

Exhibit 2

Technical Criteria Transfer Pumps

1.0 INTRODUCTION

1.1 General Overview

Components of the work consist of, but are not limited to, the following:

- a) Review all existing as-built drawings and confirm on site dimensions of pipelines, pressure ratings of pipes and fittings, grades, top and bottom water levels, suction regimes and duty points of existing pumps, which will include step testing of the existing pumps, (and report on any underperforming pumps),
- b) Review and confirm the capacity of the existing electrical supply, including all conduits, cables, transformers, switchgear, motor control centers, space availability and the ability to accommodate the proposed larger pumps and related electrical equipment,
- c) Design and select two new pumps to run in parallel with the existing eight pumps and calculate new system curves complete with all pump curves (ten in parallel, but with five on standby), indicating the new upper, lower and average duty points, and how the new VFD pumps will be integrated into the operations of the existing pumps and the standard operating rules for the WTP,
- d) Confirm the acceptability of the existing (for existing pumps) and new suction regimes (for new pumps), including NPSH requirements, in accordance with the American National Standard for Pump Intake Design (ANSI/HI 9.8 – 1998) and report on and make improvements necessary,
- e) Perform a surge analysis to confirm the proposed new operating rules (including a power failure scenario) for the new proposed pumps in parallel with the existing pumps, and to confirm the non-exceedance of pressure ratings of the existing pipelines, fittings and the sizes of air valves,
- f) Design, manufacture and delivery of the new pumps and motors (VFD driven inverter duty-rated motors),
- g) Design, manufacture and install the new VFD's and associated switchgear and Motor Control Center components taking into consideration the integration thereof within the existing electrical grid and the potential of harmonic interferences,
- h) Integrate new VFDs, MCCs, and associated instrumentation into an existing ControlLogix PLC L55 and into the facility's existing Factory Talk SCADA System. Communication with new equipment will use Ethernet IP where available.
- i) Connect and integrate new VFDs, MCCs, and instrumentation with existing Facility SCADA PLC in HSPS #2 using Ethernet communication over new fiber optic cable.
- j) Perform all PLC and HMI programming based on existing standards and conventions and in co-ordination with Operations staff.
- k) Verify the status (and report on any deficiencies) of all existing pump control instruments and design, manufacture and install the associated instrumentation and electrical equipment for the new pumps, including detailed P&ID's and the

- control philosophy taking into consideration the integration with the existing pumping equipment,
- l) Design and construct all civil/structural work required for installation of the supplied mechanical and electrical equipment, and stamped by a Georgia PE,
 - m) Removal and disposal/salvage of original small pumps, mechanical equipment and motors,
 - n) Acceptance Testing and Commissioning of all new equipment in conjunction with the existing equipment,
 - o) Submit Operational and Maintenance Manuals and Handover,
 - p) The Design/Builder will confer with the Owner to schedule the work to be done and down time required to ensure that the existing pumping system stays operational at all times,
 - q) Quality assurance during design, manufacturing and installation of the work,
 - r) Project management and administration during the contract period,
 - s) Attendance and care during the warranty period of two years after completion,
 - t) All mechanical and electrical equipment and instrumentation installed shall have a design life of at least 25 years, taking into consideration reasonable care and maintenance during this period. Pipework will have a design life of 50 years.

All Work shall be performed in accordance with the General Conditions of Contract, all codes, details, specifications and the drawings.

1.2 General Requirements

The requirements for the mechanical installation of the pumps, valves and associated pipework and shall be read in conjunction with all other standards, project criteria requirements and technical specifications.

1.3 Scope of Work

The Work comprises the design, selection, manufacture, supply, testing, care and storage, delivery, installation and commissioning of pump sets (defined as a direct-coupled axial flow pumps and motors), instrumentation, valves (isolation, air and non-return) and connecting pipework together with new VFDs, motor control center, cabling and all instrumentation and control requirements. The Design/Builder shall also work closely with the Owner to establish the pump station control philosophy.

The specific areas of Work include but are not limited to the following:

- a) Design and/or selection of suitable pump sets (pump, motor, pipework and valves) to comply with the performance criteria below, and with all other relevant project requirements and data provided. The new pump set design/selection will be based upon the premise that the pump sets will be controlled by VFD's and will operate in parallel with identical pump sets.
- b) Selection of a suitable combination of pump sets, operating in parallel, to meet the required flow ranges and delivery pressures. The provisional system curves attached in **Exhibit 6**, indicate the characteristics of the pipeline and operating levels of the suction clear water well and delivery ground storage tanks. The new configuration will be made up of the existing eight pumps with the two new pumps (of equal duty) operating in parallel. On completion of this project, at any point in

time, one, two, three, four or five pumps, (of the available ten pumps) in any configuration, can be operational in parallel, at the same time.

- c) The new pump sets will be designed and manufactured in such a way that they can:
 - Meet the duty point of the existing large pumps, i.e. 17,500 gpm flow and a head of 47 feet, at its most efficient operating point at full speed,
 - Augment the flow in parallel with four or less existing pumps at full speed (non-VFD) by incrementally increasing and decreasing the pump speed to maintain a near full level of the ground storage tanks, and
 - Operate as a single duty pump with none of the existing pumps operational, thereby having a minimum operating speed (MOS) to ensure the duty is achieved for the lowest potential head in accordance with the system curves.
- d) Submission of all reports, design calculations, plans and shop drawings to the Owner for review. The Owner's review of these designs and drawings shall not relieve the Design/Builder of any of his/her obligations under the Contract.
- e) Corrosion protection of all equipment to the relevant standards.
- f) Confer with the Owner and the Owner's Representative regarding final pump selection and the control philosophy.
- g) Design, manufacturing, supply, assembly and the quality control requirements of pumps, motors, valves, pipework, civil/structural work, an anchored roof structure (canopy) over the new pumps (similar to the existing), electrical equipment and instrumentation.
- h) Shop testing (at full and minimum operating speed (MOS) and required duty point) of the new pump sets to prove the guaranteed efficiency.
- i) Supply and installation of instrumentation (temperature, vibration and flow switch) for new pumps only. (No new float switches are required, but if the Design/Builder required new or additional ones, they should not be the mercury type.) Re-programming of the PLC will be required to accommodate the two new pumps in place of the old four smaller pumps. Integration of new pump VFDs into the SCADA system is also required. This will be done in accordance with the new operating/control philosophy. PLC and HMI programming and integration to be provided under a subcontract to MR Systems, 1185 Beaver Run Rd, Norcross, GA.
- j) Insurance of all the equipment for the period of manufacture, storage, delivery and installation.
- k) Civil work to accommodate the installation of the pumps, pipework, cables, electrical panels and VFD's.
- l) Submittals of Shop Drawings for any structure, pipe fitting and part of equipment and shall consist of such detailed drawings as may be required for the execution of the Work. Shop Drawings must be approved by the Owner before the related work is performed or manufacturing commences.

- m) Where work is performed near or in the clearwell, the Design/Builder will put into place special measures to avoid any rubble, demolished concrete/steel or debris entering into the clearwell. Under no circumstances will any activities be performed that compromises the quality of the water, this includes for the disinfection of the new pumps and pipework before they are installed into the clearwell or connected to the existing header.
- n) The Design/Builder shall obtain warranties from the equipment vendors and manufacturers for a period of twenty-four (24) months after the Substantial Completion of all Work date.

The installation of the pumps shall be conducted in such manner that the existing pumps remain operational. The Design/Builder shall install one pump at a time until both pumps have been successfully installed. The duty points of the individual pumps shall be tested to the satisfaction of the Owner before commissioning, however no partial completion shall be given. **Substantial Completion** shall be given only once all the pumps have been installed and commissioned successfully and passed the Acceptance Tests.

2.0 DESIGN CRITERIA

2.1 General

This Work includes (but is not necessarily limited to) the following prime tasks and responsibilities:

- a) Selection of pump sets for stated operating performance, to include a Hydraulic Design Review Report.
- b) Electrical motor design and selection.
- c) Supply/manufacture & delivery of pumpsets including supply/manufacture of LV motors, VFD's and MCC's with specified minimum power reserve.
- d) Performance Testing of each individual pump set to demonstrate compliance with the full spectrum of the operating philosophy. Hydraulic operating envelope will be required at the pump supplier's factory prior to delivery, with the objective of proving the ability of each pump to meet the required duty point at the guaranteed efficiency. Refer to the relevant clause for the range of testing parameters:
 - Testing and commissioning of the combined pump sets after installation is also required to demonstrate compliance with the full range of specified outputs against the specified static pressure head requirement.
 - Acceptance testing of the pumps shall be performed on site after installation.
- e) Installation of all the equipment to be supplied. Where interfaces exists with existing flanges and valves, the Design/Builder will do field measurements to confirm all elevations, dimensions, standards and grades to ensure full compatibility with new equipment before the design commences.

- f) Maintenance of the commissioned pump set installation (reasonable wear and tear excluded) for the duration of the warranty period.
- g) This section of the Technical Criteria shall be read in conjunction with the following reference documents and technical specifications:
- American National Standard by the Hydraulic Institute: Pump Intake Design (ANSI/HI 9.8 – Latest edition)
 - American National Standard by the Hydraulic Institute: Rotodynamic Centrifugal Pumps for Manuals Describing Installation, Operation and Maintenance (ANSI/HI 1.4- Latest edition)
 - American National Standard by the Hydraulic Institute: Rotodynamic Centrifugal Pumps for Design and Application (ANSI/HI 1.3- Latest edition)
 - American National Standard by the Hydraulic Institute: Rotodynamic Pumps for Hydraulic Performance Acceptance Tests (ANSI/HI 14.6- Latest edition)
 - NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities
 - The following American Water Works Association Standards (LR – latest revision):
 - C200-(LR): AWWA Standard for Steel Water Pipe-6 In. (150mm) and Larger
 - C205-(LR): AWWA Standard for Cement–Mortar Protective Lining and Coating for Steel Water Pipe-4 In. (100 mm) and Larger –Shop Applied,
 - C206-(LR): AWWA Standard for Field Welding of Steel Water Pipe
 - C207-(LR): AWWA Standard for Steel Pipe Flanges for Waterworks Services- Size 4 In. Through 144 In. (100mm Through 3,600 mm)
 - C208-(LR): AWWA Standard for Dimensions for Fabricated Steel Water Pipe Fittings
 - C210-(LR): AWWA Standard for Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
 - C218-(LR): AWWA Standard for Coating the Exterior of Aboveground Steel Water Pipelines and Fittings
 - C219-(LR): AWWA Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe
 - C221-(LR): AWWA Standard for Fabricated Steel Mechanical Slip-Type Expansion Joints.
 - C500-(LR): AWWA Standard for Metal-Sealed Gate valves for Water Supply Services (Including addendums)
 - C512-(LR): AWWA Standard for Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Services
 - C651-(LR): AWWA Standard for Disinfection of Water Mains.
- h) The schedules contained herein summarize the conditions of service.
- i) Provision shall be made for pump sets to be equipped with sensors to monitor pump and motor vibration and motor winding temperatures. A paddle type flow sensor shall be provided in the pipework downstream of the pump, between the delivery isolating valve and the pump. Sensors shall be of the type to ensure effective operation during low flows and be installed complete with all wiring, junction boxes, power supply from the MCC (if required) and integrated with the PLC/SCADA.

- j) All mechanical, electrical, instrumentation and control, civil and structural designs will be stamped by Georgia certified Professional Engineers in accordance with the specific discipline of design work provided. This also relates to the structural modifications to the existing clear well, including the roof, where the new pumps will be installed. The Design/Builder may have to reinforce or replace structural elements of the roof to accommodate the additional loads.
- k) The Design/Builder shall be responsible for all mechanical, electrical, instrumentation and control, civil and structural work for the project, including the integration of the various instruments and controls with the PLC/SCADA. It is expected that the Design/Builder will have a number of Sub-Contractors and it will be the Design/Builders responsibility to manage these.

2.2 Pump Requirements

The following minimum requirements shall apply:

- Bowl and Volute : Spherical Graphite Iron (Ductile Iron) or alternatively Cast Steel (Epoxy Ceramic Replaceable liner and Epoxy Coated)
- Impeller : Bronze
- Riser Pipes : Mild Steel (Epoxy Coated and Epoxy Ceramic Replaceable Liner)
- Shafts : Stainless Steel
- Shaft Couplings : Mild Steel (Epoxy Coated)
- Collet Plate : Mild Steel (Epoxy Coated)
- Shaft Bearings : Neoprene Rubber
- Intake Bearing : Phosphor Bronze
- Seals : Mechanical
- Anchor Bolts : Type 316 stainless steel

The minimum bearing rating life for 24-hour continuous duty and maximum reliability shall be 100,000 hours at best efficiency point.

Where oil lubricated bearings (preferred) are used, they shall be fitted with a sight window. The Design/Builder shall specify oil lubrication for high-temperature or high-thrust services where bearing temperatures could exceed 200°F.

Exposed pump shafts and couplings shall be protected by OSHA-approved guards supplied by the pump manufacturer.

2.2.1 Pump Station Capacity, Design and Operating Philosophy

The pump station shall transfer a total of approximately 104,000 gpm of potable water by pumping with five pumps with the average system curve scenario. This includes for the one new pump at full speed.

Throttling of valves at the pump delivery ends shall not be employed as a measure to reduce flowrate.

At some point in the future, the pump sets shall be dually controlled from within the High Service Pump Station #2 and the main control room. However, for the purposes of this Contract the PLC within the pump station electrical room shall be the controller and in future the system shall be controlled and monitored from the main control room. The main control room is located in the WTP Administration building. It is expected that the existing instrumentation shall be suitable for monitoring and control purposes and therefore it will be necessary for the pump supplier to maintain the status quo with the new equipment. The new pump/motor/VFD will however be equipped with all of its own instruments as specified and the PLC will require additional programming to substitute the two new pumps with the old four pumps which will be removed.

The new operating/control philosophy shall typically be as follows (each item below, to be confirmed with the Owner):

- a) The average water level in the ground storage tanks will be maintained at at least 90% full,
- b) All pumps will switch off when the ground storage tanks level reach 95% of their full supply level,
- c) When the ground storage tank levels drop below 95%, one VFD pump will start up, and the speed will vary to maintain level at 90%,
- d) With the VFD pump at full speed, when the ground storage tanks level drops below 90% a second fixed speed pump will start up,
- e) If the level drops further more fixed speed pumps will start up in parallel with the VFD pump,
- f) When the water level in the clearwell drops below the low water level, no pumps will be operational,
- g) The standby pump status will be selected by the PLC and will alternate between the combinations of pumps operating in parallel based on total operating time, although the two VFD pumps will be operational most of the time.

2.2.2 Pump Station Electro/Hydro-Mechanical Equipment

The existing pump sets are designed for vertical axial flow pumps and therefore the Design/Builder will be required to supply and install the same.

The pumps shall be designed to meet the following:

- a) One pump operating at full speed in parallel with four other pumps shall meet the minimum flow duty point of 17,500 gpm (at the motor rated speed) against the head of 47 feet. This is the guaranteed duty point.
- b) The static head (zero flow) that the pumps will be designed for is as follows:
 - Highest static head: 63 feet: Clearwell at lowest water level (EL.993.5 feet) and ground tanks almost full (EL. 1056.5 feet)
 - Lowest static head: 21 feet: Clearwell at highest water level (EL.1004.0 feet) and highest point on 84” steel clearwell discharge pipeline (EL. 1025.00 feet)
- c) The dynamic head the pumps will be able to perform at is in accordance with the indicative system curves provided for in **Exhibit 6**. The Design/Builder will design the final system curves.
- d) Notwithstanding 1, 2, 3, 4 or 5 pumps being operated in parallel, at no time will a condition occur where the pumps are run beyond their safe operating limits, i.e. to abnormal vibrations, high temperature, speed variation, or pump running off its curve. The new pumps will therefore be fully compatible in performance to the existing pumps at full speed at 880 rpm, or less.
- e) The efficiency of a new pump will not be less than 86% at the duty point (most efficient operating point).

Other design considerations are:

- a) Because the pumps will be operated with VFD’s, all bearings, seals, cooling mechanisms will be designed to accommodate the operating lower speeds.
- b) Motors shall be either 8 or 10 pole. Pumps operating in excess of 900 rpm are not acceptable.
- c) Motors shall be totally enclosed fan-cooled (with additional cooling) premium energy efficiency (NEMA Premium[®]) or higher, with a NEMA Enclosure Type 4X.
- d) The motors shall be designed to operate with VFD’s including but not limited to, additional cooling mechanisms for the motor, modified motor bearings and windings, insulation systems for bearings and windings, thermostats on windings, thermistors, RTD’s, and additional instruments (if required).

2.2.3 Factory Performance Testing of Pumps and Penalties

Witnessed factory testing shall be performed in accordance with Grade 1U of ANSI/HI 14.6 – Rotodynamic Pumps for Hydraulic Performance Acceptance Tests, of each individual pump at full and minimum operating speed (MOS) and three incremental points between full and MOS, to demonstrate compliance with stated guarantees:

- a) Flow at specified duty head,

- b) Power requirement at duty flow,
- c) Efficiency at duty flow,
- d) NPSH requirement at duty flow,
- e) Closed valve head.

Note that no negative tolerance on flow, head or efficiency at the duty head shall be allowed. This shall be specifically observed during the factory tests.

Should factory tests indicate that pump performance deviates by more than 5%, pumps will be totally rejected. If pump performance fall between 5% and the specified acceptance criteria of the test standard, the Design/Builder will be allowed a time of three weeks to make the necessary adjustments. Should the pump test fail again, the pumps will be rejected.

Should the pump supplier be unable to perform a works test at his factory, alternative recognized pump test facilities in the Country of Manufacture shall be utilized and the cost of testing, transportation of the pumps, insurance etc. shall be included in the cost for testing.

Should pump Acceptance Tests indicate that the pump performance fall outside of the requirements of the test standard, penalties as deemed by the Owner may be applied.

Pumps shall be tested in the factory for release purposes but acceptance tests of the pumps shall be performed on site. The Design/Builder shall ensure that adequate facilities are available on site to execute an accurate pump test.

2.2.4 Commissioning and Testing

On site commissioning and testing will be done in the following steps after the installation of all equipment has been completed:

- f) Pre-Operation Checkout
- g) Functional Test
- h) Operational Test (5-day Test)
- i) Acceptance Test (30-day Test)

Commissioning and testing of pumpsets (and appurtenant contractual mechanical & electrical works) shall be carried out to the Owner's approval. The Design/Builder will be required to draw up a comprehensive programme of on-line measurements to demonstrate the effectiveness, efficiency and reliability of the installed system. Where it is deemed necessary, the Design/Builder shall propose and install a suitable and accurate on site flow measurement system to record and substantiate flow rates and pressure heads for the new pumps.

- a) Pre-Operation Checkout

Draft versions of the Operating & Maintenance manuals shall be submitted for review by the Owner's Representative thirty days (or more) in advance of the Pre-Operation Checkout.

Pre-Operation Checkout (Dry commissioning) of each piece of equipment may commence directly after installation provided power is available and testing operation shall not interfere with the operation of the other pumps. Pre-Operation Checkout shall comprise visual inspections, inspection of corrosion protection, confirming final colours, check motor turning direction before coupling is assembled, loop checks for all instrumentation cable, check and confirm alignment parameters, cycle valves, etc.

b) Functional Test

Functional Testing (Wet Commissioning) of the individual pumpsets shall follow after the Pre-Operation Checkout of the individual pumpline equipment has been duly completed. Functional Testing may extend (in aggregate) over a period of up to two weeks (not necessarily including 'down-time' to resolve problems). During Functional Testing, pipework shall be filled with water and pumpsets shall be run for the first time, first individually, then in parallel with either one or more pumpsets. All instrumentation shall be set and calibrated, alarm and emergency conditions shall be simulated (e.g. power failure, overheating bearing, etc.). This process will continue until both the pumps have been tested.

c) Operational Test (5-day Test)

After successful Functional Testing, the clearwell pumps shall be prepared for an Operational Test which will last for not less than 5-days. The new pumps will fully integrate with the existing pumps and in various operational modes, to be agreed with the Owner.

For instance:

- At 12:01 – 6:00 pm; operate a VFD pump at minimum speed with one or more of the existing pumps,
- At 6:00 – 10:00 am; operate a VFD pump at full speed with one or more of the existing pumps,
- At 10:00 – 5:00 pm; operate a VFD at mid-speed with one or more of the existing pumps. Keep VFD pump running at mid-speed and vary number of fix speed pump,
- At 5:00 – 12:00 pm; operate a VFD at variable speed (modulating between minimum and maximum speed) with one or more of the existing pumps. Keep the VFD pump running at maximum speed and vary number of fix speed pump.

During this time and all other testing periods trending will be done on all the instruments of the new pumps (including the clearwell and ground level tank levels) and the Design/Builder shall insure that sufficient capacity exists to store the data for this period. The data will be handed over to the Owner in the form of graphs displaying the data in relation to the set points and tank levels.

The Functional Testing shall be successful only if no failures occurred during the five day period. If any piece of the equipment or an instrument fails (or

operates beyond its limits), the operations do not follow the functional design specification or leaks occur on the pipes, the tests will not be deemed as successful and the failure will be addressed and the test repeated.

d) Acceptance Test (30-day Test)

On completion of the Operational Test the pump station shall be prepared over a period of fourteen days for the Acceptance Testing. Any changes that were made during the Operational Test shall be signed off by the Owner.

On approval of the Owner the Acceptance test will commence and will be conducted over a period of thirty days. Various operational modes during this period will be agreed with the Owner in advance. These may be as follows, for instance:

- Keep one of the VFD pumps running at the certain speed at certain period of time, with one or more of the existing pumps in parallel,
- Operate one of VFD pumps at minimum speed for a couple of hours a day with one or more of the existing pumps in parallel,
- Operate one of VFD pumps at maximum speed for a couple of hours a day with one or more of the existing pumps in parallel,
- Operate a VFD at variable speed (modulating between minimum and maximum) with one or more of the existing pumps in parallel for most of the time,
- Operate a VFD at variable speed (modulating between minimum and maximum) on its own without one of the existing pumps in parallel for a couple of hours a day,
- Ensure that the VFD pumps are rotated as duty pumps to equalize their running hours,
- The above scenarios will be achieved without the ground level tank level falling below 85% full.

During this time and all other testing periods trending will be done on all the instruments of the new pumps as described above.

Acceptance tests shall include that the performance of each pumpline individually and of the full system operating at maximum capacity shall be determined. NPSH testing on site shall not be required. The results of the tests shall be evaluated by the Owner and a decision regarding the application of penalties shall be made.

Acceptance tests for pumps shall not be conducted in the manufacturer's factory or at alternative facilities but shall take place on site.

At this stage, the Operating & Maintenance Manuals shall have been revised to reflect the findings of successive individual pumpset testing and the complete copies with modifications will be issued to the Owner within 7 days after completion of the tests.

Once the tests have been completed and Operating & Maintenance Manuals have been approved, the clearwell pumps shall become the responsibility of the

Owner for operation. It is the Design/Builder's sole responsibility to prove the performance of the pumps and complying with all the above tests and submission of the Operating & Maintenance Manuals will constitute **Substantial Completion**.

2.2.5 Conditions of Service

Schedule 1: Technical

DETAILS	PROJECT SPECIFICATION	REMARKS
1. Pumps N = No. of Duty Units S = Standby Unit Total No. of Units = N+1	2 N (with VFDs) (2 new pumps in parallel with 8 existing pumps)	A maximum of five pumps operational at any point in time
2. Required Type	Vertical Axial Flow, Single Stage	Manufacturer to enter details in Pump Schedules
3. Liquid Medium	Potable Water	
3.1 Temperature	typically 68° F (+20/-25 °F)	To be confirmed by the Design/Builder
3.2 pH	typically 7.6 (+/- 0.3)	
3.3 Turbidity	typically 0.14 NTU	
4. Operating parameters: Flow 4.1 Capacity Q : 4.2. Pumpset Capacity q :	q = 17,500 gpm	Refer to: Pump Station Hydro-Mechanical Operating Parameters Refer to attached system curve
5. Operating parameters: Head. 5.1 NPSH available 5.2 Initial condition	>30 ft Approximately 30 ft	Varies with Water Level in Reservoir
6. Operating Speed "n"	880 rpm at full speed Reduced speed at minimum as per the Design/Builder's design	Manufacturer to confirm/revise
7. Pump Efficiency h (most efficient operating point for a single pump)	$86\% \leq h \leq 100\%$	Manufacturer to enter values in Guarantee Schedule
8. Control	Variable Frequency Driver	Manufacturer to enter values in Guarantee Schedule
9. Motor	480V air cooled squirrel cage induction motor (Design/Builder to provide additional forced or water cooling (if required))	Motors shall comply with NEMA MG 1 Standards
10. Cabling between Motors and Drive		Shall be replaced to suit new motors. Old cabling to be removed.
11. Motor Control Centre		To be provided by the Design/Builder (while keeping existing large

DETAILS	PROJECT SPECIFICATION	REMARKS
		pumps operational)

2.3 Cranage

No overhead crane is available for offloading and installation purposes. It is the responsibility of the Design/Builder to ensure that a suitable crane is provided for all removal and installation purposes taking into consideration the space and load constraints as the loading area is on top of the clear water tank which will have some specific loads restrictions. It is the Design/Builder's responsibility to do all necessary calculations to ensure that these restrictions are not exceeded at any point in time taking into consideration all the various climatic and load conditions.

2.4 ELECTRO-MECHANICAL SPECIFICATIONS

2.4.1 Scope

This scope covers the design, supply, delivery, installation, testing, commissioning and guarantee of the electric motors for the Pumpsets. Installation and commissioning shall occur as soon as the pumps are available. Shutdowns for periods of no more than 3 hours duration are accepted but must be prior arranged with the Owner.

This scope includes (but is not necessarily limited to) the following prime tasks and responsibilities:

- a) The evaluation of existing conditions and new work plans for use in the calculation of HVAC loads to be used in design and selection of systems and equipment for upgrade or replacement.
 - i) Design/Builder shall perform calculations for the upgraded pump room to determine the HVAC loads and upgrade the ventilation systems and/or provide cooling systems as necessary to allow the VFDs and Controls to operate under manufacturers' recommended conditions.
 - ii) Cooling and ventilation systems shall be designed and installed to meet the 2012 IMC and other applicable codes and requirements, per the Georgia's Construction Code Program, including GA amendments, Energy Codes, and any local codes or requirements that may be in effect.
- b) The selection, manufacture and supply of suitable pumps complete with LV (<1000 volt) motors including pump bases (soleplates);
- c) Control instrumentation and signal cable terminating in a terminal box at the pumpset;
- d) Network communications between the VFDs and SCADA network interface;
- e) All pipework and valves in accordance with the existing large pump assemblies;
- f) Any other installation materials stated or implied to provide for a complete installation in accordance with the Specifications, Drawings and Schedules supplied; and
- g) Commissioning after installation and supplying of Draft O&M manuals.

2.4.2 Equipment Supplied and Installation by Others

No equipment shall be supplied or installed by others. The Design/Builder will design and supply all equipment but the following is preferred by the Owner:

- a) PLCs: Rockwell Automation ControlLogix model L55, configured redundantly – no exception
- b) VFDs: Rockwell Automation PowerFlex

2.4.3 General Information

- a) Only equipment based on proven technology and of high reliability shall be considered for use.
- b) All schedules included in this Document shall be completed in full and submitted with the Proposal.
- c) All relevant technical information regarding each component or item proposed shall be reflected in the relevant section of the Request for Proposal (supplemented by additional information where deemed necessary by the Design/Builder), in order that the Owner can make a proper evaluation of the Proposal.
- d) After award preference will be given to locally Georgia manufactured equipment and components. Should items not be locally manufactured, The Design/Builders shall clearly identify these in their Proposal and state how maintenance backup will be provided in future.
- e) Where products of a particular supplier are specified, ‘equal’ products from other suppliers may also be offered if approval for such products has been obtained from the Owner.

2.4.4 Standards and Regulations

All materials and equipment shall be new and of the standard and quality specified.

The Design/Builder’s shall ensure that they are fully acquainted with the contents of the applicable electrical codes and standards.

All wiring installations shall comply fully with NEMA WC5 and UL 83 as amended.

The design and manufacture of equipment and the complete installation shall be carried out and tested in accordance with the latest issue or amendments of the following Regulations, as applicable:

- DeKalb County’s Department of Watershed Management Design and Construction Standards, latest edition.
- Georgia Environmental Protection Division Minimum Standards for Public Water Systems
- Codes adopted and enforced by DeKalb County:

- International Building Code, 2012 Edition, with Georgia Amendments
- International Mechanical Code, 2012 Edition, with Georgia Amendments
- International Plumbing Code, 2012 Edition, with Georgia Amendments
- International Fire Code, 2012 Edition, with Georgia Amendments
- International Energy Conservation Code, 2009 Edition, with Georgia Supplements and Amendments
- NFPA National Electrical Code, 2014 Edition
- 2012 NFPA 101 Life Safety Code with all Georgia State Amendments
- Georgia Accessibility Code Chapter 120-3-20, as amended
- 2010 ADA Standards for Accessible Design
- Any local electrical and I&C codes.

Where conflicting information to this bid document is contained in the above codes and standards, this bid document will take precedence. The Design/Builder will inform the Owner of any conflicting information found before continuing with the design or ordering of any equipment.

Land and Easements:

No easements will be required as part of this project.

Utilities:

The Design/Builder will ensure that no utilities exists in the areas where breaking of concrete, excavations for new services, penetrations through walls or drilling for securing new supports, will take place. All necessary means will be exhausted to detect, protect and ensure that no concealed or visible cable, pipe or duct is damaged during the execution of the project.

Demolition and Removal of Concrete, Pipes and Cables

The work will include for the demolition and removal of concrete supports and new openings in the tank roof for the installation of the new pumps. The existing opening for the pumps in the tank roof will be reinforced concrete with steel bars and closed off on removal of the pumps. The structure of the tank roof and adjacent columns will be assessed by a professional structural engineer (Georgia licensed Professional Engineer) and recommendation made (and implemented) regarding any additional strengthening required for the cutting of two clearwell roof holes for the new pumps.

The Design/Builder shall include in his Cost Proposal the lump sum cost to:

- Remove and properly dispose of all redundant equipment and material from the site including but not limited to the building rubble, concrete and old electrical wires/conduits. All equipment removed, including pumps, motors pipework and valves shall be disposed of by the Design/Builder. All steel reinforcing and holding down bolts remaining above the concrete grade shall be cut off at least two inched below the surface of the concrete and the holes shall be filled with a non-shrink concrete repair mortar.
- Structural strengthening of the clearwell roof may be required to accommodate the additional loads from the new pumps. Based on the Design/Builder's calculations additional roof reinforcement may be required and will be deemed to be included

for the lump sum cost. The cost will also include for any surveys and testing that will be required to determine the extent of the current reinforcing and concrete characteristics.

- Demolition activities shall be performed in accordance with the Technical Specifications, Division 2.

2.4.5 Environmental and Site Conditions

The following information pertains to the Site and Works:

Elevation above sea level	< 1000 feet
Nominal MV supply	4160 V; 3 phase; 60 Hz
Nominal LV supply	480/277 V; 3 phase; 4 wire with earthed neutral
Fault level	TBA

The temperature at the pump station located in Dunwoody, Atlanta can reach up to 105 degrees Fahrenheit and therefore the motor shall have a suitable cooling in order to maintain continuous operation especially during low speed operation.

Surge protection shall be provided on all 480 V distribution boards to generally limit the impulse level to 1 kV.

No other special allowances for short- or long-term over- or under voltages, impulses, transients, spikes, surges, mains borne interferences or power failures are provided.

The Design/Builder shall ensure that all equipment, electrical or electronic, will be suitable for continuous, reliable operation under these circumstances, and the Design/Builder shall ensure that all equipment is adequately protected in this regard, whether such protection has been specified in detail or not.

Failure or malfunction of any component of the installation, even if attributable to the quality of supply, shall be rectified at the Design/Builder's expense.

2.4.6 Testing

All tests as detailed in the electrical codes and standards are to be performed by the Manufacturer for the Design/Builder and shall be witnessed by the Owner (the cost of travelling to the Manufacturers testing facility by the Owner and his representatives will be borne by the Manufacturer).

Site testing and commissioning shall be in accordance with the Commissioning and Testing schedule above.

2.4.7 Notices and Labels

All notices, labels and designations shall be in English. A list of wording, terms, designations etc., shall be submitted for approval before manufacturing of labels and notices commences.

2.4.8 Uniformity of Equipment and Equipment Procured

Where the Specifications call for specific makes and types of equipment, the Proposal prices shall be based on such equipment. No alternatives allowed unless agreed in writing with the Owner.

2.4.9 Workmanship

The Design/Builder shall employ only competent staff to execute the installation.

The Design/Builder shall be executed with the best workmanship in a workmanlike manner and to the satisfaction of the Owner.

Should any material or workmanship not be to the satisfaction of the Owner, it shall be rectified at the cost of the Design/Builder and all rejected material shall be removed from site.

The Design/Builder shall be responsible for the correct and complete erection of the Installation. Inspections by the Owner shall not release the Design/Builder from this responsibility.

2.4.10 Supervision

The Design/Builder shall provide full time supervision while staff is working on the site.

The person nominated by the Design/Builder to supervise the works shall have the authority to issue instructions on behalf of the Design/Builder.

2.4.11 Power Supply

The power supply is 480V 3 Phase and 120V. In the event of the Design/Builder requiring power for power tools that operate on 120V but exceeding 20 Amps, an alternative power source will be supplied and operated by the Design/Builder.

2.4.12 Low Voltage Induction Motors

Motors shall generally comply with the DeKalb County Design Standards: Low Voltage Induction Motors. It is the responsibility of the Design/Builder to decide whether water cooling is required (to be determined at Proposal). If water cooling is required then the Design/Builder must include a cooling water system in terms of quality, quantity, pressure and these shall be stated in the Proposal. The cooling water for pump bearings and lubricating water for the pump gland seals shall be supplied from the same system.

In addition, it will be expected that additional care will be taken in the avoidance of Bearing Voltages and Currents, excessive vibration due to machine resonance and best possible efficiency over the operating speeds.

As noted elsewhere, the motors and shall be sized by the Design/Builder to provide a minimum of at least 20% power reserve after taking into account the hydraulic efficiency of the pumpsets when operating at peak throughput. For axial flow pumps

the maximum power may be absorbed at lower flows and the reserve will be calculated at the point where the maximum power is absorbed.

All the motors must have anti-condensation heaters fitted that operate off 20 Volts A.C., 1 Phase.

Cable termination boxes must be compatible with the existing installation.

2.4.13 Factory Testing of motors

Each motor shall be tested at the Manufacturer's factory for temperature rise and excess torque in terms of NEMA MG 1 Standards.

The Design/Builder shall provide torque and load curves for the pump, motor and drive combinations, at proposal stage, to prove successful starting and stopping of pump sets.

The measurement of the temperature rise of the stator windings of motors shall be by the increase in resistance method.

Test certificates in duplicate, showing the results of all tests performed, shall be supplied at a date not later than the delivery date of the motors.

The test certificates shall contain power factor and efficiency figures for full load conditions as calculated from the test results.

2.4.14 Variable Frequency Drives

The Design/Builder shall indicate at Proposal stage the cable type required between the drive and the motor and the maximum length of cable allowed. The existing starters for the small pumps shall be removed from the motor control centers and replaced with properly sized circuit breakers to feed the VFD units, one unit for each pump. The VFDs shall communicate with the PLC and SCADA System via Ethernet.

The variable frequency drive shall preferably be a Rockwell (Allen-Bradley) PowerFlex drive with the following features:

- NEMA 1 enclosure with ventilation fans and air filters
- 18-pulse front end including isolation transformer
- Circuit breaker disconnect on input, rated for 65K AIC, with interlocked handle on enclosure exterior
- dV/dt output filter where distance between drive and motor is greater than 100 ft.
- Enclosure front door to include: Hand-Off-Auto Selector Switch; LCD display; manual speed control keypad; Run, Control Power On, VFD Fail LED Indicator Lights; Fault Reset pushbutton
- UPS to power control circuits
- Surge protection on all control conductors that exit the building
- Backup card for redundancy to keep pump running at reduced frequency if VFD failure occurs
- Ethernet port for communications
- No bypass starter.

2.4.15 Instrumentation

The Design/Builder shall be responsible for all instruments related to the monitoring of pumps and motors and valves. These signals must be relayed to the PLC.

The following instrumentation shall be allowed for on the pump/motor sets as applicable:

- a) All Bearing Temperatures – PT100 type measuring devices cabled to a termination box on the motor frame.
- b) Bearing Vibration Monitoring – Two sensors per bearing, one axially mounted and the other radially mounted. Requires 4-20mA output for the controls. Wiring to be available at a terminal box on the motor frame.
- c) Motor Winding Temperature Monitoring is to be provided for each motor. Each motor to have a spare thermistor provided and both to be terminated in a termination box on the Motor Frame.
- d) A paddle type flow sensor (Fantini Cosmi -Agent: BEP Bestobell- or equal) shall be provided and installed in the reducer upstream of the pump. Wiring shall terminating in the associated pumpline terminal box.
- e) Electronic pressure sensors (Endress + Hauser or equal) shall be supplied and installed downstream of each pump. The delivery sensor shall have a pressure range of 0 to 50 PSI.
- f) *Equipment and Instrumentation Identification:* All equipment and instrumentation (e.g. piping, valves and gates) shall be shown and identified with appropriate tags on the process and mechanical drawings. All devices shall be tagged in accordance with the process and instrumentation diagrams (P&IDs).
- g) *Equipment Data Sheets:* The Design/Builder shall develop an equipment data sheet and submit to the Owner for review. The data sheet shall be filled out completely for each piece of equipment selected. Data sheets are required for all process equipment, such as pumps, motorized valves and process devices.
- h) *Calculations and Supporting Data:* The list below shows calculations or support data that shall be required as part of the mechanical work. The list shall not limit the Design/Builder from performing other calculations that are required for specific facilities or systems. Calculations for the following items are required for mechanical work:
 - i) Pipe sizing and pressure ratings,
 - ii) Pressure-piping thrust forces,
 - iii) Surge pressure calculations and mitigation actions required,
 - iv) Hydraulic calculations that support the selection of pumps, which shall be accompanied by data sheets, system and pump curves,
 - v) Valve, air and check valve sizing, including closing times and sizing of counter weights, which shall be accompanied by data sheets.

2.4.16 Labelling and Numbering

Equipment and terminals shall be marked clearly in accordance with the approved Drawings and DWM WTP standards.

Equipment shall be labelled by means of a unique numbering system for ease of identification in accordance with DWM WTP Standards. The Design/Builder shall submit a numbering system as well as examples of the labels for approval by the Owner.

2.4.17 Operation and Maintenance Manuals

Two weeks before the Pre-Operation Checkout date, the Design/Builder shall submit three draft sets of complete Operation and Maintenance Manuals to maintain service and repair the installation. Data Books which shall also be submitted shall also include all the factory and site test certificates and final test set-points.

Information included in the manuals shall be the following:

- Contact details of all suppliers of equipment.
- Descriptions of pump station and equipment installed.
- Wiring diagrams.
- All record (as built) drawings.
- Operation of the pump station, including full comprehensive operating philosophy.
- Maintenance, disassembly & re-assembly procedures.
- Spare parts lists.
- Commissioning procedures.
- Decommissioning (mothballing) procedures.

Six complete hard copy sets, including two electronic copies, of the final Operation and Maintenance Manuals and Record (“As Built”) Drawings, certified as accurate, shall be submitted to the Owner seven days after completion of the Acceptance Test.

2.4.18 Tools, Accessories and Spare Parts

The supply of all tools, special tools and accessories required for the normal operation and maintenance of all the equipment and systems supplied, shall be included in the Contract.

All keys, tools and special tools shall be in duplicate and handed to the Owner upon completion. The Contract shall be deemed to be incomplete until this requirement has been met.

The Design/Builder shall ensure that all tools and equipment required are available during inspections and testing. This includes two-way radios, flow meters, keys, conductivity meters, bridging pieces, and recorders as required.

As part of the Lump Sum offer, the Design/Builder shall include the spare parts as per the manufacture recommendations. These will include for all mechanical, electrical and instrumentation and control equipment.

2.4.19 Maintenance and Guarantee

The equipment and installation included in this Contract shall have a warranty and the Design/Builder shall maintain all equipment in all respects for the duration of the Warranty period of 24 months.

The Design/Builder shall, for the full duration of the Warranty Period, be responsible for all work and equipment replacements required, including labour, travelling costs, the replacement of lamps and fuses, etc. The Design/Builder shall repair/replace faulty equipment within 48 hours of notification.

The Design/Builder shall submit full details of his maintenance and repair service facilities, including statutory holidays, weekends, after hours and normal hours.

The Design/Builder shall stock the accepted list of spares during the Defects Notification Period. All repairs to be made to the installation due to causes not covered by the warranties shall be done utilizing the above spare parts. At the end of the Warranty period, the remaining material shall be documented and handed over to the Employer for the ongoing maintenance of the installation.

2.4.20 Information Schedules

The Design/Builder shall complete the Schedule contained elsewhere in this document giving details of the motors he proposes. Where Design/Builders wish to bring special characteristics of equipment offered to the attention of the Owner, the Design/Builder shall supply descriptive literature and brochures to supplement information in the Schedules.

2.4.21 Installation Schedule

Before any activities commence on site, the Design/Builder will prepare and submit a work plan of activities that will take place on site. The schedule shall clearly indicate when access will be required to any of the facilities which could impact on the current operations, including access to the clearwell, ground tanks, manifolds, pipework, electrical and instrumentation equipment and cables, etc.

A detailed method statement indicating the procedure that will be followed to make modifications or install equipment shall also be submitted for approval prior to the commencement of any work. This shall include for tests to be done to ensure the existing isolation valves are in a proper working condition and are able to prevent any backflow from any of the tanks when work needs to be conducted on the pressure main or headers. The Design/Builder shall be responsible for contingency plans in the event of the isolation valves not being operational.

No disruption of the existing operations will exceed more than 3 (three) hours on any day. This time will not include for dewatering and refilling of the pressure main or header which will be done in liaison with the operational staff at the plant. The penalty for any period longer than 3 (three) hours is \$5,000 per hour or any portion thereof.

Once approval of the schedule is given by the Owner, the Design/Builder will still be required to obtain written permission 72 hours in advance of any operations to be

interrupted and access required. Access to structures or equipment or the temporary disruption of operations may be delayed due to high water demands, but the Design/Builder will be given the necessary access within 14 days of the scheduled date.