volt, with ground fault circuit protection. Mount one receptacle inside the
control panel behind the inner door. Mount another beside the panel in an FS box with a Meyers hub, and plastic in-use type cover. Provide separate breakers for each inside the control panel.

5.20 Uninterruptible Power Supply (UPS)

A. Provide a 1,000 VA UPS in the main control panel. UPS shall be American Power Conversion (APC) Model No. SUA1000XL or approved equal capable of connecting to additional battery packs.

B. Provide an aluminum or stainless steel platform in the bottom of the panel for mounting the UPS.

C. Provide a dedicated, single (non-GFI) receptacle inside the bottom of the panel for the UPS.

D. The UPS shall power the following equipment:

1. SCADA PLC power supplies, including all I/O modules
2. Radio
3. Ethernet switch
4. Radar level sensor
5. High level float (intrinsically-safe relay)
6. MultiTrode controller (future)
7. Telephone dialer
6.0 STANDBY POWER

All requirements for standby power shall conform to the following specifications:

6.1 General Requirements

A. Standby power shall be provided for each permanent pump station and any other station where required by the Ohio EPA or the Utility (see Appendix A) through a permanent on-site standby generator with an automatic transfer switch and fuel tank.

B. Installation must comply with local electrical codes, as well as with any and all EPA and OSHA regulations.

C. NEC Compliance – Comply with applicable standby generator requirements of NEC including, but not limited to, emergency and standby power generation systems, and Articles 230, 517, 700, 701, and 702.

D. NFPA Requirements – Comply with applicable requirements of NFPA No. 37 and 110 pertaining to stationary combustion engines, and life safety code.

E. UL Compliance – Comply with applicable requirements of UL 1008, Automatic Transfer Switches.

6.2 Permanent On-Site Generator Set

A. Each generator set shall be sized to supply emergency backup power capable of starting and operating a sufficient number of pumps to pump the maximum design flow for the station, as well as operating all other electrical components. The generator set shall be manufactured by Caterpillar, Onan/Cummins, or Kohler, for 480 Volts (same as main power supply), 3 phase, 4 wire, 60 Hz operation, complete with all standard equipment and all accessories described herein.

B. Generator set shall be sized for sequential pump starting with a maximum voltage dip of 10%, maximum frequency dip of 10%, maximum harmonics of 10%, minimum 0.8 power factor and 130 °C temperature rise. Generator set shall be designed to allow pumps to run on future VFDs.

C. The backup power supply unit shall be a modular, self-contained package. Each permanent generator set shall be mounted on a raised reinforced concrete pad in a weatherproof steel enclosure with louvers and lockable, gasketed, removable panels to allow access to the engine, generator, and controls for easy routine maintenance. Enclosure shall be constructed of 14 gauge sheet metal with a minimum ambient capability of 125°F. The enclosure shall be mounted to the generator set structural steel base and shall be completely rodent-proofed. All hinges and locks shall be stainless steel with zinc plated hardware. A lockable service access cover shall be provided for easy access to the radiator fill cap. The roof shall be pitched to prevent moisture accumulation, and the exhaust silencer shall be mounted on top of the enclosure. An external mounted emergency stop switch shall be provided. Each piece of the enclosure shall be painted utilizing electrostatically applied polyester powder bake paint, prior to assembly. Enclosure color shall be a standard color to be selected by the Utility. Permanent
generators shall be located so as to be accessible by a truck for maintenance purposes.

D. A sound-attenuating treatment shall be provided to reduce sound levels to no more than 60 dBa at the closest existing or future residence. Information regarding sound levels shall be provided by the manufacturer with shop drawing submittals.

E. Engine:

1. The engine shall be water cooled in line, 4 stroke cycle compression ignition diesel. It shall meet specifications when operating on No. 2 domestic burner oil (ASIM D396). Diesel engines requiring premium fuels will not be considered. The engine shall be equipped with fuel, lube oil, and intake air filters; lube air coolers; fuel transfer pump; flexible fuel lines; fuel pressure gauge; oil drain extension and gear driven water pump. The engine shall be manufactured in the United States.
2. The governor shall maintain frequency regulation three (3) percent from no load to full rated load. Steady state operating band shall be ± 0.33 percent.
3. The unit shall be mounted on a structural steel base and shall be provided with vibration isolators between the base and generator set.
4. Safety shutoffs for high coolant temperature, low coolant level, low oil pressure, overspeed, and engine overcrank shall be provided.
5. Lube Oil shall be furnished by the generator set supplier.
6. Cooling system: An engine-mounted radiator with a blower-type fan shall be sized to maintain safe operation at 125° F. maximum ambient temperature. Air flow restriction from the radiator shall not exceed 0.5 in H₂O. The engine cooling system shall be filled with a solution of 50% ethylene glycol.
7. Exhaust system: Provide a stainless steel flexible exhaust element, hospital-grade exhaust silencer (unless otherwise approved), tail pipe and rain cap.

F. Each location with a permanent generator shall be equipped with a UL 142 listed sub-base fuel tank capable of supplying fuel sufficient for a minimum of forty eight hours of generator operation at full load. The fuel tank shall be self-contained and double-walled and with threaded pipe connections, mechanical fuel gauge, low level fuel switch with alarm contact, leak detection with alarm contact, vent with cap, emergency pressure relief vent and whistle valve to alarm when tank is full. Fuel tank shall comply with all local codes and ordinances. Provide a stub-up area to accommodate power wiring to the generator. The tank shall be factory installed to the generator set structural steel base by the generator set manufacturer.

G. Generator:

1. The generator shall be a 3 phase, 60 Hz, single bearing, synchronous type with brushless exciter and be built to NEMA Standards. Class H insulation shall be used on the stator and rotor, and both shall be further protected with 100% epoxy impregnation and an overcoat of resilient insulating material to reduce possible fungus and/or abrasion deterioration. Generator shall incorporate reactive droop compensation for parallel operation and shall also include fuses for exciter/regulator protection against extended low factor loads and faults. The generator rotor shall be layer wound, tested for 150% overspeed at 170° ambient and dynamically balanced to ½ mil. A 120 volt anti-condensation heater shall also be provided.
2. A generator mounted volts per hertz type regulator with 3 phase voltage sensing shall
be provided to match the characteristics of the generator engine. Voltage regulation shall be ± 1/2 % from no load to full rated load. Readily accessible voltage droop, voltage level and voltage gain controls shall be provided. Voltage level adjustment shall be a minimum of ±10%. Overvoltage shutdown protection shall be included.

3. A permanent magnet pilot excitation system shall provide power to the voltage regulator to improve the generator motor starting ability and short circuit support. It will also isolate the voltage regulator power circuit from voltage distortions created when the generator supplies a non-linear load.

H. Automatic Starting System:

1. A 12 or 24 volt DC electric starting system with positive engagement drive shall be furnished for each unit.

2. Fully automatic generator set start/stop controls in the generator control panel shall be provided. Control shall provide shut down for oil pressure, high water temperature, overspeed, overcrank and one auxiliary contact for activating accessories. Control shall include cycle crank with adjustable 1 - 60 second crank/rest period.

3. A 12 or 24 volt lead acid storage battery set of the heavy duty diesel starting type shall be provided for the unit. The battery set shall be of sufficient capacity to provide for 1 1/2 minutes total cranking time without recharging. A battery rack with necessary cables and clamps shall be provided.

4. A current limiting 2 rate battery charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicone diode wave reflectors, voltage surge suppressors, DC ammeter, DC voltmeter, low DC voltage alarm relay, and fused AC input. AC input voltages shall be 120 volt single phase. Amperage output shall be no less than 10 amperes. The charger shall be mounted inside each diesel generator enclosure. Chargers mounted inside the automatic transfer switch enclosure are not acceptable.

5. Provide on the engine, a unit mounted thermal circulation type water heater, incorporating a thermostatic switch that shall be furnished to maintain engine jacket water to 90°F in an ambient temperature of 30°F. Voltage shall be 120 volt, single phase, 60 Hz. Valves shall be installed in the inlet and outlet lines at the block to allow replacement of the lines and heater element without draining the cooling system.

I. Main Line Circuit Breaker

1. Provide a generator mounted UL listed main line molded case circuit breaker (minimum rating of 100 amp), which shall be installed as the generator load circuit interrupting and protection devices. It shall operate both manually for normal switching function and automatically during overload and short circuit conditions.

2. The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection. The circuit breaker shall meet standards established by Underwriter’s Laboratories, National Electric Manufacturer’s Association, and National Electrical Code.

3. The circuit breaker must include all necessary lugs for the required wire size.

J. A generator mounted NEMA 1 type vibration isolated dead front, 14 gauge steel generator control panel, built in accordance with NFPA 110, shall be provided. The panel shall
contain, but not be limited, to the following:

1. Voltmeter/ammeter,
2. Frequency meter,
3. Ammeter/voltmeter selector switch,
4. Service hours,
5. Tachometer (engine rpm),
6. Oil pressure gauge,
7. Engine coolant temperature gauge,
8. Safety shutdown protection with led indicators or alarm lights (for low oil pressure, high coolant temperature, low coolant level, overcrank and overspeed),
9. Engine control switch (auto, manual start and off/reset),
10. Automatic starting controls as specified above,
11. DC battery voltmeter,
12. Cooldown timer, adjustable 1 – 30 minutes. Factory set for five minutes.
13. Emergency stop push button with LED indicator – red
14. Voltage adjust rheostat
15. Panel lights and on/off switch
16. Digital displays for meters must be accurate through a temperature range of -40°F to 158°F and distorted wave forms and SCR load applications shall not affect instrument accuracy.
17. Panel anti-condensation heater, if available.
18. Auxiliary prealarm module with LED annunciation or alarm lights for high coolant temperature, low coolant temperature, low oil pressure, low battery voltage, battery charger malfunction, low fuel level and system not in auto mode.
19. Alarm horn and silence button.

K. Auxiliary contacts shall be furnished and installed to interface with the SCADA system for monitoring purposes. This shall include an engine run relay and a common failure relay. Common failure shall include the following alarms:

1. Overspeed.
2. Overcrank.
3. High engine temperature.
4. Low oil pressure.
5. Low coolant temperature.
6. Low coolant level.
7. Pre-alarm high engine temperature.
8. Pre-alarm low oil pressure.
9. Battery charger malfunction and/or low battery voltage.
10. Low fuel level.
11. Fuel tank leak.

6.3 Automatic Transfer Switch

A. The Automatic Transfer Switch (ATS) shall be the electrically-operated type that is mechanically held in both operating positions. ATS shall be suitable for use in standby systems described in NFPA 70. The complete switch assembly shall be listed under UL-1008 for use on emergency systems. ATS shall be rated for continuous duty at the continuous current rating specified. All rating data shall be shown on shop drawings, and shall equal or exceed those specified. Switches shall be adequately rated for the
application indicated and shall have the following characteristics and features.
1. Voltage: 480 Volts AC (same as main power supply)
2. Number of Phases: Three (3)
3. Number of Wires: Four (4)
4. Number of Switched Poles: Three (3)
5. Frequency: 60 Hz
6. Type of Load: Total system load
7. Continuous Phase or Main Current Rating: Equal to or exceeding the rating shown, but in no case less than 125 percent of the full load rating of the emergency power source or 100 amperes.
8. Overload Rating: minimum 100 amperes, RMS symmetrical
9. Main and Neutral Contacts: Contacts shall have a silver composition and shall be protected by approved arcing contacts. Neutral contacts or busbar shall have not less than 1.5 times the continuous current rating of the main or phase contacts.
10. Auxiliary contacts for normal and emergency positions that shall be connected to SCADA.
11. Pilot lights to indicate normal or emergency switch position as well as normal or emergency source availability.
12. Maintain-type test switch and automatic exercise capabilities with load/no-load selector switch.
13. Enclosure: Stainless steel NEMA 4X with enclosure heater and drip shield. All switches, lights and other controls for the transfer switch shall be accessible to the operator without being exposed to wiring and terminals; such control devices shall be internal to the enclosure. Either on an inner hinged door or an inner removable “standout.” This inner door or “standout” shall shield the operator from all exposed wiring, terminals, and devices not accessed for routine operation. No controls or devices shall be mounted through the outside of the enclosure.

B. The transfer switch shall be double throw, actuated by two electrical operators momentarily energized and connected to the transfer mechanism by a simple over-center linkage to provide “quick-make”, “quick-break” operation of the contacts when operated electrically or manually. The switch shall provide a time delay in the “Off” position between the opening of the closed contacts and the closing of the open contacts to allow for the demagnetizing of motor and transformer loads. The time delay shall be a minimum of 25 Hz, and shall be adjustable 0-2 minutes (timers TETD and TNTD, both field set to 5 seconds). In-phase monitor systems are not acceptable.

C. The transfer switch shall be capable of transferring successfully in either direction with 70% of rated voltage applied to the switch terminals.

D. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Designs relying on electrical interlocks only are not acceptable. Main contacts shall be mechanically locked in position in both the normal and emergency positions without the use of hooks, latches, magnets or springs, and shall be silver tungsten alloy. Separate arcing contacts, with magnetic blowouts, shall be provided on all transfer switches. Interlocked molded case circuit breakers or contact are not acceptable.

E. The transfer switch shall be equipped with a safe manual operator designed to prevent injury to operating personnel. The manual operator shall provide the same contact-to-contact transfer speed as the electrical operator to prevent a flashover from switching the
main contacts slowly.

F. The transfer switch shall be equipped with a microprocessor based control system, to provide all the operational functions of the automatic transfer switch. The controller shall have two asynchronous serial ports. The controller shall have a real time clock with Nicad battery back-up. Other features include:

1. The CPU shall be equipped with self diagnostics which perform periodic checks of the memory I/O and communication circuits, with a watchdog/power fail circuit.
2. The controller shall include a 20 character LCD display, with a keypad, which allows access to the system.
3. The controller shall include three phase, over/under volt, over/under frequency, phase sequence detection and phase differential monitoring on both normal and emergency sources.

G. When the voltage on any phase of the normal source drops below 90% (Undervolt DO) or increases to 110% (Overvolt PU); or frequency drops below 90% (Underfreq DO) or increase to 110% (Overfreq PU); or 20% voltage differential between phase occurs (Differentialvolt PU), after a programmable time delay period of 0-9999 seconds to allow for momentary dips (timer TD1, field set to 5 seconds), the engine starting contact shall close to start the generating plant.

H. After the generating plant has reached specified voltage and frequency and following another programmable time delay period of 0-9999 seconds to allow the emergency source to stabilize (timer TD3, field set to 3 seconds), the transfer switch shall begin the transfer to emergency sequence.

I. After restoration of normal power on all phases to a preset value of at least 95% (Undervolt PU) to 105% (Overvolt DO) of rated voltage, and at least 95% (Underfreq PU) to 105% (Overfreq DO) of rated frequency, and voltage differential is below 20% (Differential PU), an adjustable time delay period of 0-9999 seconds (timer TD2, field set at 600 seconds) shall delay retransfer to allow stabilization of normal power. If the emergency power source shall fail during this time delay period, the switch shall automatically return to the normal source. Emergency source operating parameters shall be field set as follows: Undervolt PU = 90%, Undervolt DO = 80%, Overvolt PU = 120%, Overvolt DO = 110%, Underfreq PU = 90%, Underfreq DO = 70%, Overfreq PU = 120%, Overfreq DO = 110%, and Differentialvolt PU = 20%.

J. After retransfer to normal, the engine generator shall be allowed to operate at no load for a programmable period of 0-9999 seconds (timer AUT). The combined time of timer AUT and the cool-down timer in the generator controller shall be field set to no more than 330 seconds.

K. Approval - as a condition for approval, the manufacturer of the automatic transfer switches shall verify that his switches are listed by Underwriters Laboratories, Inc., Standard UL-1008 with 3 cycle short circuit closing and withstand of 42,000 RMS Symmetrical Amps.

L. During the 3 cycle closing and withstand tests, there shall be no contact welding or damage. The 3 cycle test shall be performed without the use of current limiting fuses, and
oscillograph traces across the main contacts shall be furnished to verify that contact separation has not occurred, and there is contact continuity across all phases after completion of testing. Test procedures shall be in accordance with UL-1008, and testing shall be certified by Underwriter’s Laboratories, Inc.

M. Transfer switch shall be Russelectric or approved equal.

N. The transfer switch shall have the following label affixed to the exterior surface of the panel:

DANGER
HIGH VOLTAGE
ENERGIZED BY MULTIPLE POWER SOURCES
DISCONNECT BEFORE SERVICING

6.4 Portable Generator (Temporary Pump Stations Only)

If no permanent generator is provided, a weatherproof auxiliary receptacle and manual transfer switch shall be provided suitable for connecting to the Utility’s portable generator. The transfer switch shall be 3-pole, 480 VAC, double-throw (center position off) stainless steel, externally-mounted. The transfer switch shall be Square D Class 3140 or equal. The receptacle shall be Killark, 200-amp, Style 1, 4-wire, 4-pole.
7.0 INSTRUMENTATION

All instrumentation shall conform to the following specification.

7.1 General Requirements

A. All pump stations shall be supplied with Supervisory Control and Data Acquisition (SCADA) equipment. The SCADA equipment shall include all materials and software; and all necessary installation, programming, and testing procedures shall be performed by the Contractor or by the Utility at the Contractor’s expense (as determined by the Utility). SCADA equipment shall conform to the existing WWTP SCADA system.

B. Level sensors and associated hardware shall comply with the specifications set forth in Part II – Liquid Level Devices.

C. Flowmeter, where required, shall comply with the specifications set forth in Part III – Flow Metering.

Part I – Supervisory Control and Data Acquisition (SCADA)

7.2 SCADA Equipment

A. The SCADA equipment shall be Allen Bradley SLC 500 with modular design to allow expansion and upgrading by adding or replacing individual modules. Configuration of the SCADA equipment shall consist of one complete Allen Bradley SLC 5/05 Enet processor module (Model No. 1747-L551), 7 slot mounting rack (Model No. 1746-A7) and power supply (Model No. 1746-P2). The processor shall be equipped with all input/output (I/O) modules needed to monitor and/or control all functions outlined in Sections 7.5 and 7.6, below. A 24 VDC power supply (Phoenix Contact Model No. PS100-240AC/24DC/1 or equal) shall be provided to power the I/O modules. A Model No. MDS entraNET 900 spread spectrum radio as manufactured by Microwave Data Systems and an Ethernet switch (Hirschmann RS2-TX or equal) shall also be included. The radio shall be programmed as necessary to integrate with the Utility’s existing systems. All cables necessary to connect the various components shall be provided. Use Category 5E Ethernet cable for Ethernet connections.

B. The processor shall be housed in the main control enclosure (see Section 5.2).

C. The Allen Bradley SCADA equipment can be obtained from Rexel Electric, Northwest Controls or other supplier.

7.3 Electrical

A. All wiring, conduits, and grounding shall adhere to the provisions and specifications in Section 5.10, Wiring and Cable; Section 5.11, Raceways and Conduit; and Section 5.12, Grounding.

B. Lightning protection must be provided on all DC signal loops connected to the RTU or instrumentation from a location outside of the main control enclosure. Surge protection shall be provided for the level sensor and signal. Equipment to be:
1. Level sensor power surge protection shall be CITEL Model DS210-D or approved equal.
2. Analog surge protection shall be Phoenix Contact Type UFBK-M2-PE-24DC-ST (Order No. 28 17 05 5) protective plugs with Type UAK-BE (Order No. 2748674) base elements or approved equal.

7.4 Antenna

A. A computer path study and an actual path study at the site shall be performed by J & K Communications, Inc., 222 South Tower View Drive, Columbia City, IN 46725, (260) 244-7975, or other approved in advance by the Utility, to determine antenna type and placement. A formal report with all documentation and data obtained from the study shall be provided to the Utility.

B. The antenna shall be an all-copper radiating structure enclosed in a weather-sealed, UV suppressed fiberglass tube. Included shall be a gold-anodized aluminum mounting sleeve and end cap. Rated wind velocity shall be for 150 mph. Antenna shall be Cellwave Model PD10108-2 (directional), Model A09209-24TO (omni-directional) or equal by decibel, as recommended by the path study and approved by the Utility. Location and height of the antenna shall be such that a 99% communications rate with the City of Oxford WWTP shall be guaranteed year round with a 15-year design goal.

C. Mounting shall be as determined by the path study. Wood utility poles used for antenna mounting shall be Class #5 up to 30' long and Class #4 for 30' to 70' long. Composite/fiberglass poles may be used instead of wood poles. Fiberglass poles shall meet the following requirements: 1) Direct burial, tapered shaft fiberglass reinforced composite, with color specified by the OWNER, 2) Include a coating to protect against ultraviolet radiation for at least 25 years, 3) Strength shall be comparable or greater than a Class #4 wood pole, 4) Horizontal load shall be 2,400 pounds or greater. Installation of poles must be plumb and straight. Poles with heights of 20-45 feet shall be buried to a depth determined by the following formula: 2 + (height/10). It is the responsibility of the Contractor to ensure that underground utilities are properly marked before digging. All mounting brackets shall be aluminum, stainless steel, or galvanized steel. Shop drawings for all antenna and antenna cable assembly hardware shall be submitted and approved.

D. Connection from the antenna to the RTU shall be through the use of Andrews ½-inch helix. Cable connectors shall be Andrews helix connectors Type N.

E. Installation of the cable, grounding and lightning protection shall conform to all manufacturer’s specifications.

F. The helix cable shall be properly grounded by the use of shield grounding kits. Surge suppression which is rated for exterior weather conditions shall be provided at the RTU end of the helix cable. A Polynhase bulkhead type lightning surge protector shall be provided for the antenna installation and shall be mounted on the outside wall of the main enclosure. Provide a lightning rod elevated above the antenna sufficient to provide a 60 degree core of protection.

G. The installation of the antenna shall be by a certified radio Contractor (J&K Communications or approved equal). This includes mounting antenna, installing all connectors, lightning protection and programming the radio.
7.5 I/O Requirements

A. All input/output points on a standard two-pump sanitary sewer pump station are presented in the list below. All inputs and outputs at the sanitary sewer pump station shall conform to this listing. Pump stations using soft starters will Ethernet communication and pump stations having more than two pumps will have slightly different input/output arrangements as directed by the Utility.

**Slot 1 Digital Input Module (1746-IB16)**

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Site entry</td>
<td>Limit switches on exterior doors</td>
<td>0 = alarm 1 = secure</td>
</tr>
<tr>
<td>2</td>
<td>Operator switch</td>
<td>Switch on subpanel door</td>
<td>0 = depart 1 = entry</td>
</tr>
<tr>
<td>3</td>
<td>Tamper switch</td>
<td>Limit switch on SCADA subpanel door</td>
<td>0 = secure 1 = alarm</td>
</tr>
<tr>
<td>4</td>
<td>Site Power</td>
<td>3-phase voltage monitor</td>
<td>0 = normal 1 = alarm</td>
</tr>
<tr>
<td>5</td>
<td>Spare</td>
<td>(Reserved for Smoke Detector)</td>
<td>0 = normal 1 = alarm</td>
</tr>
<tr>
<td>6</td>
<td>Spare</td>
<td>(Reserved for High Sump)</td>
<td>0 = normal 1 = alarm</td>
</tr>
<tr>
<td>7</td>
<td>Spare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Level Sensor Reset</td>
<td>Momentary pushbutton on Ctrl Panel</td>
<td>0 = normal 1 = reset</td>
</tr>
<tr>
<td>9</td>
<td>Pump #1 Auto</td>
<td>Relay contact from H-O-A Switch</td>
<td>0 = manual 1 = auto</td>
</tr>
<tr>
<td>10</td>
<td>Pump #2 Auto</td>
<td>Relay contact from H-O-A Switch</td>
<td>0 = manual 1 = auto</td>
</tr>
<tr>
<td>11</td>
<td>Spare</td>
<td>(Reserved for Pump #3 Auto)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Spare</td>
<td>(Reserved for Pump #4 Auto)</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Pump #1 Lead</td>
<td>From Lead Pump Selector Switch</td>
<td>0 = Auto 1 = Lead</td>
</tr>
<tr>
<td>14</td>
<td>Pump #2 Lead</td>
<td>From Lead Pump Selector Switch</td>
<td>0 = Auto 1 = Lead</td>
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<tr>
<td>15</td>
<td>Spare</td>
<td>(Reserved for Pump #3 Lead)</td>
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</tr>
<tr>
<td>16</td>
<td>Spare</td>
<td>(Reserved for Pump #4 Lead)</td>
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**Slot 2 Digital Input Module (1746-IB16)**

<table>
<thead>
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<th>No.</th>
<th>Name</th>
<th>Description</th>
<th>Status</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>P1 run status</td>
<td>Auxiliary contacts from motor starter</td>
<td>0 = off 1 = on</td>
</tr>
<tr>
<td>2</td>
<td>P1 fail</td>
<td>Contacts from motor starter</td>
<td>0 = normal 1 = fail</td>
</tr>
<tr>
<td>3</td>
<td>P1 overtemp</td>
<td>Contacts from Flygt MiniCAS</td>
<td>0 = normal 1 = fail</td>
</tr>
<tr>
<td>4</td>
<td>P1 seal leak</td>
<td>Contacts from Flygt MiniCAS</td>
<td>0 = normal 1 = fail</td>
</tr>
<tr>
<td>5</td>
<td>P2 run status</td>
<td>Auxiliary contacts from motor starter</td>
<td>0 = off 1 = on</td>
</tr>
<tr>
<td>6</td>
<td>P2 fail</td>
<td>Contacts from motor starter</td>
<td>0 = normal 1 = fail</td>
</tr>
<tr>
<td>7</td>
<td>P2 overtemp</td>
<td>Contacts from Flygt MiniCAS</td>
<td>0 = normal 1 = fail</td>
</tr>
<tr>
<td>8</td>
<td>P2 seal leak</td>
<td>Contacts from Flygt MiniCAS</td>
<td>0 = normal 1 = fail</td>
</tr>
<tr>
<td>9</td>
<td>Spare</td>
<td>(Reserved for P3 run status)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Spare</td>
<td>(Reserved for P3 fail)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Spare</td>
<td>(Reserved for P3 overtemp)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Spare</td>
<td>(Reserved for P3 seal leak)</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Spare</td>
<td>(Reserved for P4 run status)</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Spare</td>
<td>(Reserved for P4 fail)</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Spare</td>
<td>(Reserved for P4 overtemp)</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Spare</td>
<td>(Reserved for P4 seal leak)</td>
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**Slot 3 Digital Input Module (1746-IB16)**

50
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Spare</td>
<td>(Reserved for Multi-Trode Level 1)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Spare</td>
<td>(Reserved for Multi-Trode Level 2)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Spare</td>
<td>(Reserved for Multi-Trode Level 3)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Spare</td>
<td>(Reserved for Multi-Trode Level 4)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Spare</td>
<td>(Reserved for Multi-Trode Level 5)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Spare</td>
<td>(Reserved for Multi-Trode Level 6)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Spare</td>
<td>(Reserved for Multi-Trode Level 7)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Spare</td>
<td>(Reserved for Multi-Trode Level 8)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Spare</td>
<td>(Reserved for Multi-Trode Level 9)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Spare</td>
<td>(Reserved for Multi-Trode Level 10)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>High Level Float</td>
<td>From float in Sluice Gate Manhole</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Spare</td>
<td>(Reserved for Grinder Fail)</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Generator status</td>
<td>Auxiliary contacts from generator</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Generator fail</td>
<td>From generator common fail relay</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>ATS Status</td>
<td>Auxiliary contacts from transfer switch</td>
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</tr>
<tr>
<td>16</td>
<td>Spare</td>
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Slot 4 Digital Relay Output Module (1746-OV16)

<table>
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<th>No.</th>
<th>Name</th>
<th>Description</th>
<th>Status</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Communications fail</td>
<td>Local pilot lamp (Red)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Spare</td>
<td>(Reserved for High Sump pilot lamp)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Lead Pump Call</td>
<td>Local pilot lamp (Amber)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Generator Alarm</td>
<td>Local pilot lamp (Red)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Lag Pump</td>
<td>Call Local pilot lamp (Amber)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Spare</td>
<td>(Reserved for Grinder Fail pilot lamp)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Pump #1</td>
<td>Call Connect to pump cntrl cct</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Pump #2</td>
<td>Call Connect to pump cntrl cct</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Spare</td>
<td>(Reserved for Pump #3 Call)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Spare</td>
<td>(Reserved for Pump #4 Call)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>High Level Float</td>
<td>Local pilot lamp (Red)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Backup level control</td>
<td>Local pilot lamp (Amber)</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Pump #1 Fail</td>
<td>Local pilot lamp (Red)</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Pump #2 Fail</td>
<td>Local pilot lamp (Red)</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Spare</td>
<td>(Reserved for Pump #3 Fail)</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Spare</td>
<td>(Reserved for Pump #4 Fail)</td>
<td></td>
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</table>

Slot 5 Analog Input Module (1746-NI18)

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Station flow</td>
<td>0 - xxxx gpm</td>
</tr>
<tr>
<td>2</td>
<td>Wet well level</td>
<td>0 - xx feet</td>
</tr>
<tr>
<td>3 - 8 Spares</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Slot 6 Filler Plate (1746-N2)

Notes:  
1. Digital input: 0 = open contact, 1 = closed contact  
2. If applicable to site configuration

7.6 I/O Equipment

All input devices shall be identical to existing equipment previously installed on existing SCADA systems within City of Oxford sanitary sewer pump stations and/or specified in Section 5.

7.7 Programming and Testing

A. Programming of the local RTU, the Utility's central SCADA system, and other related equipment, as well as all testing procedures (OATs & FATs) shall be performed at the Contractor's expense by an integrator/programmer approved by the Utility. The Contractor shall resolve any equipment or wiring deficiencies discovered during the testing.

Part II – Liquid Level Devices

7.8 Float Switches

A. Float switches shall be supplied with a normally open contact closure rated at 10 amp. All floats shall have an adjustable external cable weight.

B. Each station shall have one float switch, which shall be located in the sluice gate manhole. It shall be connected to the SCADA system and will be used to indicate a high level and activate a pump if the radar level sensor fails.

C. All floats shall be provided with enough extra cable to permit installation at the bottom of the manhole. Cable shall be continuous from the float to the wet well junction box. Excess cable shall be neatly looped on a stainless steel float hanger. Cable support shall be provided for the float cable and shall consist of a stainless steel braided wire sleeve with attachment tails for the connection to the stainless steel float hanger. Float hanger shall be located at the edge of the hatch opening, unless otherwise shown on the plans or directed by the Engineer.

E. Float switches shall be non-mercury type, encapsulated mechanical tilt float type. Floats shall be Warrick F Series, Anchor Scientific or approved equal.

7.9 Radar Level Sensor

A. The radar level sensor shall be a pulse based microwave level sensor with the following basic features:

1. 4-20 mA analog output signal
2. 3" stainless steel flange
3. Aluminum epoxy coated housing
4. PTFE antenna material

B. Mount sensor to a flanged stainless steel plate anchored over a 6" diameter (or larger) sleeve in the top slab of the wet well. Level sensor shall be located over the lowest portion of the wet well away
from the grout fillet, pumps, pump cables, incoming sewer flow, and other items that could interfere with the radar signal.

C. Sensor to be Siemens Milltronics IQ Radar 300 or approved equal.

Part III – Flowmetering

7.10 General Requirements

A. All pump stations with variable frequency drives, all pump stations with a pumping capacity of 1,200 gpm or greater, as well as other pump stations specifically identified by the Utility, shall be provided with a flowmetering device for monitoring the discharge from each station. Station discharge piping shall be configured with a straight run of pipe with no valves, tees or reducers upstream of the flowmeter equal in length to at least ten pipe diameters and downstream of the flowmeter equal in length to at least six pipe diameters—or as otherwise recommended by the flowmeter manufacturer, to provide an acceptable flow pattern through the flowmeter.

B. All flowmeters shall be calibrated at the factory prior to shipment to the site. The contractor shall be responsible for the complete installation.

C. All new pump station flowmeters shall be magnetic flowmeters and shall include the transmitter, the remote-mounted flow tube, and the vendor-supplied shielded cable between the two elements.

7.11 Magnetic Flowmeter Flow Element

A. The flow element of the magnetic flowmeter shall conform to the following specifications.

B. Pulsed DC electromagnetic induction-type, providing a signal that is linear in relation to the liquid flow rate.

C. Functional/performance specifications shall be as follows:

1. Power requirements shall be matched to the flow transmitter/ converter.
2. Accuracy shall be 1 percent of rate (including the transmitter/ converter).
3. The flowmeter liner shall be suitable for operations in process liquid temperatures up to 95° C.
4. RFI protection shall be provided.
5. The flowmeter shall be capable of operations under pressures of 240 psi, if 150-pound flanges are used, and 700 psi, if 300-pound flanges are used.
6. The flowmeter shall be capable of running under no-flow conditions without damage to any component.

D. Physical specifications shall be as follows:

1. The metering tube of the flowmeter shall be carbon steel, unless otherwise indicated.
2. Flowmeter flanges shall be ANSI 150-pound carbon steel, unless otherwise indicated.
3. The flowmeter tube shall have a neoprene liner with liner protectors.
4. Electrodes shall be 316 stainless steel, bullet-nosed or elliptical self-cleaning type, unless otherwise indicated. The flowmeter shall have self-grounding electrodes.
5. Flowmeters shall be housed in below-grade vaults and shall have a submersion kit that will allow continuous submergence at a water depth of 33 feet. The unit shall be FM
certified for installation in Class 1, Division 2 hazardous locations.
6. All external surfaces of the flowmeters shall be painted with a chemical- and corrosion-resistant epoxy finish.

E. Accessories/options required:

1. All flowmeters shall be factory-calibrated. A copy of the calibration report shall be available during start-up and be included in the operations and maintenance manual. A startup report including the flow range, calibration factor, and other relevant information shall also be included in the O&M manual.
2. Flowmeters shall be grounded according to manufacturer’s recommendation. All accessories, such as a ground ring, ground wires, gaskets, etc., shall be provided as required or as otherwise specified. All materials shall be suitable for the liquid being measured.
3. The flowmeter shall be complete with potting compound and proper conduit seal to provide a water-tight seal for the cable.
4. The flowmeter shall comply with NEC Class 1, Division 2, Group D location.

F. Flowmeters shall be a Foxboro 9200 Series, Krohne, or approved equal.

7.12 Magnetic Flowmeter Transmitter/Converter

A. The flow transmitter/converter shall be supplied by the manufacturer of the flow element. It shall be Foxboro IMT-25 or approved equal.

B. Functional/performance specifications shall be as follows:

1. Power requirements shall be 120 volt AC, 10 percent.
2. Accuracy shall be as defined for the flow element.
3. The operating temperature range shall be -25 C to 65 C
4. The output shall be isolated 4-20 mA. DC into 0 to 1000 ohms

C. The flowmeter transmitter/converter shall be mounted in the main control panel.

D. Accessories/options required:

1. A signal cable shall be provided between the flow element and the signal converter.
2. A local indicator shall be provided with an engineering scale to indicate actual flow rate and total flow.
3. A second flow rate indicator and non-resettable totalizer shall be provided on the enclosure RTU subpanel if the transmitter is not located in the enclosure. This unit shall be a Newport P6000 ratemeter/totalizer, Kessler Ellis (KEP) Intellect-69 or approved equal.
8.0 PERIMETER FENCE

All fencing and related equipment shall conform to the following specifications:

8.1 General Requirements

A. The pump station area shall be enclosed with industrial-grade chain-link fence. This fence shall be 9-gauge chain link, with 3-inch end posts and 2-inch line posts. A 1-5/8" top rail shall be placed on the fence. The end posts, line posts, and top rail shall be structural galvanized steel with a rating of SS40. The fence shall be six feet high and shall be topped with three strands of barbed wire facing outward. The fence fabric shall be kept approximately 3-4 inches off the ground to allow trimming but prevent access under the fence.

B. Access through the perimeter fence shall be by means of a lockable sliding gate with a working length of 16 feet. In the event that the site layout makes a sliding gate impractical, dual-leaf swinging gates (8' each) may be acceptable. Either gate shall be constructed with SS40 structural galvanized steel for the outside frame (2.5" for sliding gate or 2" for dual-leaf swinging gates) and SS40 structural galvanized steel 1-5/8" filler supports. All welding shall be completed prior to galvanizing. All open pipe ends shall be permanently capped. The frame shall be covered in 9-gauge chain link. The gate shall be capable of being padlocked to prevent unauthorized access to the station.

C. A personnel access swing gate (minimum 3 feet wide) shall also be installed in the fence in addition to the sliding gate. This gate shall be located on the perimeter fence as appropriate for convenient access to the station. This personnel access gate shall be capable of being padlocked to prevent unauthorized access to the station. The gate shall be constructed of SS40 structural galvanized steel tubing and 9-gauge chain link. The frame shall be 2" tubing with 1-5/8" filler support.

D. The perimeter fence shall be constructed no closer than ten feet from the wet well, valve pit, or any building, or four feet from the generator pad, control panel pad, or SCADA pole. Gate placement shall be such that there is adequate truck access to the wet well, valve chamber, and generator, or, if a portable generator is used, to a plug and transfer switch. There shall be sufficient room within the fence to permit later installation of a generator (if one is not initially installed) while still meeting the above requirements.

E. The Contractor shall post the following 14" x 20" sign on the sliding gate: “DANGER: HIGH VOLTAGE” (EMED Co., Inc. Sign No. PD102859 or equal). The sign shall be according to State and Federal OSHA requirements. The sign shall be heavy gauge 0.063" aluminum with rounded corners and 1/4" I.D. corner eyelets for mounting. The sign shall be attached with aluminum or stainless steel fasteners. Paint or ink shall be weather-resistant, and the face of the sign shall be covered with a clear mylar topcoat.

8.2 Chain Link Fence Specifications

A. The Contractor shall provide all labor, materials, tools, and equipment required to furnish and install in good workmanlike manner the chain link fence and gates complete as shown on the plans and as specified herein.

B. GENERAL.
1. **Layout.** Unless directed otherwise by the Engineer, the fence shall be erected in close conformance with lines, grades, and locations shown.

2. **Hot Dip Zinc Coating (Galvanizing).** After fabrication, all steel fence parts shall be coated with a minimum of 1.2 ounces of zinc per square foot of surface area. The coating shall be applied by the hot dip process. Provide manufacturer's certification as to process and thickness of coating.

3. **Shapes.** All post, rails, and gate frames noted herein are nominal size, Schedule 40 steel pipe; however, "H" shapes may be substituted with the approval of the Engineer.

C. **DRAWING APPROVAL.** Shop drawings for all work in this section shall be presented to the Engineer for approval and shall indicate size, gauge, weight and finish of all materials, method of anchorage, gate details, hardware, and a plan layout. Fabrication and erection shall be in accordance with the approved shop drawings.

D. **MATERIAL**

1. **Fabric.** Fence fabric shall be 2 inch mesh of a 9 gauge medium carbon steel wire. Fabric shall be woven as one piece to the heights shown on the plans. Fabric shall have the selvage edges twisted and barbed at the top and at the bottom.

2. **Top Rail.** Top rail shall be 1-5/8 inch at 2.49 pounds per foot of length.

3. **Bottom Rail or Tension Wire**
   a. **Bottom Rail.** Bottom rail shall be 1-3 inch at 2.27 pounds per foot.
   b. **Tension Wire.** Tension wire shall be 0.177 inch diameter, high carbon steel coil spring wire.

4. **Line post.** Line post shall be 2 inch diameter at 3.65 pounds per foot.

5. **Terminal and Straining Posts.** Terminal and straining posts shall be 3 inch diameter at 7.58 pounds per foot.

6. **Gate Posts.** Gate posts shall be sized to meet the following:
   a. 2-2 inch at 5.79 pounds per foot for gate leaves up to 6 feet wide
   b. 3-2 inch at 9.11 pounds per foot for gate leaves from 6 to 13 feet wide
   c. 6 inch at 18.97 pounds per foot for gate leaves from 13 to 18 feet wide
   d. 8 inch at 24.70 pounds per foot for gate leaves over 18 feet wide

7. **Post Brace.** Post brace shall be 1-5/8 inch diameter at 2.49 pounds per foot.

8. **Truss Rod.** Truss rods shall be 2 inch diameter steel rod complete with turnbuckle.

9. **Gates.** The gates shall be of the same height and fabric as the fence to which the gate is installed. Gate frame shall be fabricated from 2 inch diameter galvanized steel pipe at 3.65 pounds per foot (for gate leaves up to 11 feet wide) or 2-2 inch diameter pipe at 5.79 pounds per foot (for gate leaves from 11 to 18 feet wide). Gates shall be adequately braced for the size or sizes shown with all corners electrically welded. Sliding gates shall slide fully open one way with stops at both ends to prevent derailment. Swinging gates shall be capable of opening 180 degrees in at least one direction.

10. **Barbed Wire.** Fence posts shall be fitted with adjustable barbed wire arms for carrying three strands of barbed wire at a 45 degree angle. Barbed wire shall be four point pattern consisting of two strands of 12.5 gauge steel wire with heavy steel barbs spaced not greater than 5 inches on center.

11. **Hardware.** Fence shall come complete with all necessary hardware; such as, tension bars, tension bands, brace bands, end clamps, gate post caps, nuts, and bolts. Gate hardware shall consist of bottom corner pivot hinge, upper hinge,
latch fork with lock keeper and guide, fork catch, stop and hold open, and
plunger bar and "mushroom" catch (for double leaf units).
12. Concrete. Concrete for setting posts in the ground shall be at least Class B (ODOT
Specification).

E. INSTALLATION

1. Clearing and Grading. The Contractor shall perform such clearing, grubbing and
grading as may be necessary to construct the fence to the required alignment and
shall provide a reasonably smooth ground profile at the fence line.

2. Posts

a. Ground Installation. Post placed in the ground shall be set vertically in concrete
not less than 32 inches below finished grade. Concrete encasement shall be a
minimum of 36 inches below finished grade with 6 inches around the post and
a 1 inch crown.

b. Concrete Installation. Posts placed in concrete slabs, walls, or floors shall be set
vertically in preformed holes, not less than 8 inches deep with the inside
diameter 1 inch greater than the outside diameter of the post. Fill the annular
space with non-shrink grout.

C. Spacing. Lines posts shall be spaced at not more than 10 foot centers, except when
fence is utilized as railing, then post spacing shall meet all local, state, and
OSHA codes.

3. Fabric. The fabric shall not be erected until after 5 days from the time of setting
posts in concrete. The fabric shall be fastened to the line posts with clips or bands
spaced at approximately 14 inches apart, and to the top and bottom rails with bands
or tie wires at approximately 24 inch intervals. The fabric shall be fastened to
terminal posts using a tension bar with tension bands spaced 12 inches apart. Fabric
shall be rigid and taut.

4. Horizontal Deflection. Special treatment will not be required at deflection points
where the fence changes alignment by 5 degrees or less. At points of deflection
where the fence changes alignment by more than 5 degrees, a post brace and truss rod
shall be provided in each fence panel adjacent to the post located at the angle point.

5. Post Braces. A post brace and truss rod shall support each gate, straining, and
terminal post. The brace shall extend from the line post back to the gate, straining, or
terminal post.

6. Bottom Rail or Tension Wire. When a bottom rail is not shown or noted on the
plans, the bottom of the fabric shall be reinforced by a galvanized spring steel wire
stretched through the fabric and tied to the posts with the fabric.

7. Barbed Wire. Three strands of barbed wire shall be pulled and anchored to the arms.
Alternate location of bars in each strand so that bars will be spaced not greater than
22 inches on center in alternate layers. Barbed wire shall not be spliced.

8. Any galvanized piping that is cut or welded after galvanizing shall be protected with
an appropriate cold galvanizing compound. Covering damaged galvanizing with any
other paint or coating is not acceptable.
9.0 FINAL GRADING AND FINISH WORK

Site grading and finish work shall conform to the following specifications:

9.1 General Requirements

A. Initial backfill for the pump station structure shall be non-compacting, size #57 washed round stone, extending to five feet above the bottom of the wet well. From that point to a point two to three feet (2'-3') below final grade, backfill shall consist of compacted fill dirt excavated from the station site, unless otherwise directed by the Utility. The next 18" – 30" shall be backfilled with compacted clay. No rock or unstable backfill will be accepted. The Contractor shall ensure that compaction is sufficient to prevent any subsidence. All ground shall be stable, and Contractor is responsible for repairing all subsidence and associated damage for twelve (12) months from acceptance of the pump station by the Utility.

B. Any access driveway longer than 120 feet should be constructed with a turnaround at the pump station allowing a minimum 50 foot turning radius for a truck 8 ft. - 5 in. wide with an overall length of 33 ft. - 6 in.

C. Access driveways and turnarounds shall be paved. Base for paving shall consist of one 4-inch (minimum) course of Item 304 Aggregate Base of the State of Ohio Department of Transportation (ODOT) Construction Materials and Specifications. The intermediate course shall consist of 4½ inches of ODOT Item 301 Bituminous Aggregate Base. The surface shall consist of one 1½ -inch (minimum) course of ODOT Item 448 Asphalt Concrete. Access driveway shall not slope more than ten percent (10%).

D. A concreted parking area with slope not greater than 12:1 shall be provided for trucks. This area shall be located inside the perimeter fence if site considerations allow; otherwise, it shall be located outside the perimeter fence as near as possible to the sliding gate. This area shall be a minimum of 8" of 4,500 psi concrete with steel mesh reinforcing. A reinforced concrete slab (minimum 4" thick) shall be poured under the control panel. This slab shall have at least four times the horizontal surface area of the control panel to help prevent settlement. A minimum 4"-thick gravel base of ODOT Item 304 shall be provided under all concrete.

E. Six inches (6") of AASHTO M 43 Size No. 57 crushed stone or ODOT Item 304 aggregate base shall be provided around the wet well, valve chamber, generator pad, etc., over all non-concreted areas within the perimeter fence. A solid layer of visqueen plastic (minimum 6 mil thickness) shall be placed under the crushed stone to prevent vegetative growth.

F. Pavement subgrades shall be compacted in accordance with Section 3.4, D, iii. of these specifications.

G. Finish grading shall provide positive drainage away from the wet well, valve pit, manholes, control panel, generator, and parking areas. Grade shall not be greater than 3:1. Unless otherwise indicated on the plans, tops of all structures shall be elevated six to twelve inches (6" - 12") above surrounding grade. The area around the pump station site shall be graded to drain away from the pump station.
H. All unpaved areas around the pump station shall be finish-graded and planted with grass seed, to meet ODOT Item 659 requirements. Shrubs and trees shall be planted in accordance with the surrounding landscaping and anticipated land use, as approved by the Utility. In general, the site shall be left in an aesthetically pleasing manner.
APPENDIX A: TEMPORARY PUMP STATIONS

In general, ALL pump stations shall be considered to be permanent unless a project exists on the City of Oxford’s 5-year Capital Improvement Plan that would eliminate the pump station or the Developer has specific plans for eliminating the pump station within approximately 5 years. However, each pump station will be reviewed at the inception of design by the Utility to determine whether the pump station will be considered “permanent” or “temporary” for design purposes.

The criteria to be considered by the Utility will include: 1) capacity of the pump station, 2) complexity of operation, 3) overflow impact upon customers, 4) overflow impact upon the environment, 5) location and ease of entry/exit for emergency equipment such as sludge trucks, etc., 6) proximity to the nearest gravity sewer and likelihood of a future sewer extension to eliminate the pump station, 7) proximity to existing and proposed residential development, and 8) other factors unique to a given pump station site.

If a pump station is to be “temporary” (as determined by the Utility), certain requirements may be modified or omitted at the discretion of the Utility. An outline of what these modifications and omissions will generally be is provided below.

A. The Utility will not require the pump station to be sized for the total upstream watershed. Instead, the pump station shall be sized for all existing and planned development (including all preliminary plans) within the watershed, regardless of whether or not all such development is associated directly with the pump station. This means that the pump station shall have the capacity to both eliminate any existing upstream pump stations and serve development in the watershed being planned by others. Also, the requirement of one hour emergency storage at twice ultimate average flow will remain.

B. A permanent on-site generator and automatic transfer switch will not be required. Instead, a manual transfer switch and auxiliary receptacle shall be provided as described in Section 6.4. There shall be sufficient room within the perimeter fence to park a portable generator or install an on-site generator at a later time (see Section 9.1, Paragraph D). Also, if the generator required to operate the pump station would be too large to pull on a trailer behind a pickup truck, a permanent on-site generator will be required.

The Utility will assess each “temporary” pump station individually, based on the criteria listed above, to determine the acceptability of each modification and omission. Therefore, it is possible that a “temporary” pump station may be required to meet some or all of the “permanent” standards.

All other requirements listed within the Sanitary Sewer Pump Station Requirements shall apply universally to all pump stations, regardless of their status as “permanent” or “temporary.”
APPENDIX B: REQUIRED SUBMITTALS

The Contractor shall submit at least five (5) copies (size 24”x36”) of submittals for each of the following items. One of the five copies will be returned to the Contractor with comments and/or approvals.

Wet well structure
Valve pit structure
Flow meter manhole (if applicable)
Sluice gate manhole
Other manholes & covers (if applicable)
Aluminum hatches
Ladder(s) & safety post
Vent pipe & screen for wet well
Waterproofing (if applicable)
Gaskets/seals for pipe & conduit penetrations through concrete structures

PVC drain pipe & check valve
Gravity sewer pipe
Ductile iron pipe, fittings, flange adapter, mega-lugs, etc.
Polyethylene encasement
Pipe mounting brackets (for mounting to wet well walls)
Plug valves
Check valves
Sluice gate & related components
Surge relief valve (if applicable)
Air release valve(s) (if applicable)
Pipe supports (in valve pit)
Bauer fitting(s)
Pressure gauge, sensor, valves, piping, etc.
Misc. fasteners, anchors, & hardware
Epoxy paint for ductile iron piping

Pumps (incl. discharge bases, other misc. components, & spare parts)
Float switch
Cable support bracket
Stainless steel (Kellems or equal) cable grips
Guide rails
Upper & intermediate guide rail brackets
Chains and Grip-eye for lifting pumps

Influent grinder—incl. frame, hydraulic drive unit, grinder unit, etc. (if applicable)
Flow meter (primary & secondary devices, cables, grounding kit, etc.) (if applicable)

Generator and automatic transfer switch (incl. housing, battery charger, controller, etc.)
Enclosure for ATS

SCADA: All Allen Bradley SCADA equipment, including processor, power supply, I/O modules, etc.
Ethernet spread spectrum radio
Ethernet switch
Path study
Antenna
Lightning surge protector, grounding kit, connectors, etc.
SCADA wiring diagram and LO list

Electrical, Instrumentation & Control:

Interconnecting diagrams/wiring and control schematics for pump station and control panel
Panel layout (dimensioned) for all planes
Site electrical plan
Conduit routing/layout and wire-pulling schedules
Grounding scheme
Bill of materials

Conduit, wiring & connectors
Enclosure(s) & junction boxes, incl. all accessories
Panel supports (i.e. stainless steel strut, anchors, etc.)

Equipment: Quartz yard light
Main disconnect, incl. stl. enclosure (outside panel)
Control transformer, incl. stl. enclosure (outside panel)
Power blocks & terminal blocks
Ground lugs
Lightning arrestor and surge capacitor
Main circuit breaker (inside panel)
Pump circuit breakers
Voltage monitor, incl. disconnect and fuses
Motor starters w/ electronic overloads
Radar level sensor—incl. mounting details
Primary circuit breaker for control xfrm. (& secondary CB, if applicable)
Auxiliary circuit breakers
Handle assembly for main CB (& pump CB’s, if applicable)
All fuses and fuse holders
Panel light(s)
Panel heater(s)

Duplex GFCI receptacle & cover plate
Selector switches, pushbuttons, and pilot lights
Elapsed-time meters
Relays, incl. intrinsically-safe relay
24V transformer for MiniCAS (if applicable)
MiniCAS relay or equivalent relays
Limit switches for security and tamper alarms
Engraved labels/tags

Concrete slabs (incl. reinforcing) for generator, control panel, transformer, etc.
Chain link fence & gates
Signage
Ready mixed concrete
Granular materials & other fill
Testing reports (backfill compaction, leakage tests, etc.)
City of Oxford Contact Numbers

Service Department 524-5206
Utility Inspections 524-0203
Engineering Division 524-5208
Water Treatment Plant 523-1753
Water Distribution 523-5014
Wastewater Collections 523-2017
Wastewater Treatment 523-2911
Streets & Maintenance 523-8412
Building Inspections 524-5209
- To schedule an inspection

Other Numbers

Ohio Utilities Protection Service (Call Before You Dig) 1-800-362-2764
Butler County Engineer's Office 513-867-5744
Oxford Police Department 911 (emergency) or 523-4321
Oxford Township Police 523-7131
Miami University Police 529-2222
Butler County Sheriff's Office 844-1515
Ohio State Highway Patrol 863-4606 (Butler County)
Oxford Fire Department 911 (emergency) or 524-4731
McCullough Hyde Memorial Hospital 523-2111
Ohio EPA 1-800-282-9378
Report Toxic Chemical and Oil Spills
Any Individual or Company hired to perform work within the City of Oxford limits is required to complete the following form and mail to the Income Tax Division.
FAX: (513) 785-7401 BUSINESS QUESTIONNAIRE

Telephone: (513) 785-7400
Or 1-800-854-1684

☐ City of Hamilton 2.00%
☐ City of Eaton 1.50%
☐ City of Oxford 1.75%
☐ Village of New Miami 1.75
☐ Village of Phillipsburg 1.50%
☐ Village of West Milton 1.50%
☐ Butler County Annex 2.00%
☐ JEDD 2.00%
☐ JEDD II 2.00%

Please fax or mail this questionnaire to the Income Tax Division, 345 High Street, Suite 410, Hamilton, Ohio, 45011.

1. NAME ______________________________ PHONE NO. __________________
2. TRADE NAME (if any) ______________________________ FAX NO. __________________
3. ADDRESS __________________________________________________________
4. FEDERAL IDENTIFICATION NO. _______________________________________
5. SOC. SEC. NO. _______________________________________________________
6. GIVE DATE WORK OR BUSINESS BEGAN IN THIS CITY ______________
7. Name and Address where tax forms are to be sent (if different from above) __________________________________________________________

8. Check whichever is applicable: Individual Proprietorship ______ Partnership ______ Other (explain below) __________

Non-Profit Organization ______ Corporation ______

Do you have employees subject to income tax for the entity indicated at the top of this form?

Yes______ Approximate # ______ None______

Does your accounting period end on December 31st? Yes______ No______

If a fiscal year, give day and month of fiscal year end. __________________________

NOTE: (A fiscal year ending cannot be used unless used for your federal return.)

9. If you operate more than one place of business or own rental property, please give name and/or location of each. If more space is required, use the reverse side of this form.

10. If a partnership, please give name, address, and social security numbers of all partners. If more space is required, use the reverse side of this form.

11. Are you conducting business within the limits of the entity indicated? Yes______ No______

12. Are you only withholding city income tax as a convenience for resident employees? Yes______ No______

13. Contact person ______________________________________________________ Date __________________

14. Brief description of company’s scope of work: (check all that apply)
    Performing work at the job site ______ Supplying Materials ______ Installation______ Construction ______
    Professional Services (Architect, Accountant, Engineering, Lawyer) ______ Other ______

15. If the work is performed offsite, please supply the address.
You are required to furnish this information within ten (10) days in order for your account to be properly evaluated.