Board of Water and Sewer Commissioners
of the
City of Mobile, Alabama

Update of Standard Specifications
Section 13

Sewage Pumping Station
Guideline Specifications

Revised December 2019

PART 1 – GENERAL

13.1.01 SCOPE

A. These Specifications form a part of the Contract Documents and shall govern for the construction of new and renovation of existing duplex sewage pumping stations and grinder pumping stations. The Work covered by this Section includes the furnishing of all parts, labor, equipment, appliances and materials, and performing all tasks in connection with the construction and installation of sewage pumping stations complete with pumps, piping, wet well, controls, electrical work and all necessary auxiliary equipment. The pumping station shall be completed in strict accordance these specifications and the applicable plans and specifications issued for the project.

B. Reference Appendices D and E of this Specification for MAWSS Standard Details pertaining to this Section.

13.1.02 REVISIONS

These Specifications will be modified and updated as required to keep abreast of current technologies, industry standards, regulatory agency requirements, and best management practices. It shall be the responsibility of the end user of these Specifications to insure the latest and most current revision is applied to the project.

13.1.03 REFERENCED SECTIONS

A. Section 5 – Control of Work

13.1.04 REFERENCED CODES AND STANDARDS

A. ASTM C478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections

B. ANSI/AWWA C150/A21.50

C. ANSI/AWWA C151/A21.51

13.1.05 CONTRACTOR SUBMITTALS

A. General

1. Reference Section 5, Control of Work, of these Standard Specifications for general requirements regarding this subsection. The work delineated here is in addition to other requirements of this Standard Specification.

2. Shop drawings are defined as drawings, diagrams, illustrations, schedules, performance charts, brochures and other data prepared by the Contractor which illustrate how specific portions of the work shall be fabricated and/or installed.

3. All submittals shall be marked with the Specification Section number containing the item for review or Drawing Number for items specified on Drawings only.

4. All submittals shall include the MAWSS Standard Valve, Piping, or Pump Specification number appropriate for the item submitted per Appendix D.

5. To assure that manufacturers and suppliers are aware of the use to which their equipment and products will be subjected, the Contractor shall require the manufacturer to place the following certification on submittal data:

   "This is to certify that we have examined the Plans and Specifications for this Project and have ascertained that this equipment or material is suitable for the Purpose and use intended.

   _____
   Authorized Signature

   _____
   Printed Name

   _____
   Company and Job Title"

6. Shop drawings are not part of the Contract Documents but are a supplementary means of communications to assist in the understanding of what the Contractor proposes to provide and to establish that whatever he intends to install either does or does not conform to the Project Drawings and Specifications.

7. In the instance of a request for a substituted item, the Contractor must request the substitution prior to bidding the project. All requests must be made seven (7) days prior to bid date and any accepted substitutions will be issued by addendum. This shall be the Contract responsibility to verify that the substituted item will fit into the space allocated to the originally required item giving due regard to all requirements of other trades. Where modifications to the Contract Documents are proposed, the Contractor must clearly indicate such deviation in writing in his transmittal letter. The Contract Documents will be appropriately modified if the modification and/or substitutions are agreed to by the Design Engineer and MAWSS. However, when additional work is required, the Contractor is advised that he must pay the Design Engineer for redesign to accommodate the revised substitution as well as pay other Contractors for extra work required by them for the change. No increase in MAWSS construction cost will be allowed.

8. Certified pump curves from the manufacturer are to be submitted to the design engineer immediately upon the curves being available. No pumps shall be installed in the wet well until the design engineer has reviewed the certified pump curves for each pump and approved their installation in the wet well. Such approval shall be provided in writing to the contractor with a copy to MAWSS. The certified pump curve for each pump shall be included in the As-Build drawings.

B. Catalog Sheets

1. For standard manufactured items considered by MAWSS as not requiring special Shop Drawings, the Contractor shall submit six (6) hard copies and one (1) electronic copy on flash drive of manufacturer's catalog sheets showing model numbers and illustrated cuts of the items to be furnished, scale details, sizes, dimensions, performance characteristics, capacities, wiring and control diagrams and all other pertinent information. This information shall be highlighted on all six (6) copies when appropriate.

2. The Design Engineer will retain two (2) copies and return four (4) copies to the Contractor submitting the catalog sheets.

C. Manuals

1. The Contractor shall submit for review six (6) copies of all requested operating and maintenance manuals with the shop drawing submittals. The materials shall be bound in a 3-ring binder.

2. The Operating and Maintenance manuals shall provide, as a minimum, the following information for any major component of the equipment and the total assembly:

   a. Installation instructions
   b. Startup and operating procedures
   c. Maintenance and lubrication procedures
   d. Equipment drawings with parts list
   e. Electrical drawings
   f. Troubleshooting guide
   g. Recommended spare parts

3. The Operation and Maintenance manuals shall contain a Project Information sheet with the following information:

   a. Project Name
   b. Consultant name
   c. Consultant project number
   d. Contractor name
   e. Date project awarded

4. The Design Engineer will retain two (2) copies and return four (4) copies to the Contractor.

5. Prior to final payment, provide six (6) hard copies of updated operating and maintenance manuals including parts lists along with one PDF copy on a flash drive for MAWSS use.

13.1.06 GUARANTEE AND WARRANTY

A. All work by the Contractor shall conform to the latest edition of the Board of Water and Sewer Commissioners of the City of Mobile Alabama, Standard Specifications for Water Mains, Sanitary Sewers, and Sewage Pumping Stations. The work delineated here is in addition to other requirements of this Standard Specification.

B. Guarantee: In addition to the manufacturer's standard guarantee, the Contractor shall include the services of a factory-trained serviceman to provide repair service for the equipment for the period of two years commencing with the time the equipment is placed in continuous permanent operation. This service shall include the cost of all replacement parts required during the interval.

C. Warranty: The pumping units shall be warranted by the manufacturer for a five-year period. Wear items such as seals, bearings, impellers, rotors and stator may be prorated during the five-year period. The warranty shall be 100% (parts and labor) for the first year, 50% from the beginning of the second year to the end of the fifth year (parts and labor).

13.1.07 SYSTEM TESTING AND ACCEPTANCE

A. Before placing the pumping system into service, and prior to the Final Inspection, the pumps shall be run continuously for 30 minutes under full load with no damage resulting to the pump motors. During this test, the pumps shall produce the designed GPM and TDH conditions and shall

experience a heat rise of no more than 45°C above ambient temperature. Pump vibration shall also be tested, and results provided. An authorized pump service representative, in the presence of the Design Engineer, shall perform testing.

B. A manufacturer's representative shall make adjustments required to place the pumping system in proper operating condition.

C. A pump manufacturer's representative shall check and approve the installation before operation.

D. The pump manufacturer's representative shall provide, as part of this Contract, a follow up site visit for inspection of these pumps in operation and operation assistance of the equipment supplied six (6) months following completion of the Project.

E. A manufacturer's representative shall provide, as part of this Contract, system testing of all automated equipment including, but not limited to, the following items:

1. Emergency electrical power generation equipment including controls, automatic and manual switching, fuel storage and supply systems, engine, etc.

2. Engine driven back-up pumping systems including, controls, fuel systems, engine, etc.

3. Odor control and chemical feed systems.

4. Instrumentation Equipment.

F. Equipment manufacturers, or their representative, shall complete the Equipment Certification statement below for those items of equipment noted in paragraphs E above.

"This is to certify that we have examined the installed Equipment for this Project and have ascertained that this equipment is installed correctly and is suitable for the purpose and use intended.

_____
Authorized Signature

_____
Printed Name

_____
Company and Job Title"

G. Final Inspection: Before acceptance of the pumping installation and prior to final payment to the Contractor by MAWSS, a complete inspection of the Work of the Project will be undertaken. Members in attendance of the Final Inspection shall include the Contractor's Project Supervisor, representatives of the Design Engineer, and representatives of MAWSS. The inspection shall include investigation of all Work for conformance with MAWSS Standards and Practices and those of the Project Contract.

1. All equipment, machinery, valves, electrical, instrumentation, etc. will be operated and checked for proper installation and operation both manually and in automatic modes as applicable.

2. All site work shall be inspected for conformance to the Contract Documents and best construction practices.

3. The Design Engineer shall complete a Final Inspection Punch List describing all items of defect or omissions detected during final inspection and submit it to MAWSS and the Contractor. The Contractor shall make all corrections within 30 days of receipt of the form and shall mark those items on the form indicating the date completed. The Contractor shall submit a copy of the completed form to MAWSS and the Design Engineer for field review of the work performed before final payment to the Contractor will be authorized by MAWSS. A sample copy of the Final Inspection Punch List is included in Appendix D.

13.1.08 AS-BUILT DRAWINGS

A. Contractor's Responsibilities

1. Drawings: The Contractor shall maintain one set of blue or black line white prints of the Contract Drawings and Shop Drawings to be used for As-Built Drawings.

2. Preparation: The Contractor shall mark As-Built Prints to show the actual installation where installation varies from that shown originally.

   a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
   b. Accurately record information in an understandable drawing technique.
   c. Record data as soon as possible after obtaining it.
   d. Record and check the markup before enclosing concealed installations.

3. Content: Types of items requiring marking include, but are not limited to, the following:

   a. Initial operation parameters (include design and actual operating): GPM, TDH
   b. Dimensional changes to Drawings
   c. Revisions to details shown on Drawings
   d. Depths of foundations below first floor
   e. Locations and depths of underground utilities
   f. Revisions to routing of piping and conduits
   g. Revisions to electrical circuitry
   h. Actual equipment locations
   i. Duct size and routing
   j. Locations of concealed internal utilities
   k. Changes made by Change Order or Change Directive
   l. Changes made following Design Engineer's written orders
   m. Details not on the original Contract Drawings
   n. Field records for variable and concealed conditions
   o. Record information on the Work that is shown only schematically
   p. Pump Curve for installed pump
   q. Installed pump make and model

4. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.

5. Mark record sets with red-colored ink or pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

6. Mark important additional information that was either shown schematically or omitted from original Drawings.

7. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

8. Identification: As follows:

    a. Project name
    b. Date
    c. Designation "PROJECT AS-BUILT DRAWINGS"
    d. Name of Design Engineer
    e. Name of Contractor

9. Deliver the marked-up As-Built Drawings to the Design Engineer as part of the contract closeout documents as noted in sub Section 5.17 of the Board Standards.

13.1.09 CONSTRUCTION PHOTOGRAPHS

A. When required as part of the Contract, the contractor shall provide Construction Photographs.

B. The Contractor shall provide pre-construction views of the entire construction area before any work begins. Views shall be in the form of electronic video and/or 8 inch by 10 inch photographs and/or high resolution digital photographs at the discretion of the Design Engineer.

C. The Contractor shall provide the imaging from commencement of Project through completion of all Work. These progress images shall be submitted to the Design Engineer each month in conjunction with the current Monthly Estimate. Interior and/or exterior views shall be made as requested by the Design Engineer.

D. Each photograph shall have the following information clearly noted on the picture. The information shall be typed or neatly printed on a label and placed on the face of the picture, and not obscure important construction features.

1. Date Photo was taken and photo number
2. Client/MAWSS
3. Project Title and Contract number
4. Contractor
5. Description of what is shown on the photo including direction of field of view

E. If digital photographs are utilized, both an electronic copy on a flash drive and paper formats shall be submitted.

PART 2 – PUMPING STATION MATERIALS AND EQUIPMENT

13.2.01 NEW WET WELLS

A. Generally, the wet well shall be constructed using reinforced pre-cast concrete cylindrical riser sections resting on a reinforced cast-in-place concrete foundation and having a reinforced cast-in-place concrete top slab. Larger pumping stations may require an engineered reinforced cast-in-place concrete wet well. Reference Appendix D of this specification for drawings indicating standard configuration and details of the wet well.

B. The foundation slab shall be reinforced concrete poured on undisturbed earth. If over excavation is required, the Contractor shall place select back fill in the excavation in 6" maximum lifts and compact each lift independently until restoring excavation to desired elevation. Geotechnical testing of the backfill will be required. Reference Section 13.3.03, Excavation and Backfill for Pumping Stations, for additional requirements.

C. The wet well riser shall be fabricated in accordance with ASTM C478, "Standard Specification for Circular Precast Reinforced Concrete Manhole Sections". Concrete shall be Type II Portland cement with 100% calcareous aggregate. Resilient connectors shall be used when installing piping through the risers. The connectors shall be in accordance with ASTM C923-07 "Standard Specification for Resilient Connections between Reinforced Concrete Manhole Structures, Pipes, and Laterals." The riser joints shall include flexible watertight gaskets in accordance with ASTM C443-05a "Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets." Joints in precast wet well sections shall be wrapped on the exterior with a minimum of 6 inch wide outside joint wrap at locations where the joint is below grade. Rub'R-NEK by Henry Company. or an approved equal shall be used.

D. The top slab shall be reinforced concrete, formed and cast-in-place, upon the wet well risers. The top slab shall include an access hatch cover with fall-through protection specifically sized to suit the pumping installation. The top slab shall provide other items as detailed on the plans, including, but not limited to, wet well vent, by-pass pumping suction connection, pump discharge piping wall pipes, and penetrations for small piping and electrical work.

E. Exterior Coating: All exterior surfaces of the wet well riser sections shall be coated with a 14-20 mils minimum dry film thickness of coal tar epoxy.

F. Interior Lining System: All interior concrete surfaces of newly constructed wet wells, including the bottom slab, riser, and underside of the top slab, and the pump discharge piping within the wet well, shall receive a field applied protective lining/coating system. The protective lining system shall be one of the following approved products as stipulated in project specifications, "Special Provisions".

- Urethane Wet Well Lining System, per Appendix D Section 09748
- Calcium Aluminate Cementitious Wet Well Lining System, per Appendix D Section 09749

13.2.02 RENOVATED WET WELLS

A. Existing wet well renovation requiring extension of the riser shall be accomplished using similar precast concrete construction when possible. New wet well top slabs shall conform to the requirements noted in subsection 13.2.01 of this specification.

B. Interior Lining System: Interior concrete surfaces of renovated wet wells not requiring extensive repair shall be lined in accordance with subsection 13.2.01 of this specification.

13.2.03 SINGLE & MULTI-SPEED SUBMERSIBLE PUMPS

A. General

1. Pump impeller selections shall be based on the most economically practical solution for the individual installation. Pumps with motors drawing more than 7 1/2 horsepower shall be of the non-clog design capable of passing solids of 3" in diameter. All pumps, other than grinder pumps, shall have a minimum 4" diameter pump discharge connection.

2. The pumping units shall automatically and positively mate with an automatic discharge connection when lowered into place. The pumps shall be removable for inspection or service requiring no bolts, nuts or other fastenings to be disconnected. No portion of the pump shall bear directly on the floor.

3. The pump discharge connection shall be permanently mounted to the wet well floor with type 316 stainless steel expansion anchors.

4. Each pump shall be fitted with a type 316 stainless steel guide rail system extending from the top of the wet well to the pump discharge connection.

5. Each pump shall be fitted with type 316 stainless steel lifting chain. The working load of the lifting system shall be at least 50% greater than the pump unit weight. For drawings of the MAWSS Standard Submersible Pump Lifting Chain, reference Appendix D.

6. The pumps, with motor cable, appurtenances and lifting cable, shall be designed for continuous operation under submergence, without leakage, in water to a depth of sixty-five (65) feet.

B. Materials of Construction

See Appendix D, Pump Specification Sheets

C. Motors

1. Motor shall be solid stainless steel shaft, ball bearing type. Motor casing shall be oil-filled, or air-filled and watertight with moisture resistant Class F 155 C insulation. Motors shall be explosion proof design.

2. Motor shall be NEMA Design B, normal starting torque, normal slip, squirrel cage induction motor, continuous duty.

3. Cable entry shall be isolated with an internal terminal board.

4. Motor shall be designed for continuous operation in a non-submerged or partially submerged (see pump down elevation) condition without damage.

5. Motor shall be non-overloading for the entire pump operating curve.

6. Pump motor cable shall be designed for submersible duty and shall be indicated by code or legend permanently applied to cable.

7. Motors shall be provided with a service factor of 1.15.

8. Motor thrust bearings shall be designed for continuous thrust loads under all conditions of pump operation from zero head to shut-off. The anti-friction bearings shall be rated for a L-10 life of 50,000 hours.

9. Motor Tests and Data

   For each motor, furnish an inspection report for the motor, or for a previously manufactured electrically duplicate motor, which was tested. Provide the following minimum data:

   - No-load running current
   - Locked rotor current
   - Winding resistance measurement
   - Bearing inspection
   - Full load power factor
   - Full load efficiency
   - Vibration test

D. Motor Cooling Systems

Air-filled or oil-filled motors will be accepted. The motors may be fitted with an internal closed loop fluid cooling system. The cooling system fluid shall not come in contact with the pumped media. Pumps with motor cooling jackets, whether using recirculated pumped product or any outside cooling source, will not be considered.

E. Accessory Equipment: Provide the following accessories for each pump as required for a complete installation:

1. Pump discharge elbows

2. Guide rail brackets

3. Stainless steel guide rails

4. Stainless steel lifting chain/cable hook per Appendix D detail drawing

5. Stainless steel expansion anchors sized to suit each individual pump installation

F. Product and Manufacturer: The owner has developed training standards and spare parts inventory to maintain and support a limited number of pumps installed in the system. Provide submersible end suction pumps as manufactured by one of the following only:

1. Flygt Corporation (non-clog)

2. WILO EMU (non-clog)

3. KSB (non-clog)

Consideration of submittals from other pump manufacturers will not be reviewed.

G. Controls

See Part 4 of this specification for requirements.

13.2.04 VARIABLE SPEED SUBMERSIBLE END SUCTION PUMPS

A. General

Pumps shall meet the same requirements of subsection 13.2.03 except as noted below:

1. The pump manufacturer/supplier shall furnish the pumps and associated variable frequency drive controlling system as a sole source responsibility. The manufacturer/supplier shall provide a written guarantee for the pumps and controls as a single unit installation relative to materials quality, operation, system durability, and performance.

2. Reference Part 4 of Section 13 for accepted MAWSS standard variable frequency drive manufacturers.

3. The pump manufacturer/supplier shall have sole responsibility for providing all related incidentals required for a complete system exclusive of the MAWSS Standard Pump Control Panel per Appendix D and E.

4. The pump manufacturer/supplier shall provide performance curves for the pumps indicating a family of curves for the ranges of pressures, flows, and speeds anticipated at the specific location of the pumps within the hydraulic system.

13.2.05 ENGINE DRIVEN BACK-UP PUMPS

A. General

1. Engine driven back-up pumps shall be skid mounted or portable (meeting all DOT regulations and suitable for intended use), self-contained, and diesel fueled. The pump shall be sized to pump peak flow without the engine operating above its continuous horsepower or torque range. The pump shall be a dry-type self-priming unit with minimum 3" spherical solids handling capability. The installation shall be designed for outdoor, all-weather applications. All installations shall include critical grade sound attenuation enclosures.

    a. The skid mounted pump shall be installed on a reinforced concrete foundation designed to absorb engine and pump vibrations and not transmit vibrations or loads to the pump station wet well. Portable type pumps shall be installed to meet DOT regulations and additional requirements as may be provided on the project drawings.

    b. Pump inlet suction piping shall be isolated from the pump with a flanged elastomeric expansion joint coupling bolted to the pump suction inlet flange. The pump suction piping shall be supported independently from the pump.

    c. Pump discharge piping shall be isolated from the pump with a flanged elastomeric expansion joint coupling, with expansion control rods, bolted to the pump discharge outlet check valve flange. The pump discharge piping shall be supported independently from the pump.

    d. The installation shall include a trickle charger and battery for automatic starting upon failure of the electrical power service.

    e. The pumping system shall include a programmable digital control system with a touch-pad for user input to automatically start and stop the pump. The controls shall include, but not be limited to, the following features:

        - Manual remote or automatic starting capabilities

        - Security levels to allow limited or full access to control functions

- 8 programmable relays and 66 selectable features, including pump running, and pump failure
- RD-232 and RD-485 communications ports to enable communication with SCADA and alarm equipment
- Capable of automatically throttling engine rpm in response to changing pressures, level, flow transducers
- Maintain an "event history" of all warning alarms (up to 32)
- User can pre-set engine rpm to maintain flow and head parameters when running unattended
- Track oil and filter usage and alert operator when replacement is recommended
- Diesel engine warm up/cool down cycle

f. The engine driven back-up pump system manufacturer shall provide all materials, submittals, and system testing previously noted in this Specification and shall provide system calculations of the pump operating conditions indicating a family of curves for the ranges of pressures, flows, and speeds anticipated at the specific location of the pumps within the hydraulic system.

g. The engine driven back-up pump manufacturer shall warrant the installed system for a minimum of 12 months or the accumulation of 2000 hours operation starting from the date of system acceptance by MAWSS.

h. See Appendix D of this specification for Engine Driven Back-Up Pump Specification Sheet and Drawing Details. Acceptable manufacturers include:

- Cornell
- Pioneer
- Godwin

13.2.06 PIPING

A. General

Unless otherwise noted in the Contract Plans and Specifications, all piping related to the pumping station used for sanitary sewer pump discharge, force main, and gravity shall be Grade 60-42-10 ductile iron in accordance with the latest edition of ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51, Special Thickness Class 52. The ductile iron pipe shall be furnished with an exterior layer of zinc applied to a mass of 200 g/m^2 of pipe surface area. The zinc coating system shall conform to ISO 8179 standard.

B. Exposed Piping

1. Pump discharge piping shall be flanged pipe and fittings with a shop applied interior ceramic epoxy lining similar to Tnemec Series 431 Perma-Shield PL or Permox CTF. The coating shall meet the performance requirements of AWWA C210.

2. The piping located within the wet well, of newly constructed pumping stations, shall receive a final top coat of the wet well lining system. The piping located within renovated wet wells shall receive a final top coat as noted on the Plans and Specifications for the specific Construction Project. See Appendix D for Piping Specification Sheet D-3C for additional details.

3. Pump station piping located outside the wet well and above grade shall have an exterior coating of high solids epoxy primer. See Appendix D for Piping Specification Sheet D-3B for additional details. The pipe, valves, and fittings shall be primed and painted hi-gloss gray (ANSI No. 70) in accordance with the following table:

SURFACE PREPARATION	SPECIFIC COMPONENTS	COATS, DMFTPC AND COVERAGE
Clean all shop surfaces with solvent. Remove any rust and prime	Primer: Tnemec Series 1 Omnithane	1 Coat 3.0 dry mils,326 sq. ft./gal
	Intermediate: Tnemec Series 66 Epoxiline	1 Coat 4.0 dry mils, 225 sq. ft./gal.
	Finish; Tnemec Series 1074 Endura-Shield II	1 Coat 4.0 dry mils, 265 sq. ft./gal
		11mils TDFT

C. Buried Piping

Pump station piping located outside the wet well and below grade shall be mechanical joint with restrained joint pipe and fittings with a shop applied interior ceramic epoxy lining similar to Tnemec Series 431 Perma-Shield PL or Permox CTF. The same piping shall have an exterior layer of zinc applied to conform to ISO 8179 standard. The mass of zinc applied shall be 200 g/m^2 of pipe surface area. See Appendix D for Piping Specification Sheet D-2A for additional details.

D. Water Line

Each newly constructed pumping station with available water service shall have a meter, backflow preventer, and yard hydrant. MAWSS will provide the water line tap and water meter. The Contractor shall run a ¾" schedule 80 PVC line from the water meter to the Contractor supplied ¾" backflow preventer, and the Contractor supplied ¾" yard hydrant. The backflow preventer shall be a reduced pressure principle backflow assembly as outlined in the MAWSS Policy and Procedure Manual Section 6 (see Appendix F of the Policy and Procedure Manual Section 6 for approved manufacturers). The yard hydrant shall be a Corn King #903 Yard Hydrants manufactured by John C. Kupferle Foundry Co., St. Louis, MO., or equal. See Appendix D for Yard Hydrant Detail.

13.2.07 VALVES

A. General

All valves shall meet, or exceed, the AWWA specified requirements for application and service. Valves shall have the same nominal inside diameter as the piping in which they are installed. Unless otherwise noted in the Contract Documents, all stop-valves shall be resilient wedge gate valves, and all check valves shall be outside weight and lever swing check valves.

See Appendix D for Valve Specification Sheets indicating approved valves and materials of construction. The Design Engineer shall develop additional Valve Specification Sheets for inclusion in the Contract Specifications for other valve designs as required. Valve substitutes shall not be accepted unless approved by Owner and Engineer prior to bid opening.

Additional requirements for installation and operation of valves follow:

1. Manually operated valves, with or without extension stems, shall require not more than a 40-pound pull on the manual operator to open or close a valve against the specified criteria. The gear actuator and the valve components shall be able to withstand a minimum pull of 200 pounds on the manual operator and an input torque of 300 pounds feet to an actuator nut. Manual operators shall include hand wheel, chain, crank, lever and a T-handle wrench.

2. All valves to turn clockwise to close, unless otherwise specified.

3. Provide exposed valves with flanged ends conforming to ANSI B16.1. The pressure class of the flanges shall be equal to or greater than the specified pressure rating of the valves.

4. Provide buried valves with mechanical or push-on joints, restrained or unrestrained, as required by the piping with which they are installed.

5. All materials of construction of the valves shall be suitable for the application as shown on the Drawings.

6. Protect wetted parts from galvanic corrosion due to contact of two different metals.

7. Provide all valves with manufacturer's name and rated pressure cast in raised letters on the valve body.

8. Clean and descale fabricated stainless steel items in accordance with ASTM A380, and as follows:

    a. Passivate all stainless steel welded fabricated items after manufacture by immersion in a pickling solution of 6 percent nitric acid and 3 percent hydrofluoric acid. Temperature and detention time shall be sufficient for removal of oxidation and ferrous contamination without etching the surface. Perform a complete neutralizing operation by immersion in a trisodium phosphate rinse followed by a clean water wash.

    b. Scrub welds with the same pickling solution or pickling paste and clean with stainless steel wire brushes or by grinding with non-metallic abrasive tools to remove weld discoloration, and then neutralize and wash clean.

    c. For stainless steel bolting, except where Nitronic-60 nuts are required, use anti-seize compound, graphite free, to prevent galling. Strength of the joint shall not be affected by the use of anti-seize compound.

B. Bolting and Gaskets

1. Flanged Joints

    a. Bolts and hex nuts shall be 316 Stainless Steel conforming to ASTM A307 as specified in AWWA C110 and C115. When bolting valves back-to-back or encountering other constrictions, the Contractor shall use studs and nuts as required. The use of all-thread rod cut to length will not be allowed.

    b. Bolts shall be tightened in a sequence which will insure equal distribution of bolt loads. Alternately tighten bolts 180 degrees apart to compress the gasket evenly.

    c. The length of bolts shall be uniform, and they shall not project beyond the nut more than 1/4-inch, or fall short of the nut when fully taken up. The ends of bolts shall be machine cut so as to be neatly rounded. No washers shall be used.

    d. Bolt threads and gasket faces for flanged joints shall be lubricated prior to assembly.

    e. Bolts shall be tightened in a sequence which will insure equal distribution of bolt loads. Alternately tighten bolts 180 degrees apart to compress the gasket evenly.

2. Mechanical Joints

    Mechanical joint valve connections shall be made-up using the gaskets and bolting provided with the serrated wedge type joint restraints and installed in accordance with manufacturer's recommendations. Single point contact set screw type joint restraints will not be allowed.

C. Painting of Exposed Valves, and Appurtenances

Exterior steel, cast iron and ductile iron surfaces except machined surfaces of all exposed valves and appurtenances, shall be finish painted in accordance with the table shown in Section 13.2.06, B, 2 of these Specifications

D. Painting of Buried Valves

Exterior steel, cast iron, and ductile iron surfaces, except machined or bearing surfaces of all buried valves, shall be shop-painted with an epoxy coating.

E. Installation

1. Install all valves and appurtenances in accordance with the manufacturer's instructions.

2. Conform to appendices of AWWA Standards, where applicable.

3. Install all valves so that operating handwheels or levers can be conveniently turned from operating floor without interfering with access to other valves and equipment, and as approved by MAWSS. Orient chain operators out of the way of the walking areas. Mount valves so that indicator arrows are visible from floor level.

4. For motor-operated valves located lower than five feet above the operating floor, orient the motor actuator to permit easy access to the push buttons and the handwheel.

5. For buried valve installations, set valve boxes plumb and centered, with soil carefully tamped to a lateral distance of four (4) feet on all sides of the box, or to the undisturbed trench face if less than

four (4) feet. Provide a flexible coupling next to a buried valve for ease of valve removal. Install a concrete "Donut" around the top of the valve box.

6. Install plug valves in horizontal liquid lines with the stem horizontal and the plugs on top when the valves are open, and the plugs on upstream end when the valves are closed. Install valves in vertical liquid lines with the plug at the top when closed.

13.2.08 FLOW METER

A. General

Each duplex pumping station shall include an electromagnetic type in-line volumetric flow meter installed in the discharge piping. Installation shall be above grade in a section of off-set piping to ensure the meter and piping are full at all flows. Reference Part 4 of this Section for flow meter/flow measurement details. See Appendix D for drawings relating to requirements for installation.

13.2.09 PIPE HANGERS AND SUPPORTS

A. General

1. Hangers and supports shall be constructed of type 316 stainless steel and designed for the loads applied. Whenever possible, the supports and hangers shall be a manufactured item available for purchase by the Contractor.

2. Pipe shall be adequately supported by pipe hanger and supports as specified by the Design Engineer. Hangers for insulated pipes shall be sized to accommodate insulation thickness.

3. Horizontal piping shall be supported at each change of direction and to facilitate maintenance of valves, flow meters, and other pipe line equipment.

4. Place a hanger within 12 inches of each horizontal elbow.

5. Support vertical piping independently of connected horizontal piping

6. Where several pipes are installed in parallel and at the same elevation, they may be supported by a single support designed for the purpose.

7. Do not support piping from other pipes, ductwork or other equipment.

13.2.10 ACCESS HATCH COVER

A. General

The types of access hatch covers include the following:

1.

2. Two (2) door non-draining angle frame access hatch covers of aluminum construction for surface mounted installation for direct replacement of existing hatch covers of similar size openings.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. O.S.H.A. Standard 1910.28 (fall-through protection)

2. Aluminum Association, Inc., 5th Edition – Bridge Type Structures (safety grate design)

3. ANSI/AWS d1.2-90 Structural Welding Code for Aluminum

4. ASTM B221

C. Materials and Fabrication

1. Provide manufacturer's standard fabricated units, modified, if necessary, to comply with the requirements. Where standard units are not available for the sizes and types required, custom fabricate units to match manufacturer's similar units.

2. Fabricate each unit in the shop, complete with stainless steel anchors, gaskets, hardware and accessory items as required.

3. The access covers shall be as manufactured by:
   a. East Jordan (EJ) USA, Inc.
   b. U. S. F. Fabrication, Incorporated
   c. Or equal

D. Covers and Frames

1. The access hatch covers and frames shall be constructed of 6061-T6 aluminum bars, angles and extrusions and 5086 diamond pattern aluminum plate of a minimum thickness of ¼".

2. Each unit shall be designed for a minimum loading of 300 pounds per square foot. Deflection shall not exceed 1/150th of the span.

3. Frames shall be of extruded aluminum with continuous anchor flange for embedment in concrete or flange-attachment to surface of concrete, as required. Aluminum in contact with concrete shall be coated with coal tar epoxy.

E. Accessories

1. Hinges shall be of heavy-duty design. Hinge leaves shall be brass alloy or type T316 stainless steel. Hinge pins shall be 3/8" diameter grade T316 stainless steel. The hinges shall be bolted to the cover plates and frames with grade T316 stainless steel bolts and lock nuts.

2. Each hinged cover plate shall be furnished with a grade T316 stainless steel 'slam-lock' with keyway protected by a threaded aluminum plug. The slam-lock shall be fastened to the grade T316 stainless steel fasteners.

3. Each hinged cover plate shall be furnished with an aluminum lift handle. The handle shall rest flush with the surface of the cover plate and be withdrawn for use.

4. Each hinged cover plate shall be equipped with an automatic aluminum hold open arm. The door shall lock open in the 90-degree position. Each hold open arm shall be equipped with a red

vinyl handle. The hold open arm shall fasten to the frame with grade T316 stainless steel hardware.

5. Hinged cover plates of 10 square feet, or larger, shall be equipped with stainless steel torsion bars to reduce the effort required to open the covers.

F. Fall Through Protection

1. Each access frame and cover assembly shall be provided with fall through protection in accordance with OSHA Std. 1910.28.

2. The fall through protection shall be composed of hinged aluminum grate spanning the opening.

3. The aluminum grate shall be designed to withstand a minimum live load of 300 pounds per square foot with a deflection not to exceed 1/150th of the span.

4. The aluminum grate openings shall be no greater than 2" x 7" to allow visual inspection of the wet well and adjustment of the floats switched when the cover is opened.

5. Each aluminum grate shall be provided with a permanent hinging system. The grate shall lock in the 90-degree opened position.

6. Each grate shall have an opening arm, with a red vinyl handle. The opening arm shall be provided with a controlled confined space entry locking device (lock by OWNER).

7. The grate shall be painted OSHA 'safety orange'.

G. Finish

1. All aluminum covers shall be mill finished. Protect finish with a factory applied coating of lacquer standard with the manufacturer.

2. All surfaces in contact with concrete shall be bituminous coated.

13.2.11 MISCELLANEOUS

A. General

All metals inside the wet well other than piping and pumps described, shall be type 316 or 316L stainless steel unless otherwise noted.

B. Expansion Bolts

1. Expansion bolts shall be the type requiring a drilled hole diameter equal to the bolt diameter such as Hilti, Inc. "Kwik-Bolt," or equal.

2. All expansion bolts shall be stainless steel, Type 316.

C. Anchor Bolts

Anchor bolts shall be as detailed on the Drawings. Bolts, nuts and washers shall be hot-dip galvanized, type 316 stainless steel, as noted.

D. Adhesive Anchors

1. Adhesive shall be a non-expansion anchor adhesive using a stress free chemical bond, such as Hilti HIT C-100 adhesive, or equal.

2. The resin shall be contained in a premeasured, manufactured cartridge, for field installation. The resin shall be a two component, chemically resistant adhesive that will not deteriorate or lose strength with age.

3. Anchor rods shall be type 316 stainless steel with a double chisel pointed end.

4. The Design Engineer shall specify the minimum embedment depth for each adhesive anchor location.

13.2.12 GRINDER PUMPING STATIONS

A. General

This subsection identifies minimum acceptable criteria for Grinder Pumping Stations owned and operated by MAWSS.

1. All installations for commercial use shall include two pumping units (duplex). And shall adhere to the duplex lift station standard specification.

2. Only one home may be connected to a simplex grinder station.

3. Individuals constructing a grinder pumping station with the intent of turning it over to MAWSS for ownership and operation must provide a system in accordance with this Specification Section and all other applicable Board Standards.

4. The grinder station and all associated components shall be furnished by manufacturer providing single source responsibility, guarantee, and warranty of the system.

B. Duplex High Flow, Low Head Grinder Pumping Station

1. The volute, seal plate, cord cap and motor housing shall be constructed of high quality ASTM Class 30 minimum cast iron. All exposed hardware shall be 316 stainless steel.

2. The pump impeller shall be of the recessed, vortex design. The impeller shall be capable of being trimmed to meet specific performance characteristics.

3. The pump shall have a three (3) bearing design consisting of an upper ball bearing for the purpose of carrying the thrust loads, a lower ball bearing to carry radial loads, and lower sleeve ball bearing shall handle all radial shock loading due to the grinding action, and also to act as a flame path for seal chamber. Ball bearings shall be designed for 50,000 hours B-10 life.

4. The motor shaft shall be of 316 stainless steel.

5. The pumping units shall be UL listed for class 1, division 1 hazardous locations.

6. The grinder mechanisms shall consist of radial cutter threaded and locked on the motor shaft by a screw, washer, and a shredding ring. Both the shredding ring and radial cutter shall be

constructed of 440C stainless steel hardened to a minimum Rockwell C55 and shall be finish ground for a fine cutting edge

7. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects," such as paper, wood, plastic, glass, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the discharge piping. The grinding mechanism must be capable of handling reasonable amounts of grit, often found in domestic sewage systems.

8. The motor shall be explosion-proof, squirrel-cage, induction type. Three phase motors shall be NEMA B design. The stator windings shall be the open type with Class F insulation rated for 155 degrees C maximum operating temperature.

9. Three phase motors shall have heat sensor thermostats attached to top end of motor winding and connected in series with the magnetic contactor coil in control panel to stop motor if motor winding temperature reaches 221 degrees F. Thermostat shall reset automatically when pump cools.

10. The basin shall be constructed of filament wound fiberglass/resin. Basin capacities, dimensions and minimum burial depth to ensure pipe cover shall be as shown on plans. Basin shall be capable of withstanding 150% of the anticipated maximum internal loading and wind loads based on 120 miles per hour.

11. The interior and exterior surfaces shall be protected from environmental impacts by a minimum thickness of 1/8" polyester gel coat.

12. Aluminum or fiberglass basin covers shall be provided with each basin assembly. Covers for the basin assemblies shall have a hinged access opening properly sized for installation and removal of the grinder pump and check valve assembly.

13. The lift-out rail system shall be stainless steel guide rails.

14. An adequate length of stainless steel lifting cable shall be supplied for removing the pump. The cable shall be of sufficient length and strength to effectively support the weight of the pump assembly during removal or installation.

15. A heavy-duty spring loaded, all rubber flapper type check valve with cast iron body shall be an integral part of the discharge seal assembly and lift out with the pump assembly.

16. Pump discharge piping shall be schedule 80 PVC.

17. Each pump shall have a check valve.

18. A PVC true union ball type shut off valve with Teflon seats shall be furnished as an integral part of the internal pipe assembly. If the discharge depth is more than 2 feet from the surface, an extension handle shall be supplied.

19. Level controls shall include Pump on, off and alarm levels controlled by three (3) mercury tube float switches. The level controls shall be suspended from a stainless steel bracket and strapped to a 316 SST cable/anchor system so that adjustment or replacement may be done without the use of any tools. Level controls shall be UL/CSA listed.

20. The control panel shall be assembled and tested by a shop meeting U.L. Standard 508 for industrial controls. The control panel shall include the following features: visual alarm; push-to-run switch; a generator receptacle and transfer switch; and redundant pump start with high level alarm capability. All power and control cable splices will be made outside the wet well in a junction box with terminal strips.

21. Approved system manufacturers:

    a. Myers

    b. Flygt

    c. KSB

C. Low Flow, High Head Grinder Pumping Stations – Residential

1. The manufacturer shall furnish complete factory-built and tested Grinder Pump Station, each consisting of grinder pump mounted in a basin constructed of Fiberglass Reinforced Polyester Resin, NEMA 6P electrical quick disconnect, pump removal system, shut-off valve, anti-siphon valve, check valve, each assembled in the basin, electrical alarm panel, and all necessary internal wiring and controls.

2. The pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with a single mechanical seal. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel.

3. The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece motor shaft. The grinder will be of the rotating type with a stationary hardened and ground stainless steel shredding ring spaced in close annular alignment with the driven impeller assembly, which shall carry two hardened type 400 series stainless steel cutter bars.

4. As a maximum, the motor shall be a 1 HP, 1725 RPM, 240 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, air-cooled induction type with a low starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. The motor protector combination shall have been specifically investigated and listed by Underwriters Laboratories, Inc., for the application.

5. The pumps may be mounted in a fiberglass wet well having the characteristics noted in subsection B, 10 above.

6. Each grinder pump station shall include a NEMA 4X, UL-listed Alarm Panel suitable for wall or pole mounting. The panel shall contain a push-to-run feature, an internal run indicator, a generator receptacle and transfer switch, and a complete alarm circuit. All circuit boards in the Alarm Panel are to be protected with a conformal coating and the AC power circuit shall include an auto resetting fuse. The Alarm Panel shall include the following features: external audible and visual alarm; push-to-run switch; and redundant pump start with high level alarm capability. All power and control cable splices will be made outside the wet well in a junction box with terminal strips.

7. Approved system manufacturers:

a. Environment One Corporation (E-One)

13.2.13 BY-PASS PUMPING

A. General

The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor who can demonstrate to the Design Engineer and MAWSS that he specializes in the design and operation of temporary bypass pumping systems. The vendor shall provide at least five (5) references of projects of a similar size and complexity performed by his firm within the past three years. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

B. Submittals

1. The Contractor shall prepare, with the vendor, a specific detailed description of the proposed pumping system and submit it and the vendor's references with his bid proposal. Bid proposals without an acceptable detailed plan for the temporary bypass pumping system may be rejected.

2. The Contractor shall submit to the Design Engineer detailed plans and a description outlining all provisions and precautions to be taken by the Contractor regarding the handling of existing wastewater flows. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials and all other incidental items necessary and/or required to insure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these Contract Documents.

   No construction shall begin until all provisions and requirements have been reviewed by the Design Engineer.

C. Equipment

1. All pumps used shall be fully automatic self-priming units that do not require the use of foot-valves in the priming system. The pumps may be electric or engine driven. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows.

2. All by-pass pumping units used within, or within 1,200 feet of areas zoned residential shall be enclosed in critical level sound enclosures. Sound of operating units shall not exceed 68 dBA measured at 25 feet from the unit.

3. The Contractor shall provide the necessary stop/start controls for each pump.

4. The Contractor shall include one stand-by pump of each size to be maintained on site. Backup pumps shall be on-line, isolated from the primary system by a valve.

5. In order to prevent the accidental spillage of flows, all discharge systems shall be temporarily constructed of rigid pipe with positive, restrained joints. Only materials that withstand pressures greater than the peak bypass system pressure may be used. All materials shall be suitable for contact with domestic sewage. Discharge hose will only be allowed in short sections and by specific permission from the Design Engineer. The bypass pumping system shall be 100% watertight.

D. Design Requirements:

1. Bypass pumping systems shall have sufficient capacity to pump the wet weather peak flow of the sewer. The Contractor shall provide all pipeline plugs, pumps of adequate size to handle peak flow, and temporary discharge piping to ensure that the total flow of the main can be safely diverted around the section to be repaired. Bypass pumping system will be required to be operated 24 hours per day.

2. The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. One standby pump for each size pump utilized shall be installed at the mainline flow bypassing locations, ready for use in the event of primary pump failure.

3. Bypass pumping system shall be capable of bypassing the flow around the work area and of releasing any amount of flow up to full available flow into the work area as necessary for satisfactory performances of work.

4. The Contractor shall make all arrangements for bypass pumping during the time when the main is shut down for any reason. System must overcome any existing force main pressure on discharge.

E. Performance Requirements:

1. It is essential to the operation of the existing sewerage system that no interruption in the flow of sewage throughout the duration of the project. To this end, the Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, all necessary power, and all other labor and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with his work, carry it past his work and return it to the existing sewer downstream of his work.

2. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

3. The Contractor shall provide all necessary means to safely convey the sewage past the work area. The Contractor will not be permitted to stop or impede the main flows under any circumstances.

4. The Contractor shall maintain sewer flow around the work area in a manner that will not cause surcharging of sewers, damage to sewers and that will protect public and private property from damage and flooding.

5. The Contractor shall protect water resources, wetlands, and other natural resources.

F. Field Quality Control and Maintenance

1. The Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to actual operation. The Design Engineer will be given 24 hours notice prior to testing.

2. Contractor shall inspect bypass pumping system every two hours to ensure that the system is working correctly.

3. The Contractor shall insure that the temporary pumping system is properly maintained and a responsible operator shall be on hand at all times when pumps are operating.

4. The secondary by-pass system must be available for immediate start-up upon failure of the primary by-pass system.

G. Preparation

1. Contractor is responsible for locating any existing utilities in the area of the bypass pipelines. The Contractor shall locate his bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from MAWSS and the Design Engineer. All costs associated with relocating utilities and obtaining approvals shall be paid by the Contractor.

2. During all bypass pumping operation, the Contractor shall protect the Pumping Station and force main and all local sewer lines from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage to the pumping station and force main and all local sewer lines caused by bypass pumping operations.

H. Installation and Removal

1. The Contractor shall remove manhole sections, or make connections to the existing sewer, and construct temporary bypass pumping structures only at the access location indicated on the Drawings, and as may be required to provide adequate suction conduit.

2. Plugging or blocking of sewage flows shall incorporate primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance of work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.

3. When working inside manhole or force main, the Contractor shall exercise caution and comply with OSHA requirements when working in the presence of sewer gases, combustible oxygen-deficient atmospheres, and confined spaces.

4. The bypass pipeline must be located off streets, sidewalks and on shoulders of the roads. When the bypass pipeline crosses local streets and private driveways, the Contractor must place the bypass pipelines in trenches and cover with temporary pavement. An alternate method to ensure vehicle passage may be the use of purpose built metal ramps. Upon completion of the bypass pumping operations, and after the receipt of written permission from the Design Engineer, the Contractor shall remove all the piping, restore all property to pre-construction condition and restore all pavement. The contractor is responsible for obtaining any approvals for placement of the temporary pipeline within public ways from the applicable Authorities.

I. Pump Specification Sheet

Reference Appendix D of this Section for Portable By-Pass Pump Specification.

13.2.14 Odor Control System

A. General

Each pumping station shall include a Wager 2050-i-450 Vent Scrubber, manufactured by Wager Company, or pre-approved equal. The odor scrubber shall be installed in connection with the 6" air vent. See Appendix D for drawings relating to requirements for installation.

PART 3 – SITE WORK

Part 3 of this specification includes Civil Site Work applicable to construction of new and renovation of existing Pumping Stations and related facilities. Additional specifications will be developed by the Design Engineer as required to ensure performance of this work in accordance with best engineering practices and as required for specific design.

13.3.01 CLEARING AND GRUBBING

A. Protection

Streets, roads, adjacent property and other works to remain shall be protected throughout the Work as defined in the General Conditions.

B. Clearing

1. Limits of clearing shall be within the limits shown on the Drawings or to limits staked on the ground by MAWSS or the Design Engineer.

2. Trees in construction zones shall not be removed until inspected and/or tagged by the Owner or his Representative.

3. All trees bordering any construction zone shall be protected by acceptable methods. Trees damaged by the Contractor will be either repaired or replaced as determined by the Owner or his Representative at the Contractor's expense.

4. Regardless of the easement width identified for the project, the contractor shall only remove vegetation within the easement where absolutely necessary to construct the project. Vegetation within the areas to be cleared, which may be designated to be saved by the Owner, shall be left standing and uninjured.

5. Stumps:

a. Stumps shall be removed to a depth of 18 inches below existing grade.

b. Engineering requirements shall control removal of stumps under fills, foundations, or any construction in contact with the stumps.

C. Grubbing

1. Limits of grubbing shall coincide with the limits of clearing.

2. Remove all stumps, roots over 4-inches in diameter, and matted roots within the limits of grubbing to a depth of 12" below existing grade.

D. Trimming of Trees

When required, and with the Owner's approval, trees shall be trimmed to remove branches or roots which interfere with construction or traffic. Contractor shall be responsible for securing all necessary permits from local governmental entities.

E. Removal and Disposal

All debris shall be removed from the site and disposed of by the Contractor in accordance with applicable regulations.

13.3.02 GRADING AND DRAINAGE

A. Temporary Erosion and Sediment Control

1. All erosion and sediment control measures are to be placed prior to any disturbance caused by grading and/or excavation and shall conform to the requirements of the appropriate regulatory agency for the State.

2. The Contractor shall be solely responsible for ensuring that erosion and sediment control measures are implemented and maintained at the site.

3. Soil disturbing activities include, but are not limited to: Clearing and grubbing, excavation for utilities and foundations, roadway and parking lot construction, construction or modification of site drainage, grading, and preparation for final seeding and sodding.

B. Grading

1. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas. Smooth subgrade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

2. Grading outside building lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes, and as follows:

3. Compaction: After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

C. Mud, Dirt and Dust Control

1. During the progress of the work, the Contractor shall conduct his operation and maintain the area of his activities so as to minimize creation and dispersion of dust.

2. The Contractor shall maintain existing access roads and facilities free of muck, dirt and debris.

D. Soil Materials

1. Select Fill:

a. Place select fill where shown or specified below and around structures, pipelines, roads, tanks, walks, and other work. Subbase, backfill, and fill material shall be tested by a geotechnical engineer provided by the contractor. All geotechnical testing reports shall be provided to the Owner and Engineer for review.

b. Use well graded granular material or bank run gravel, free from organic matter. Not more than 70 percent by weight shall pass through a No. 40 sieve; not more than 10 percent by weight shall pass through a No. 200 sieve; and 100 percent shall pass a 6-inch square sieve.

2. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural or crushed sand, approved by Design Engineer.

3. General Backfill and Fill Materials: Provide approved soil materials for backfill and fill, free of clay, rock or gravel larger than 6 inches in any dimension, debris, waste, frozen materials, vegetation and other organic matter and other deleterious materials. Previously excavated materials meeting these requirements may be used for backfill.

4. Unless otherwise specified or directed by the Design Engineer, fill shall be placed in horizontal loose lifts not exceeding 6 inches in thickness and shall be mixed and spread in a manner assuring uniform lift thickness after placing.

5. The Contractor shall repair, at his own expense, any after settlement that occurs within three (3) months of the construction. The Contractor shall make all repairs and replacements necessary within 30 days after notice from the Design Engineer or MAWSS.

E. Drainage Structures

Concrete drainage structures shall be formed and cast in place to suit conditions on installation and shall be in accordance with ALDOT Standard Specifications for Highway Construction, Latest Edition, and as noted on the Plans.

F. Drainage Piping

Unless otherwise noted on the Plans or Contract Specifications, the drainage piping shall be corrugated HDPE with smooth interior, capable of withstanding H-20 highway loading. The pipe shall conform to the latest AASHTO Standards, M 252, Corrugated Polyethylene Drainage Pipe, and AASHTO M 294, Corrugated Polyethylene Pipe, 300- to 1200-mm Diameter. The pipe shall be N-12 Duel Wall HDPE as manufactured by Advanced Drainage Systems, Inc., or an approved equal.

G. Solid Sod

1. Sod shall be Saint Augustine, Bermuda, Centipede, or as the site dictates. All the sod for sodding shall be at least 12 inches in width and 24 inches in length and shall have at least 1 inch layer of soil.

2. Sodding shall be used on all areas subject to erosion due to drainage or runoff.

3. Sodding shall be required if the grades exceed 2 to 1 slope.

4. Sod shall be planted only when the soil is moist and favorable to growth. The surface shall be loosened prior to placing the sod and kept moist, by sprinkling as required, until the sod is placed.

5. The sod strips shall be placed at right angles to the direction of the slope, starting at the lowest elevations. Wedge the edges and ends of the sod strips together and tamp and roll. Stagger the joints as far as possible.

6. A sufficient quantity of water shall be applied to all sod after laying, to insure immediate growth.

7. Contractor shall be responsible for maintenance of sod due to erosion or weeding issues during the construction warranty period.

H. Disposal of Excavated Materials

Material removed from the excavations which does not conform to the requirements for fill, or is in excess of that required for backfill, shall be hauled away from the project site by the Contractor and disposed of in compliance with ordinances, codes, laws and regulations at no additional cost to MAWSS.

I. Temporary Fencing

1. As a measure of safety and to reduce unwarranted traffic, the Contractor shall furnish and install a temporary fence surrounding the excavations and work area. Fence shall have openings only at vehicular, equipment and worker access points.

2. The fence shall be a plastic type, non-woven fabric, safety orange in color, 48 inches high supported with wooden stakes on 10' centers.

13.3.03 EXCAVATION AND BACKFILL FOR PUMPING STATIONS

A. Excavation

1. Excavations for structures and pipelines shall be open excavations. Provide excavation protection system(s) required by ordinances, codes, laws and regulations to prevent injury to workmen and to prevent damage to new and existing structures or pipelines.

2. Where the structure or pipeline is to be placed below the groundwater table, well points, cofferdams or other acceptable methods shall be used to permit construction of said structure or pipeline under dry conditions.

3. The elevation of the bottom of footings shown shall be considered as approximate only and Design Engineer may order such changes in dimensions and elevations as may be required to secure a satisfactory footing. All structure excavations shall be hand-trimmed to permit the placing of full widths, and lengths of footings on horizontal beds. Rounded and undercut edges will not be permitted.

4. When excavations are made below the required grades, without the written order of Design Engineer, they shall be backfilled with compacted gravel or concrete, as directed by Design Engineer, at the expense of Contractor.

5. Excavations shall be extended sufficiently on each side of structures, footings, etc., to permit setting of forms, installation of shoring or bracing, or the safe sloping of banks.

6. Subgrades for roadways, structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations. Subgrades which are otherwise solid, but which become soft or mucky on top due to construction operations, shall be reinforced with crushed stone or gravel. The finished elevation of stabilized subgrades shall not be above subgrade elevations shown.

B. Soil Material

Soil Material shall be as noted in subsection 13.3.02 Grading and Drainage.

C. Placement of Backfill

1. Place all backfill in excavations which are below structures, pipes, slabs, or paved areas, in horizontal layers not exceeding 6 inches in depth and thoroughly compact each before the next layer is placed. In other pipe trenches, compacted layers shall be 6 inches up to the pipe center line and 12 inches thereafter.

2. Place all backfill in excavations around wet wells and other structures in horizontal layers not exceeding 12 inches in depth and thoroughly compact each before the next layer is placed.

3. The minimum density for backfill under structures shall be 95 percent of maximum density obtained in the laboratory in accordance with ASTM D 1557 Method C including Note 2. This percentage is of Modified Proctor density. Fill around structures and that supports piping, roadways, parking areas, and walks shall be 90 percent of maximum density.

4. All subgrades shall be inspected, tested and accepted by the Design Engineer before the Contractor may proceed with the Work.

5. A soils engineering and testing laboratory shall perform sufficient tests and inspection procedures both in the field and laboratory to insure that the provisions of this Specification are met. Minimum testing shall include all fill placed within excavations for newly constructed Pumping Stations to ensure placement has been compacted in accordance with this Specification.

6. The testing and control firm shall be selected and paid for by MAWSS.

13.3.04 ACCESS DRIVE

General

Asphalt drives, turn-arounds, parking areas, etc. shall be prepared and paved to the extents shown on the Plans. All work shall be done in accordance with ALDOT Standards and any additional specifications prepared by the Design Engineer. See Appendix D of these Specifications for Typical Asphalt Pavement Details.

The Design Engineer shall make application with controlling Authorities for all permits and consent required for installation of turn-outs or connection thereto.

13.3.05 CRUSHED STONE AND GRAVEL SURFACING

A. General

1. Unless otherwise noted, all ground cover within the confines of the Pumping Station perimeter fencing shall be surfaced with crushed stone or gravel. The surfacing shall have a minimum depth of 6 inches after compaction.

2. Projects requiring a crushed stone or gravel surface access drive shall have the sub-base prepared as shown on the Plans and surfaced in accordance with this specification.

3. Subgrade shall be cleared of all vegetation and compacted to a minimum of 95% standard proctor density in accordance with AASHTO T-99.

4. Place a layer of geotextile weed control fabric directly on the prepared subsurface prior to placing the gravel surfacing. The geotextile mat shall be non-woven, ultraviolet stabilized and manufactured from polyethylene or polypropylene material. The mat shall contain no herbicides but shall be resistant to mildew and algae.

5. The surfacing shall be spread in layers of uniform thickness not exceeding six (6) inches and shall be thoroughly compacted with suitable power driven tampers or other power driven equipment.

6. The material shall be well-graded, clean screened gravel or crushed stone obtained from an approved source. Maximum size shall be 1-1/2 inches and 95 percent shall be retained on a NO.4 screen.

13.3.06 FENCING AND GATES

A. General

The Pumping Station site shall be fenced as dimensioned on the Plans and in accordance the Typical Fence Details included in Appendix D of these Specifications.

Access roads to the Pumping Station may be gated where shown on the Plans and in accordance with the Gate Details included in Appendix D of these Specifications.

B. Chain Link Fence

1. Fence Fabric

Fabric shall be woven in 2-inch mesh from No. 9 gauge steel wire conforming to the "Specification for Zinc-Coated Steel Chain-Link Fence Fabric" (ASTM A392). The height of the fence fabric shall be 72 inches unless otherwise indicated on the Drawings or specified herein. The selvages shall be twisted and barbed at the top and knuckled at the bottom.

2. Bands or Clips

Fabric shall be connected to line posts with 6 ga. wire clips; to top rail with 9 ga. wire; to terminal, corner and gate-posts with 1/4 in. x 3/4 in. tension bars tied with 11 ga., 1 in. wide steel bands and 3/8 in. diameter bolts and nuts; to tension wire with 11 ga. hog rings.

3. Barbed Wire

Barbed wire shall be No. 12-1/2 steel W.G. with four round or half-round barbs spaced 5inches apart and shall be Class 3 conforming to "Standard Specification for Metallic-Coated Carbon Steel Barbed Wire" ASTM A121).

4. Posts

Posts shall be hot-dipped galvanized steel pipe (Schedule 40, ASTM F 1083) of the sizes and weights given below or of other approved equivalent section.

a. Line posts shall have a 2-3/8 inch outside diameter and weigh 3.65 lb. per linear foot.

b. End, corner and pull posts shall have a 2-7/8 inch outside diameter and weigh 5.79 lb. per linear foot.

c. Gate post for Single-Swing Gates up to 6 ft. and Double-Swing Gate openings up to 12 ft. - shall be 2-7/8 in. outside diameter and weigh 5.79 lb. per linear foot.

d. Gate posts for double-swing gate openings wider than 12 ft. shall be 4-in. outside diameter and weigh 9.10 lb. per linear foot.

5. Caps

Steel pipe posts shall be capped with caps of the manufacturer's standard material, as approved; post shall have arms projecting outward and formed with tongues or other approved means for attachment of the barbed wire.

6. Top Rails

Top Rails shall be hot-dipped galvanized steel pipe, ASTM F 1083, schedule 40, 1-5/8 inch outside diameter.

7. Tension Wire

Tension wire shall be 7 gauge, 0.177 inch minimum diameter plus or minus .005 inches, marcelled or crimped coil spring hard-tempered carbon steel wire. Zinc coating shall be 1.2 ounces per square foot of surface or greater.

8. Fittings

Fittings shall be wrought iron, malleable iron, or pressed steel.

9. Gates

Gates shall be single or double-leaf, swing gates as indicated on the Drawings. They shall be of woven-wire fabric in suitable, amply braced frames. Hinges shall be of approved material and of ample strength. The gates shall be provided with suitable latches and provisions for locking, center bolts with center gate stop and automatic back stops to hold them in the open position.

10. Gate Locking

The Contractor shall provide a heavy brass or bronze padlock with a shackle chain for each gate. The padlocks shall be as manufactured by Yale or equal and shall have two keys. The padlock will be replaced by MAWSS on completion of the Project.

C. Wood Privacy Fence

1. Wood Fence Posts

Wood fence post shall be a pressure-treated southern pine 6”x6” S4S treated to AWPA UC 4A. Refer to Appendix D fence details for additional information.

2. Wood Fence Rails

Wood fence rails shall be pressure treated southern pine 2”x6” S4S treated to AWPA UC 3A. There shall be three rails between each post. The top rail shall be 8” below the top of the fence facing boards. Refer to Appendix D fence details for additional information.

3. Wood Fence Facing Boards

   Wood facing boards shall be pressure treated southern pine 5/4 deck boards S4S treated to AWPA UC 3A. The fence board pattern shall be straight on top, dog-ear.

4. Vehicle Gates

   Gates shall be single or double-leaf, swing gates as indicated on the Drawings. The gate leaf frames shall be fabricated from hot-dipped galvanized 1 5/8” O.D. schedule 40 tubular steel and shall include diagonal tension wires with adjustable turnbuckles. Construction of gate frame, hinges, and hardware shall be similar to that of a commercial grade chain link fence gate as specified in paragraph “C”, Chain Link Fence above. Wood face boards of similar design and spacing as the fence panels shall be attached to the outside face of the gate leaves. The gates shall be fitted with heavy duty hinges, heavy duty pull handles, and heavy duty latch with provisions for a padlock.

5. Fasteners

   a. All fasteners for framing shall be No. 10, 2-1/2” stainless steel screws.

   b. Wood fence facing boards shall be fastened to the framing with No. 10, 2-1/2” stainless steel screws.

D. Access Drive Swing Gate

The gate shall be fabricated steel of all welded construction, sized to suit drive as noted on the Plans, and in accordance with the details as shown in Appendix D.

PART 4 – ELECTRICAL

13.4.01 GENERAL ELECTRICAL DESIGN SCOPE

A. The general scope of electrical design for a MAWSS sewage pumping station shall include the following groupings of work:

1. Normal source electrical power service
2. Stand-by source electrical power service
3. Pump control panel design
4. SCADA system and instrumentation control panel design
5. Wet well electrical work
6. Site area electrical work
7. Sewage flow measuring
8. Electrical work unique to the specific pumping station

13.4.02 MAWSS EQUIPMENT STANDARDS

Unless otherwise noted, items specified herein by specific manufacturer and / or trade name shall not be subject to substitution and shall be provided as noted to maintain MAWSS equipment "Standard" practices and maintenance inventory.

13.4.03 GENERAL ELECTRICAL DESIGN CONSIDERATIONS

A. The entire volume area of wet wells shall be considered to be an NEC Class I, Division 1, hazardous location. All electrical equipment and wiring installed therein shall be in accordance therewith.

B. Each float switch cable and sensor cable exiting the wet well shall be provided with a dedicated conduit with a gas-tight compression gland type removable cable fitting. The conduit shall be schedule 80 PVC below grade and aluminum above grade.

C. Each pump unit shall be provided with a dedicated conduit for the associated power and auxiliary items control cables. The conduit shall be schedule 80 PVC below grade and aluminum above grade. The conduit shall be provided with an end bushing and shall be sealed after installation of the cables with a removable sealant such as "Chase-foam" to prevent migration of gasses through the conduit.

D. Wet well conduit installation shall be positioned to allow free removal of the pump units without interfering with cables to other pumping units and electrical items inside the wet well.

E. Conduit inside the wet well shall terminate at a position readily accessible for hand removal of cables by maintenance personnel safely working from the top of the well structure.

F. A common junction box with internal terminals shall be provided as close to the wet well as possible for gathering conduit runs from the wet well without seal-off fittings to allow field replacement of the cables to the wet well. Conduit connections from the junction box to control panels and other electrical equipment shall have poured seal-off fittings at the connection to the junction box.

G. All switch enclosures, control panel enclosures, junction boxes, and other equipment enclosures shall be 316 stainless steel.

H. Pumping station area lights shall be manually controlled with a toggle switch and not automatically by photocell unit, and shall be LED type.

I. Where electrical equipment is supported by rack mounting, the rack shall be positioned such that the wet well access doors can be fully opened, the NEC clear working space is achieved, hazardous locations as noted in NFPA 820 are observed and avoided, and vehicle access to the wet well for maintenance purposes is not restricted.

13.4.04 CONTROL PHILOSOPHY

Under normal status, the E+H Water Pilot pressure probe control unit will send the liquid level status signal to the RTU processor for pump start/stop and alternation determinations, and re-transmit the functions back to the Pump Control Panel for actual start/stop and alternation operations. Under a malfunctioning pressure probe system, the station shall automatically revert to the back-up float switch mode of operation. If required, the pressure probe control unit shall be able, by field reconnections, to automatically operate the station with a pre-programmed internal pumping control scheme.

13.4.05 EMERGENCY ENGINE OPERATION

Pumping stations designed for emergency engine pumping operation shall have float switches set for automatic "start" and "stop" of the pumps simultaneously beyond the normal liquid level operational range of the "normal" control scheme. Control circuitry for engine pumping operation shall be designed into the engine/pump assembly unit control panel by the supplier of the engine pumping unit. The engine pumping unit shall include an associated fuel supply system with storage capacity for a minimum of 48 hour full station load operation. Engine pumping status and failure reports shall be sent to the MAWSS Central Control Station via the SCADA telemetry system. As directed by MAWSS, an automatic engine exerciser shall be provided and set to run the engine from 7:00 to 7:30 each Monday morning.

13.4.06 STAND-BY GENERATOR OPERATION

See Specification Section 25 – Stand-By-Generator

13.4.07 PORTABLE STAND-BY GENERATOR OPERATION

Pumping stations designed to be powered by a portable stand-by generator shall be equipped with a manual transfer switch and female style power plug in accordance with MAWSS standards for the generator connection.

13.4.08 WIRING

A. Single conductors installed for general power and control circuits shall be rated at 600 volts, type THHN, or THHW, 75 degree (minimum) copper.

B. Conductors provided for seal failure (moisture sensing) circuits shall be rated at 1000 volts.

C. Special duty cables shall be provided to suit the unique requirements of the associated equipment.

D. Conduit installed within wet wells shall be schedule 80 PVC. Conduit for general usage shall be schedule 80 PVC below grade and aluminum above grade. Conduit connections where movement or vibration might be experienced shall be liquid-tight flexible metal type with liquid-tight type connectors.

13.4.09 OVERCURRENT PROTECTION

A. Fuses for power monitoring circuits shall be equal to Bussmann "KTK".

B. Fuses for general control circuits shall be equal to Bussmann "FNM".

C. Circuit breakers for control circuits and other small loads shall be UL listed thermal-magnetic type rated at 10K amp interruption current.

D. Circuit breakers for pump motor power circuits shall be UL listed and either thermal-magnetic type or magnetic only type with trip ratings selected for the associated motor.

13.4.10 MOTOR STARTERS AND CONTROLLERS

A. Full-voltage motor starters shall be UL listed and NEMA rated for the associated motor.

B. Reduced voltage motor starters shall be "soft-start" type manufactured in accordance with UL 508 with the following aspects:

1. 24 volt DC internal control voltage
2. Either internal or external power supply
3. Internal by-pass contactor to prevent control component overheating
4. Dry type discrete input and output control circuits
5. Electrical overcurrent protection with alarm indicator
6. Starting failure with alarm indicator
7. Phase rotation protection with alarm indicator.
8. Phase failure protection with alarm indicator
9. Voltage unbalance protection with alarm indicator
10. All soft starters shall be equipped with 3 SCR's

C. Operational and Performance Ratings:

1. Voltage, phase, and frequency of the associated motor.
2. Horsepower rating adequate for the associated motor.
3. Ampere capacity adequate for the associated motor.
4. 0.5 to 180 second adjustable time ramp for motor acceleration and deceleration.
5. Adjustable 30 to 100 % overload range.

D. Due to on-going refinements/improvements of variable frequency drives, the operational performance ratings shall be selected to suit the unique requirements of the associated specific pumping units to be controlled and approved by a MAWSS Engineer.

13.4.11 VARIABLE FREQUENCY DRIVES

A. Scope of Work

1. General: This specification defines the minimum requirements for Variable Frequency Drives (VFD) and accessories for speed control of either constant or variable torque loads.

2. Related Work: None.

3. References:

a. UL 508C
b. CE
c. NEC
d. Canadian Underwrites Laboratory (C_{UL})
e. ISO 9001
f. IEEE519-1992

B. Products

1. Acceptable Manufacturers:

a. Danfoss VLT® AQUA Series
b. ABB

c. Cutter-Hammer

C. General:

1. Furnish complete VFD as specified herein or in the equipment schedule for loads designated to be variable speed. VFD's shall be user-selectable for either constant or variable torque loads.

2. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC induction motors. The VFD shall be a six-pulse input design, and the input voltage rectifier shall employ a full wave diode bridge; VFD's utilizing controlled SCR rectifiers shall not be acceptable. The output waveform shall closely approximate a sine wave. The VFD shall be of a PWM output design utilizing current IGBT inverter technology and voltage vector control of the output PWM waveform.

3. The VFD shall include a full-wave diode bridge rectifier and maintain a displacement power factor of near unity regardless of speed and load.

4. The VFD shall utilize an output voltage-vector switching algorithm, or equivalent, in both variable and constant torque modes. Shall provide rated RMS fundamental voltage from the VFD. This allows the motor to operate at a lower temperature rise, extending its thermal life. VFD's that cannot produce rated RMS fundamental output voltage or require the input voltage to be increased above motor nameplate value to achieve rated RMS fundamental output voltage are not acceptable. VFD's that utilize Sine-Coded PWM or Look-up tables shall not be acceptable.

5. The VFD selected must be able to source the motor's full load nameplate amperage (fundamental RMS) on a continuous basis, and be capable of running the motor at its nameplate RPM, voltage, current, and slip without having to utilize the service factor of the motor.

6. The VFD shall offer a programmable motor parameter that allows the total number of poles of a motor to be programmed to optimize motor performance.

7. VFD shall automatically boost power factor at lower speeds.

8. An automatic energy optimization selection feature shall be provided in the VFD to minimize energy consumption in variable torque applications. This feature shall optimize motor magnetization voltage and shall dynamically adjust output voltage in response to load, independent of speed. Output voltage adjustment based on frequency alone is not acceptable for single motor variable torque configurations.

9. An initial ramp function shall be available to provide a user-selectable ramp, up to 60 seconds, for applications requiring a faster or slower ramp than the normal ramp.

10. An Autotuning PI controller output feature shall provide automated PI controller settings. Once the user accepts the settings, the VFD will save the settings to memory.

11. VFD shall offer a motor spinning test that will run the motor at 5 Hz until the OK button is pressed. This feature will allow the user to determine if the motor is running in the correct direction.

12. Switching of the input power to the VFD shall be possible without interlocks or damage to the VFD at a minimum interval of 2 minutes.

13. Switching of power on the output side between the VFD and the motor shall be possible with no limitation or damage to the VFD and shall require no additional interlocks.

14. It shall not be necessary to spin the motor shaft or de-couple the motor from the load to accomplish this optimization. Additionally, the parameters for motor resistance and motor reactance shall be user programmable.

15. The VFD shall have temperature-controlled cooling fans for quiet operation, minimized internal losses, and greatly increased fan life.

16. VFD shall provide full torque to the motor, given input voltage fluctuations of up to +10% to -10% of the rated input voltage (525 to 690VAC, 380 to 480VAC, or 200 to 240VAC). Line frequency variation of ± 2% shall be acceptable.

D. Harmonics

1. The VFD shall provide internal DC link reactors to minimize power line harmonics and to provide near unity power factor. DC Link reactor shall be installed so that power fluctuations to the DC Capacitors shall be reduced to increase Capacitor life. VFD's without a DC link reactor shall provide a 5% impedance line side reactor and provide spare capacitors.

E. Protective Features:

1. VFD shall include circuitry to detect phase imbalance and phase loss on the input side of the VFD.

2. VFD shall auto-derate the output voltage and frequency to the motor if an input phase is lost. This result will maintain operation without decreasing the life expectancy of the VFD. The use of this feature shall be user selectable and export a warning during the event.

3. Printed Circuit boards shall be conformal coated to reduce the corrosion effect from environmental gases and other conditions. The conformal coating must meet IEC 61721-3-3, Class 3C2 as standard and the VFD shall have an optional 61721-3-3, Class 3C3 coating available.

4. VFD shall auto-derate the output voltage and frequency to the motor in the presence of sustained ambient temperatures higher than the normal operating range, so as not to trip on an inverter temperature fault. The use of this feature shall be user-selectable, and a warning will be exported during the event. Function shall reduce switching frequency before reducing motor speed.

5. VFD shall auto-derate the output frequency by limiting the output current before allowing the VFD to trip on overload. The speed of the load can be reduced, but not stopped.

6. The VFD shall have the option of an integral RFI filter. VFD enclosures shall be made of metal to minimize RFI and provide immunity.

F. Interface Features:

1. VFD shall provide an alphanumeric backlit display keypad (LCP) which may be remotely mounted using a standard 9-pin cable. VFD may be operated with keypad disconnected or removed entirely. Keypad may be disconnected during normal operation without the need to stop the motor or disconnect power to the VFD.

2. VFD Keypad shall feature a key that, when pressed, shall display the contents of the programming manual for the parameter that is currently viewed on the display. The description shall explain the feature and how the settings can be made by the operator.

3. VFD shall display all faults in plain text; VFD's which can display only fault codes are not acceptable.

4. The keypad shall feature a 6-line graphical display and be capable of digitally displaying up to five separate operational parameters or status values simultaneously (including process values with the appropriate engineering unit) in addition to Hand/Off/Auto, Local/Remote, and operating status.

5. Two lines of the display shall allow "free text programming" so that a site description or the actual name of the equipment being controlled by the VFD can be entered into the display.

6. Keypad shall provide an integral H-O-A (Hand-Off-Auto) and Local-Remote selection capability, and manual control of speed locally without the need for adding selector switches, potentiometers, or other devices.

7. All VFD's shall be of the same series and shall utilize a common control card and LCP (keypad/display unit) throughout the rating range. The control cards and keypads shall be interchangeable through the entire range of drives used on the project.

8. VFD keypad shall be capable of storing drive parameter values in non-volatile RAM uploaded to it from the VFD, and shall be capable of downloading stored values to the VFD to facilitate programming of multiple drives in similar applications, or as a means of backing up the programmed parameters.

9. VFD Display shall have the ability to display 5 different parameters pertaining to the VFD or the load including: current, speed, DC bus voltage, output voltage, input signal in mA, or other values from a list of 92 different user-selectable parameters.

10. VFD display shall indicate which digital inputs are active and the status of each relay.

11. It shall be possible to toggle between three status read-out screens by pressing the [Status] key. Various operating variables, even with different formatting, can be shown in each status screen.

12. VFD display shall indicate the value of any voltage or current signal, including the engineering units of measurement, connected to the analog input terminals.

13. VFD display shall indicate the value of the current at the analog output terminals, including the engineering units of measurement.

14. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.

15. Two-level password protection shall be provided to prevent unauthorized changes to the programming of the VFD. The parameters can be locked via a digital input and/or the unit can be programmed not to allow an unauthorized user to change the parameter settings.

16. A quick setup menu with factory preset typical parameters shall be provided on the VFD to facilitate commissioning. Use of macros shall not be required.

17. A digital elapsed time meter and kilowatt hour meter shall be provided in the display.

18. VFD shall offer as standard an internal clock. The internal clock can be used for: Timed Actions, Energy Meter, Trend Analysis, date/time stamps on alarms, Logged data, Preventive maintenance, or other uses. It shall be possible to program the clock for Daylight Saving Time / summertime, weekly working days or non-working days including 20 exceptions (holidays, etc.). It shall be possible to program a Warning in case the clock has not been reset after a power loss.

19. A battery back-up option shall be provided to maintain internal clock operation during power interruptions. Battery life shall be no less than 10 years of normal operation.

20. VFD shall provide full galvanic isolation with suitable potential separation from the power sources (control, signal, and power circuitry within the drive) to ensure compliance with PELV requirements and to protect PLC's and other connected equipment from power surges and spikes.

21. All inputs and outputs shall be optically isolated. Isolation boards between the VFD and external control devices shall not be required.

22. There shall be six fully programmable digital inputs for interfacing with the systems external control and safety interlock circuitry. Two of these inputs shall be programmable as inputs or outputs.

23. The VFD shall have two analog signal inputs. Inputs shall be programmable for either 0 -10V or 0/4-20 mA.

24. One programmable analog output shall be provided for indication of the drive status. This output shall be programmable for output speed, voltage, frequency, motor current and output power. The analog output signal shall be 0/4-20 mA.

25. The VFD shall provide two user programmable relays with 75 selectable functions. Two form 'C' 230VAC/2A rated dry contact relay outputs shall be provided.

26. Floating point control interface shall be provided to increase/decrease frequency in response to external switch closures.

27. The VFD shall accept a N.C. motor temperature over-temperature switch input, as well as possess the capability to accept a motor thermistor input.

28. The VFD shall store in memory the last 10 faults with time stamp and recorded data.

29. Run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VFD does not start until isolation valves, seal water pumps or other types of auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VFD to start.

30. The VFD shall be equipped with a standard RS-485 serial communications port and front-of-drive accessible USB port. Danfoss FC or ModBus RTU communications shall be integrally mounted.

31. A Windows® compatible software program to display all monitoring, fault, alarm, and status signals shall be available. This software program shall allow parameter changes, storage of all VFD operating and setup parameters, and remote operation of the VFD.

G. Adjustments:

1. The VFD shall have an adjustable output switching frequency.

2. Four complete programming parameter setups shall be provided, which can be locally selected through the keypad or remotely selected via digital input(s), allowing the VFD to be programmed for up to four alternate control scenarios without requiring parameter changes.

3. In each programming set up, independent acceleration and deceleration ramps shall be provided. Acceleration and deceleration time shall be adjustable over the range from 0 to 3,600 seconds to base speed.

4. The VFD shall have four programmable "Bypass frequencies" with adjustable bandwidths to prevent the driven equipment from running at a mechanically resonant frequency. The feature shall offer a Semi-Automatic program to simplify the set-up.

5. VFD shall include an automatic acceleration and deceleration ramp-time function to prevent nuisance tripping and simplify start-up.

6. In each programming setup, independent current limit settings, programmable between 50% and 110% of the drives output current rating, shall be provided.

7. PID parameter settings shall be adjustable while the VFD is operating, to aid in tuning the control loop at start up. The VFD will also be capable of simultaneously displaying set-point reference and feedback values with appropriate engineering units, as well as output frequency, output current, and run status while programming the PID function.

8. The VFD will include a "loss of follower" function to detect the loss of process feedback or reference signals with a live-zero value and a user-selectable choice of responses (go to set speed, min speed, max speed, stop, stop, and trip).

9. An integral motor alternation function shall be provided to enable the output of the drive to alternate between two motors. The alternation interval shall be user-programmable in hours. This function shall operate external relays as required to control the motor alternation sequence. A dwell time shall be integral to the function and can prevent damage to the motor contactors.

10. The VFD will include a user-selectable Reset function, which enables the selection of between zero and twenty restart attempts after any self-clearing fault condition (under-voltage, over-voltage, current limit, inverter overload, and motor overload), or the selection of an infinite number of restart attempts. The time between restart attempts shall be adjustable from 0 through 600 seconds.

11. An automatic "on-delay" function may be selected from 0 to 120 seconds.

12. The VFD will include a user-selectable Auto-Restart function that enables the VFD to power up in a running condition after a power loss, to prevent the need to manually reset and restart the VFD.

13. VFD shall catch a rotating motor operating either in forward or reverse at up to full speed.

H. Service Conditions:

1. The ambient operating temperature of the VFD shall be -10ºC to 50ºC (14 to 122°F), with a 24-hour average not to exceed 45ºC. Storage temperatures shall be -13° F (-25° C) to149/158° F (65/70° C).

2. 0 to 95% relative humidity, non-condensing.

3. Elevation to 3,300 feet (1000 meters) without derating.

4. VFD's shall be rated for line voltage of 525 to 690VAC, 380 to 480VAC, or 200 to 240VAC; with +10% to -10% variations. Line frequency variation of ± 2% shall be acceptable.

5. No side clearance shall be required for cooling of the units.

I. Submittals:

1. Submit manufacturer's performance data including dimensional drawings, power circuit diagrams, installation and maintenance manuals, warranty description, VFD's FLA rating, certification agency file numbers, catalog information and catalog cut-sheets for all major components.

2. All drawings shall be in an 8.5 X 11" reproducible format, and incorporate the manufacturer's title block on the drawing.

3. This specification lists the minimum VFD performance requirements for this project. Each supplier shall list any exceptions to the specification. If no departures from the specification are identified, the supplier shall be bound by the specification.

4. Copies of all submittals shall be provided as indicated in Section 13.1.05.

5. Submit a computer generated Harmonic Distortion Analysis for the jobsite location.

J. Quality Assurance:

1. The manufacturer shall be both ISO-9001 and ISO-14001 certified.

2. All products shall be CE marked; UL labeled, and meet the requirements of UL-508C and maintain ULc.

3. To ensure quality and minimize infant-mortality failures on the jobsite, each VFD shall be completely tested by the manufacturer. The VFD shall operate a dynamometer at full load and speed under elevated temperature conditions.

4. All optional features shall be functionally tested at the factory for proper operation.

5. Factory test documentation shall be available upon request.

K. Examination:

1. Contractor to verify that job site conditions for installation meet factory recommended and code-required conditions for VFD installation prior to start-up, including clearance spacing, temperature, contamination, dust, and moisture of the environment. Separate EMT conduit installation of the motor wiring, power wiring, and control wiring, and installation per the manufacturer's recommendations shall be verified.

2. The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.

L. Start-up and Warranty

1. A factory-authorized service technician shall perform start-up on each drive. ("Start up" shall not include installation or termination of either power or control wiring.) The service technician shall perform start-up on up to 8 drives per day. Start-up costs provided with the bid shall include time and travel for the estimated number of visits required, but shall not be less than at least one half-day with travel. Additional labor or return trips to the site shall be billed at manufactures published straight-time rates. Upon completion, a start up service report shall be provided.

2. A 6-year On-site factory warranty shall be provided such that the owner is not responsible for any warranty costs including travel, labor, parts, or other costs for a full 6 years from the date of manufacture of the Drive. Special one-off and depot warranty is not allowed. Warranty shall cover line anomalies including electrical issues, load anomalies, accidental exposure to elements or other acts of nature. The cost of the warranty shall be included in the bid along with documentation of the warranty program.

M. In harsh environments the lifetime of electronic equipment is reduced due to the corrosiveness of the atmospheric environment. To increase the lifetime of the PCB's, we have elected to utilize conformal coated according to IEC 61721-3-3. There are not many US standards available on the levels of conformal coating so we choose to comply with the more difficult IEC standards from the European Union.

- *Class 3C1:* Applies to rural and urban areas with low industrial activities and moderate traffic. Be aware of that salt mist may be present in sheltered locations of coastal areas

- *Class 3C2:* Applies to locations with normal levels of contaminants, experienced in urban areas with industrial activities scattered over the whole area, or with heavy traffic.

- *Class 3C3:* Applies to locations in the immediate neighbourhood of industrial sources with chemical emissions.

13.4.12 CONTROL COMPONENTS

A. Switches, pushbuttons, and pilot lights shall be heavy-duty, oil-tight type. Miniature styles are not approved.

B. Control relays shall be UL listed and NEMA rated, and shall be fixed mounting, molded case frame, industrial type, with convertible contacts rated at 10 amps.

C. Plug-in relays, or "ice-cube" relays, shall be provided with a fixed base socket and screw type conductor connections, and shall have a clear plastic dust cover with "test" button. Contacts shall be rated at 12 amps, 120 volts.

D. Special duty relays or relay units shall be as specified under other paragraphs of these specifications.

13.4.13 FLOAT SWITCHES

Float switches provided within the wet well shall be tilting action, N.O. or N.C. as required, Conery 2900 B25C1 NO or 2901 B1SC1 NC, with 5 amp, 120/230 volt rated internal mercury actuated contacts, high impact resistant PVC housing, and factory sealed extra-flexible electrical cable. Substitutions are not approved in accordance with MAWSS standard inventory policy.

13.4.14 ENGRAVED NAMEPLATES

Engraved nameplates for equipment identification and other notifications shall be laminated plastic with black engraved characters on a white background. Nameplates shall be fastened with backing adhesive and stainless screws. Adhesive tape attachments are not approved.

13.4.15 PUMP CONTROL PANELS

A. Each pumping station shall have a Pump Control Panel for controlling the operations of the pump units. The Control Panels shall be constructed to the UL508A and UL698A standards and bear the associated labels. The following components shall be as specified. Where manufacturer references are made, substitutions for the item will not be approved in accordance with MAWSS standard inventory policy.

1. Control panel cabinets shall be NEMA 4X, 316 stainless steel, equal to Hoffman construction, and shall have quick release type door fasteners.

2. Circuit breakers, motor starters, control switches and pilot lights shall be as specified under other paragraphs of these specifications.

3. Main Power Surge Protection shall be CRITEC TDX200M Series Transient Voltage Surge Suppressor as manufactured by ERICO. There shall be no substitutes allowed.

4. Power Failure Relays shall be RK Electronics Model DPM-120-B with plug-in socket.

5. Pilot relays for establishing intrinsically safe separation with the wet well interior shall be RK Electrics Model ISR.

6. Pressure control units shall be Endress-Hauser pressure probe “Waterpilot” FMX, and shall be wired direct to the RTU

7. Pump seal-failure relay units shall be as specified by the associated pump supplier and may be combination type to include the pump over temperature sensing circuitry network.

8. Pump circuit current monitors shall be CT/relay type, Diversified Electronics CMG series.

13.4.16 SCADA CONTROL PANEL

A. Each pumping station shall have a SCADA/Instrumentation Control Panel for processing control commands, status data, and alarms signals from the Pump Control Panel relating to the operation of the pump units. Control Panels shall be constructed to the UL508A and UL698A standards and bear the associated labels. The following components shall be as specified. Where manufacturer

references are made, substitutions for the item will not be approved in accordance with MAWSS standard inventory policy.

1. Control panel cabinets shall be NEMA 4X, 316 stainless steel, equal to Hoffman construction, shall have quick release type door fasteners, and a hasp for pad lock.

2. RTU processor assembly shall be "ControlWave Micro" by Emerson with expanders, I/O remote modules, and accessory items required.

3. Radio transceiver unit shall be MDS SD9-C-MS with diagnostics.

4. Power supply/automatic battery charger (Meanwell # AD155-A), with battery shall be provided to suit the requirements for the equipment to be powered.

5. A complete set of software, cables, and peripherals associate with the overall SCADA Control Panel installation shall be supplied by the Contractor for installing, calibrating, and maintaining the finished installation.

B. "ControlWave Micro" Equipment and Peripherals

1. The following listing is the MAWSS standard references for component specifications relating to Emerson "ControlWave Micro" RTU installations.

a. 8 slot panel mount base.
b. 12-24 VDC PSSM, w/display interface.
c. CPU 16 MB RAM, 1 Enet, 2 RS232, 1 RS 485.
d. 12 DI/DO w/LED's, isolated.
e. 8 AI, isolated, 1-5V or 4-20 mA.
f. Keypad display, OIT 4175A, 16 key C1D2.
g. Maple OIT Communications Cable.
h. MAWSS CWLP enclosure, WTO 42707-1-Rev A.
i. MDS 9710B, w/diagnostics CA2059.
j. Communications Cable PC to ControlWave cable.
k. Meanwell Power Supply AD-155A, 12 VDC.
l. MDS Radio Interface Cable, 9710B to CW Micro, CA-2059.
m. RTU I/O and A/C-D/C kit.

C. Relays shall be as specified under paragraph "Pump Control Panel."

D. Radio antenna shall be Kathrein SCADA Division Type TY-900, and provided with a cabinet mounted Polyphaser IS-B50 bulkhead type surge suppressor and a Heliax surge suppressor installed on the antenna cable at the Control Panel.

E. Surge suppressor units shall be equal to products manufactured by Phoenix, Inc, with associated bases as follows:

1. 120 volt circuits---Phoenix PT-2-PE/S
2. 4-20 MA circuits---Phoenix TF-2-PE/SI, 24 V, DC.
3. DC circuits---Termitrab SLKK5

13.4.17 FLOW MEASUREMENT

A. The effluent flow meter shall be an electromagnetic type in-line volumetric flow meter.

B. General:

1. In-line type magnetic flow meter shall be an Endress-Hauser "PROMAG 400W" consisting of: a flow measuring element located in the process pipe; a converter unit located remote from the measurement element; and connecting cables between the measurement element and the converter unit. The system shall operate as a bi-directional frequency excitation Faraday induction principle.

2. The converter/transmitter unit shall be provided with a 316 SS NEMA 4X cabinet as additional environmental protection.

3. The manufacturer must certify the accuracy of the flow meter in writing to the Engineer prior to installation. The meter must have been tested over the anticipated flow range of the force main.

4. The manufacturer must certify the acceptable installation of the flow meter. Any parameter that has been changed from the meter setting at the time of testing must be identified in the certification of proper installation.

5. An acceptable installation includes in-place testing whereby flow volume measured by the flow meter is within 5% of the manually calculated volume from the pump down test.

6. Flow meters damaged by the Contractor (functionally or aesthetically) shall be replaced by the contractor at his cost.

7. All flow meters are to be fully submersible.

C. Flow measurement element shall be rated for continued full submergence installation in water, consisting of an all welded cast aluminum construction body, aluminum terminal box, pipe flange adapters with grounding yokes, and polyurethane liner. Metering tube and electrodes shall be 316 stainless steel electrodes and shall be field replaceable without requiring disassembly of the flow meter assembly. Cable connections to the terminal box shall be 1/2-inch NPT. The meter shall have a minimum flow range of 1 to 33 fps, pressure range of 150 psig at 40°C, and shall be rated for ambient temperature of -5 to 140°F. Flanges shall be AWWA Class D. Excitation shall utilize pulsed D.C. frequencies for zero flow stability and noise suppression. Accuracy shall be within 0.02 percent of flow rate.

D. Converter/Transmitter unit shall have solid-state electronics with surface mounting NEMA 4X aluminum enclosure, gasketed front access door and viewing windows, and alphanumeric keypad operator interface. The following features shall be provided:

1. Field settable touch window control microprocessor based values with electro-erasable prom without using battery back-up for:

    a. Volume units
    b. Time units
    c. Flow span
    d. Transducer diameter

2. Forward and reverse flow capability.

3. Built-in calibrator.

4. Diagnostic checking of internal components and drive status including fault notifications.

5. Internal surge suppression within the converter/transmitter housing to 10 kV wave from at 1 US rise, 40 US fall for:

   a. Power supply
   b. Excitation
   c. Each output channel

6. Four separate 16 character backlit LCD registers shall be provided for displaying the following flow data:

   a. Instantaneous flow in English language engineering units (GPM).

   b. Five digit totalized flow in English language engineering unit (gallons x 10^3).

7. Performance Specifications:

a. Input Power	120 VAc, 60 Hz (less than 15 VA)
b. Analog Output	4 to 20 MA, DC
c. Ambient Temperature	-5 to 140°F
d. Accuracy	+0.02 of reading

E. Interconnecting cable shall be provided as follows:

1. Meter/converter cables – special PVC jacketed multiple cable assembly, double-shielded cable, length as required.

2. Each cable shall be installed in a separate conduit with liquid tight type flexible metal conduit connections at flow meter and transmitter unit.

3. Splices in the cables will not be acceptable.

13.4.18 NARRATIVE OF PUMPING STATION OPERATION

A. Each MAWSS Pumping Station shall be designed as an unattended, remotely monitored, pump-down, automatically lead-lag alternating sequence, sewage pumping station. The wet well level is to be monitored by a pressure probe with liquid level indicated on the pressure probe control unit read-out window. There shall be a "Running" light for each pump, and an exterior "High Level Alarm" light mounted for 360-degree visibility. Upon the liquid level reaching a "low level" below the "stop pumping" pressure setting, a "low level alarm" shall be sent to the remote Central Control Station. Each pump shall have a "hand-off-automatic" control switch with identification plate.

B. Upon the liquid level reaching the High Level Alarm status, the station controls shall shift to float switch operation "back-up" mode whereby both pumps will time delay stagger "start" and "stop" simultaneously, and continue in this mode until the pressure probe system is reactivated.

C. Pumping stations provided with an emergency engine pumping system shall operate as noted under paragraph 13.4.05.

D. Pumping stations provided with an installed stand-by generator shall operate as noted under paragraph 13.4.06.

E. Pumping stations designed for operation on portable stand-by generator power shall operate as noted under paragraph 13.4.07.

13.4.19 TELEMETRY SYSTEM

A. Each pumping station design shall include remote control, status, and alarm reports to the MAWSS Central Control Station located at the Williams Wastewater Treatment Facility. Transmission shall be by the established Emerson radio SCADA (Supervised Control and Data Acquisition) system. A new active graphic shall be designed and programmed into the existing Central Control Station computer system for each new pumping station equal to other existing pumping station graphics.

B. The following status data shall be indicated by graphic display at the Central Control Station:

1. Pump "running" status for each pump
2. "Auto" status for each pump
3. Station discharge flow
4. Liquid depth level
5. Generator "running" status where a stand-by generator is provided
6. Engine "running" status where an emergency engine pumping unit is provided

C. The following audible and visual alarms shall be indicated at the Central Control Station:

1. Power failure
2. High level alarm
3. Low level alarm
4. Pump motor "overheat" for each pumping unit
5. Pump "seal failure" for each pumping unit
6. Generator "failure"
7. Engine "failure"
8. Pump Control Panel "unauthorized access"
9. SCADA Control Panel "unauthorized access"

13.4.20 WOODEN ANTENNA POLE REQUIREMENTS

A. Heights of the antenna poles above ground shall be determined by MAWSS following an on-site investigation for transmission verification to the intended receiving point.

B. Poles extending beyond 40 feet above finished grade shall have a 12-inch thick, 5'x5' (min.) concrete stabilizing pad at grade to prevent future pole leaning.

C. All antenna poles shall have a ½ inch diameter air terminal extending to 16 inches (min) above the top of the pole, and/or above the top of the installed antenna.

D. Antenna poles shall have an AWG #4 (min) copper ground conductor attached to the air terminal and to a 3/4" diameter x 20'-0" long copper-welded steel ground rod driven to 1'-0" below finished grade. The grounding conductor shall be attached to the pole at 24" intervals full length of the pole with stainless steel straps.

E. Wooden antenna poles shall be southern yellow pine, pressure treated in accordance with AWPA Standard C 16 using pentachlorophenol (penta), or chromated copper arsenate (CCA) preservative.

F. The antenna cable shall be installed in schedule 40, 1" PVC conduit from the antenna to within 2'-0" of the control panel.

G. Galvanized steel climbing steps shall be provided full length of the pole from 10' above finished grade to the top.

END SECTION