Print Form

Ohio Drinking Water Assistance Fund
Drinking Water State Revolving Fund (DWSRF)
Green Project Reserve Information Form

Ohio Environmental Protection Agency
Division of Drinking and Ground Waters

GREEN PROJECT RESERVE FORM

U.S. EPA requires Ohio EPA to use at least 20 percent of its capitalization grant funds for projects to address green infrastructure, water or energy efficiency improvements and other environmentally innovative activities. These four categories of projects comprise the Green Project Reserve (GPR).

Projects that meet GPR criteria follow the established DWSRF project process. Projects clearly eligible for GPR are known as categorically eligible projects. A list of categorically eligible projects within each project category is attached to this form. Projects not found to be categorically eligible will need to have business case documentation. For a project to be considered a GPR project, a business case requires a well-documented justification. Ohio EPA reviews all business cases to determine GPR eligibility and posts them on its website by the end of the calendar quarter in which the loan is made.

Listed below are the four categories of projects that comprise the GPR. For each category, there are corresponding pages that must be completed and submitted with this cover page. Attach additional pages as necessary. Please check the **category or categories** that are applicable to your project.

- ☐ **Green Infrastructure (G)** (pages 3-4)
- ☒ **Energy Efficiency (E)** (pages 5-7)
- ☒ **Water Efficiency (W)** (pages 8-10)
- ☐ **Other Environmentally Innovative Activity (O)** (pages 11-13)

PWS Name: City of Cleveland - Crown Water Works Plant PWSID: 1801212

Project Name: Crown Chemical Systems Upgrade and Miscellaneous Improvements Project PPL #: _____ (Assigned by Ohio EPA)

Total Est. Project Cost: $10,808,600 Total Est. GPR Amount: $357,144

Completed by:

Name: Karen Lisowski (Please print) Title: Consulting Engineer

Signature: Karen Lisowski Date: 1-27-12

For Ohio EPA use only:

Loan Number (if applicable): FS390262-0023 Eligible GPR Amount $: 357,144.00

Eligible GPR Categories: E, W Evaluated by/Date: 1/31/12

Loan Award Date (if applicable): May 31, 2012

Date Business Case Posted on webpage (if applicable): June 5, 2012

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Energy Efficiency (E)

PWS Name: City of Cleveland - Crown Water Works Plant PWSID: 1801212

Project Name: Crown Chemical Systems Upgrade and Miscellaneous Improvements Project PPL #: _____ (Assigned by Ohio EPA)

Total Est. Project Cost: $10,808,600 Total Est. GPR Amount: $292,144

Project Summary:

This project will be installing Variable Frequency Drive's (VFD's) and SCR drives on process pumps. The project also includes VFDs on HVAC equipment to utilize the displacement ventilation design concepts in the chemical facilities to provide comfort, heat removal, and humidity control.

Pump Facilities

Age of existing pumps or pumping facilities	
Existing pump/motor efficiency rating, if known	
New pump/motor efficiency rating	
Estimated annual electrical savings	
Estimated annual cost savings	

Business Case Narrative: (Calculate energy efficiency improvements and costs savings.)

See attached Energy Efficiency Business Case.

Attach Supporting Documentation

☒ Engineering Project Planning Documents ☐ Water/Energy Efficiency Determination (Ohio EPA)

☐ Public Water System Records ☐ Other: _____

Crown Chemical Systems Upgrade
and Miscellaneous Improvements Project

ENERGY EFFICIENCY – VARIABLE FREQUENCY DRIVES

SUMMARY

- The Crown Chemical Systems Upgrade and Miscellaneous Improvements Project will be replacing existing pumps in an existing system and installing new pumps in a new system with new high efficiency motors and variable speed drives to optimize energy efficiency across a wide range of operational conditions.

BACKGROUND

- The existing pumping systems for replacement include the sodium hydroxide feed equipment and the powdered activated carbon feed equipment. New systems will be installed with variable frequency drives (VFD) for AC motors. New pumping systems include the sodium hypochlorite feed equipment. These pumps will be installed with SCR drives to vary the output of DC motors.

RESULTS

- New high efficiency pumps and motors were selected to better meet the flow requirements of the processes. Variable Frequency Drives will be installed to provide additional improvements to operational flexibility.
- Variable Frequency Drives (VFD) were installed with the following pumping systems:
    - Sodium Hydroxide Feed Equipment
    - Powdered Activated Carbon Feed Equipment (Peristaltic Metering Pumps)
- SCR drives were installed with the following pumping system:
    - Sodium Hypochlorite Feed Equipment (Diaphragm Metering Pumps)

BENEFITS

- The use of variable speed drives will permit the operations staff to better match pumping to the needed flow conditions, reducing energy usage and unnecessary cycling of equipment.

CONCLUSION

- The modernization of the pumping systems to utilize high-efficiency motors combined with variable frequency drives will allow flexibility for the operational staff to optimize energy efficiency while meeting daily operational demands.

SECTION 11303
PERISTALTIC CHEMICAL METERING PUMPS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope :

1. CONTRACTOR shall provide all labor, materials, equipments and incidentals as shown, specified and required to furnish and install hose type metering pumps, pump control panel housing, VFDs, equipment control panels and appurtenances complete and operational as shown and specified.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with peristaltic chemical metering pumps.

C. Related Sections:

1. Division 1, General Requirements.
2. Division 3, Concrete.
3. Division 5, Metals.
4. Section 09900, Painting.
5. Section 11000, Equipment General Provisions.
6. Division 15, Mechanical.
7. Division 16, Electrical
8. Division 17, Instrumentation and Controls

1.2 QUALITY ASSURANCE

A. Comply with Section 11000, Equipment General Requirements, and the additional requirements below.

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

1. American Society for Testing and Materials.
2. National Electric Code.
3. Standards of National Electrical Manufacturers Association.
4. Institute of Electrical and Electronic Engineers.
5. American Gear Manufacturers Association.
6. American National Standards Institute.
7. ASTM A 48, Gray Iron Castings.
8. ASTM A53, Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
9. ASTM A276, Stainless Steel Bars and Shapes.
10. ASTM A283, Low and Intermediate Tensile Strength Carbon Steel Plates.
11. ASTM A320, Alloy Steel Bolting Materials for Low Temperature Service.

12. ASTM A743, Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
13. ASTM B584, Copper Alloy Sand Castings for General Applications.

C. All equipment provided under this Section shall be obtained from a single supplier or manufacturer who, with the CONTRACTOR, shall assume full responsibility for the completeness of the system. The supplier or manufacturer shall be the source of information on all equipment furnished regardless of the manufacturing source of that equipment.

1.3 SUBMITTALS

A. Comply with Section 11000, Equipment General Requirements, and the additional requirements below.

B. Shop Drawings: Comply with requirements of Section 01300, Submittals and the additional requirements below: Submit for approval the following:

1. Complete fabrication, assembly, foundation, and installation drawings.
2. Pump curves, and operation, maintenance and storage instructions.
3. Detailed specifications and data covering materials used.
4. Pump and motor assemblies.
5. Parts, devices and other accessories forming a part of the equipment furnished, shall be submitted for review for each separate pumping unit.
6. Manufacturer's literature, illustrations, specifications and engineering data including: dimensions, materials, size, weight, performance data and curves showing overall pump efficiencies, required net positive suction head, allowable suction lift, number of strokes per minute, flow rate, head, brake horsepower, motor horsepower and speed.
7. Shop drawings showing fabrication, assembly, installation and wiring diagrams. Wiring diagrams shall conform to JIC Standards. Wiring diagrams and suitable outline drawings shall show such details as are necessary to locate conduit stubups and field wiring. Standard preprinted sheets or drawings simply marked to indicate applicability to this Contract will not be acceptable.
8. Certified pump design points shall be provided. These points shall show number of strokes per minute, head, flow, horsepower, NPSH required, NPSH available for piping layout shown on the Contract Drawings, efficiency and current at all design points.
9. Complete layout and dimensions of SCR and VFD control panels, and metering pump local control panels, in accordance with the submittal requirements outlined in Division 17.
10. Data showing heat gain and sizing of panel cooler, if a cooler is used in the SCR or VFD panels.
11. Provide protective coating data as specified in Section 09900.

12. A letter from the peristaltic chemical metering pump manufacturer stating that the SCR controllers and VFDs furnished and installed by the peristaltic chemical metering pump manufacturer, and the peristaltic chemical metering pumps specified herein are totally compatible and will successfully operate under the operating load conditions and all other operating characteristics provided by the control package specified and/or shown in the Contract Documents.
13. Nameplate schedule for SCR and VFD control panel and pump local control panels.
14. A complete bill of materials of all equipment.
15. A list of the manufacturer's recommended spare parts to be supplied in addition to those specified in Paragraph 2.5 below, with the manufacturer's current price for each item. Include gaskets, packing, etc, on the list. List bearings by the bearing manufacturer's numbers only.
16. Complete motor data.
17. Data demonstrating compatibility of all pump materials of construction and chemicals pumped.

C. Field Test Results: Provide field test report in accordance with Part 3.3 of this Section.

D. Operation and Maintenance Data:
   1. Comply with Section 11000, Equipment General Requirements, and the additional requirements below.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with Section 11000, Equipment General Requirements.

1.5 WARRANTY

A. Comply with Section 11000, Equipment General Requirements, and the additional requirements below.

B. The CONTRACTOR shall obtain from the manufacturer a warranty for all peristaltic chemical metering pumps, controls, and appurtenances for 1 year from the date of Final Acceptance.

C. During the warranty period, the CONTRACTOR shall provide the services of a trained manufacturer's representative to make all adjustments, repairs, and replace all defective equipment at no cost to the OWNER.

D. The CONTRACTOR shall include all costs incurred by the manufacturer, including travel and expenses, under the terms of the warranty.

PART 2 PRODUCTS

PERISTALTIC CHEMICAL METERING PUMPS

2.1 GENERAL

A. The CONTRACTOR shall furnish and install peristaltic chemical metering pumps and drives, with all accessories, fittings, appurtenances, specialty items and all supports and anchors required for a complete and operating metering pumping system

B. All parts and mechanisms shall be amply proportioned for all stresses that may occur during fabrication, shipping, erection, and intermittent or continuous operation. All units shall be constructed such that dismantling and repairing can be accomplished without difficulty.

C. All anchoring hardware shall be 316 SS.

D. The pump system layout shall be as shown on the drawings. The layout shall provide a minimum of 18-inches between pumps for access and maintenance, and the maximum pump length shall be 26-inches.

2.2 SERVICE CONDITIONS

A. The pumping units shall be as follows:

Service	Powdered Activated Carbon
Chemical Service	PAC Slurry
Specific Gravity (@60°F)	1.20
No. of Pumps	3
Nominal Pump Capacity, gph	3.48~87
Hose Material	Natural Rubber
Min. Horsepower, hp	1 1/2
Nom. Inlet Size (NPT), in.	3/4
Nom. Outlet Size (NPT), in.	3/4
Motor Type/Speed Control	AC Motor/VFD

2.3 DETAILS OF CONSTRUCTION

A. General:

1. Pumping assemblies, including pump and driver, to operate within vibration and bearing temperature limits specified over the full operable range of the pump assembly.
2. Provide room and facilities for inspection, repair and adjustment.
3. Equip pumping units with all specified and necessary accessories, including lifting attachments, pressure sensor, gauges and switches, SCR controllers or variable frequency drives, suction pulsation accumulator, discharge dampeners and leak detection systems.

B. Pump

1. Type:
   a. Horizontal, positive displacement, hose or peristaltic type pump.
      1.) Capable of operation in either direction without flow variation.
      2.) Capable of running dry without damage to pump or hose.
      3.) Capable of pulling 95 percent of full vacuum.
      4.) Metering accuracy plus or minus 5 percent.
      5.) Repeatability plus or minus 1 percent accurate.
      6.) Valveless/Glandless with no dynamic seals in contact with the pumped product.
2. Pump Housing and Cover:
   a. Material:
      1.) Housing: Cast Iron, ASTM A48 Class 40 (DIN GG25).
      2.) Cover: Cast Iron, ASTM A48 Class 40 (DIN GG25),
   b. Provide housing capable of rotation in 90 degree increments.
   c. Provide a viewing window, sight glass hose, breather cap and drain with threaded plug.
   d. Provide a housing cover BUNA-N O-ring seal.
   e. Fill approximately 40 to 50 percent of the pump housing with a glycerin based lubricant blend to provide a medium for cooling and lubrication.
   f. Support pump housing by means of a welded ASTM A36 structural steel frame and baseplate.
3. Hose:
   a. Φ20 mm Natural Rubber.
   b. Burst Pressure Rating: 1,096 psi (75 bar)
   c. 53 to 68 shore durometer.
4. Shafts:
   a. Alloy steel SAE 1045.
   b. Provide two way seals for rotor shaft.
5. Rotor Assembly:
   a. Rotor: Cast Iron, ASTM A48 Class 40 (DIN GG25).
   b. Shoes: Cast Iron, ASTM A48 Class 40 (DIN GG25).
6. Bearing Frame:
   a. Use anti-friction type, minimum B-10 life of 100,000 hours at maximum operating speed and pressure. In accordance with AFBMA B3.15 and B3.16.
   b. Pumps without bearing frames are unacceptable.

C. Discharge Dampener:
   1. Discharge dampener shall have sentry II flat top, polypropylene housing, neoprene bladder with 1" FNPT connection. It shall have self-compensating air chamber with ¼" air inlet. Dampener shall be manufactured by Blacoh Fluid Control or equal.

2.4 PUMP DRIVE SYSTEM

A. Motor:

1. Provide premium efficient TENV, squirrel-cage AC induction motors, NEMA C face, conforming to the latest applicable requirements of NEMA, IEEE, ANSI, and NEC standards.
2. Provide motor HP in accordance with the description in the schedule of Part 2.2.A of this Section
3. Motors are to be designed for continuous duty for 3-phase, 230/460VAC operation, NEMA Design B with torque and starting currents in accordance with NEMA MG1 Part 31. Ratings to be based on a 40 degree C ambient 3,300 feet altitude or lower operation with a maximum temperature rise of 80 degree by resistance C at 1.0 service factor
4. Motors shall be furnished with Class H insulation utilizing materials and insulation systems evaluated in accordance with IEEE 117 classification tests. Motors shall have 1.0 service factor.
5. Bearings shall be selected to provide L10 rating of 100,000 hrs minimum for C-face flexible coupled applications, and shall be permanently lubricated.
6. Motor rotor construction shall be die cast aluminum, fabricated copper, or their respective alloys. Motor shall have copper windings.
7. Motors shall be inverter duty rated and suitable for use with PWM type variable frequency drives. Motors shall be rated for 1000:1 constant torque continuous duty over 1-60 Hz.
   a. Acceptable Manufacturers – Baldor or approved equal.

B. Gear Reducer:

1. Provide gearing with Fully Protected Drive direct-coupled mounting to the pump housing.
   a. The gearbox shall bolt directly to the pump housing which shall include a buffer zone between the gearing and pumphead to prevent gearbox contamination from pump fluid or lubricant in the event of a hose lubricant seal failure. The pump's internal bearing hub shall be vented through the rear of the pump housing to allow visual detection in the event of a hose lubricant seal failure.
   b. Close coupled pump designs which utilize the gearbox to seal the pump housing and expose the gearbox to lubricant or pumpage are not acceptable.
   c. Long coupled pumps which require external couplings, coupling alignment, and coupling guards are not acceptable.
2. Design gear reduction to match output speed requirement of the pump using two or three-stage gearing and matching torque rating of pumping equipment. Gearing shall be classified for continuous heavy shock duty, 24 hr duty with a minimum of 1.4 service factor. Gear shall be helical type with cast iron housing.

2.5 LEAK DETECTION SYSTEM

A. Provide two sensors on each pump, one to detect leakage of pumped product into pump housing and one to detect loss of lubricant.

B. Provide a float type device located near the top of the pump housing.

C. Sensor to send a normally closed or normally open signal to sound an alarm and turn pump off automatically.

D. CONTRACTOR to furnish and install switches. CONTRACTOR is responsible for alarm and relay to turn pump off.

E. Float switch to be 50 VA.

2.6 BASEPLATES

A. Bolt pump and drive to a common baseplate and frame.

B. Make baseplate of ASTM A36 fabricated structural steel.

C. Provide provisions for anchor bolts.

D. Design baseplate with adequate strength to support pump and driver.

E. Provide planed surfaces for bearing pads for pumps and drives.

F. Install pumping units and baseplates on a concrete foundation.

G. Provide coupling guard in conformance with OSHA requirements.

2.7 CONTROLS

A. Metering Pump Local Control Stations:
   1. Each metering pump shall be furnished with a local control station housed within a NEMA 4X, stainless steel enclosure with a clear cover as specified in Section 17650, Control Panels and Enclosures.
   2. Each control panel shall include the following devices:
      a. LOCAL/OFF/REMOTE Selector Switch.
      b. Start-Stop Push Buttons.
      c. ON/OFF Indicator Lights.
      d. Power Disconnect Switch
   3. With the LOCAL/OFF/REMOTE switch in the REMOTE position:
      a. The pump can be started and stopped using the push buttons.
   4. With the LOCAL/OFF/REMOTE switch in the LOCAL position:
      a. Area Control Station shall exercise control over pumps.

B. Metering Pump Area Control Stations:

1. Enclosure: 316 Stainless Steel, NEMA 4X with hinged lockable door.
2. Provide through door mains disconnect capable of being locked out.
3. Panel shall be rated for 460VAC, 60 Hz, 3-phase mains input with control transformer for powering 120V internal control devices. Provide primary and secondary fusing. Panel shall house a PWM type variable frequency drive rated to 90:1 constant torque as dictated by the motor frame size. VFD shall be fitted with input and output line reactors and shall have a minimum 150% current limit based on FLA of the motor.
4. Provide door mounted NEMA 4X operator controls as specified below:
5. Non-reset elapsed time meter which shall display pump running elapsed time.
6. Digital display of pump speed as RPM
7. Push to test pilot lights
    a. Pump Running – Red
    b. Pump Stopped – Green
    c. Pump Fault – Amber
    d. Hose Failure – Amber
    e. High Discharge Pressure – Amber
    f. Drive Fault - Amber
8. Manual Speed Potentiometer
9. Start Pushbutton – Green
10. Stop Pushbutton – Red
11. Fault Reset – Black
12. Emergency Stop – Mushroom-style, Red
13. Three Position Hand/Off/Auto Switch
14. Two Position Forward/Reverse Switch
15. Fault Alarm Horn with Silence Pushbutton
16. Control Logic – Provide control capabilities as specified herein.
    a. Panel shall be equipped with a three position hand/off/auto switch. When in the Hand position, pump speed shall be regulated via panel mounted speed potentiometer and shall be started or stopped via the panel mounted local start/stop pushbuttons. When in the Off position, the pump shall be off. When in the Auto position, the panel will require a closed contact remote start signal and will pace pump speed based on a remote 4-20mA input signal. When in Auto, pump will not stop until remote start contact is disengaged or the Emergency Stop has been engaged. Provide output status contact to indicate to a remote source when the pump is running in the Auto mode.
    b. When running, the Pump Running light shall be illuminated and running time shall be logged on the ETM. Provide output status contact to indicate to a remote source that the pump is running and an output 4-20mA signal to indicate pump speed. When stopped, the Pump Stopped light shall be illuminated.

c. Provide Pump Failure detection which shall stop the pump in the event of a hose failure, overpressure, or drive failure. When such an event occurs, the Pump Failure light shall be illuminated simultaneously with the corresponding Fault light. Provide output status contact to indicate to a remote source when the pump has stopped due to failure. Alarm horn shall engage in the event of a failure and shall be equipped with a silence pushbutton. Provide a reset pushbutton to restore the pump to functional mode once failure has been corrected.

d. Hose failure shall be detected by a Normally Closed float switch mounted on the pump.

e. High discharge pressure shall be detected by a Normally Closed pressure switch located within the discharge line of the pump.

f. Drive failure shall be detected via current limit and software fault detection of the VFD.

g. Provide local forward/reverse switch to locally change pump direction.

2.8 SPARE PARTS

A. Provide spare parts that are identical to and interchangeable with parts installed.

B. Furnish and deliver the following spare parts for each pump furnished:

1. Two replacement hoses.
2. Two sets of gaskets.
3. Two glycerin refills.
4. Two sets of special tools.

2.9 NAMEPLATES

A. Each pump and motor shall be furnished with a stainless steel nameplate securely mounted to the body of the equipment. As a minimum, the nameplate for the pumps shall include the following:

1. Equipment number.
2. Manufacturer's name and model number.
3. Serial number.
4. Rate flow capacity.
5. Head.
6. Horsepower.
7. Speed.
8. Armature voltage.
9. Armature amps.
10. Field voltage.
11. Field amps.
12. Power and service factors.
13. Any other pertinent data.

2.10 PAINTING

A. Pumps shall be finish painted by the manufacturer with his best grade finish paint system in accordance with Section 09900. Color shall be as approved by the ENGINEER. If any damage to the paint system occurs, the equipment shall be repainted as directed by the ENGINEER.

B. All gears, bearing surfaces, machined surfaces and other surfaces which are to remain unpainted shall receive a heavy application of grease or other rust-resistant coating. This coating shall be maintained during storage and until the equipment is placed into operation.

2.11 MANUFACTURER

A. Provide metering pumps of the product and manufacturer as listed below:
   1. Watson-Marlow Bredel, Model SPX20
   2. Siemens
   3. Or equal

PART 3 EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

B. Prior to installation, the CONTRACTOR shall:
   1. Ensure that the equipment shipped to the job site has been handled according to manufacturer's recommendations and has arrived in good working order.
   2. Ensure that all equipment has been stored and protected according to the manufacturer's recommendations.

3.2 INSTALLATION

A. Install in a manner and to the tolerances recommended by the equipment manufacturer. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the recommendations of the manufacturer.

B. Set anchor bolts in accordance with approved manufacturer's drawings.

3.3 START-UP AND FIELD TEST

A. Refer to Section 01650, Starting of Systems/Commissioning, Section 01660, Testing, Adjusting and Balancing, and Section 01670, Operational Demonstration.

B. After the completion of installation, each pumping unit shall be field tested to demonstrate compliance with the performance requirements as specified. Supply all electric power, water, slurry to complete the field tests.

C. Testing procedures shall duplicate as nearly as possible the conditions of operation and shall be selected to demonstrate that the equipment is operational and free from damage. Each control device, item of mechanical, electrical and instrumentation equipment and control circuits shall be considered in the testing procedures to demonstrate that the equipment has been properly services, aligned, dynamically balanced, connected, calibrated, and adjusted prior to operation.

D. CONTRACTOR shall verify through the testing that the units operate satisfactorily, without over heating or over loading of motors, and are free from excessive vibration or noise at operating pressure and capacity and at rated speed.

E. If the performance of any item of equipment does not meet the specified requirements, take corrective measures or remove the unit and replace with one which satisfies the conditions specified. A fourteen (14) day operating period of each item of equipment will be required before acceptance. During this fourteen (14) day operating period, supply all power and water necessary.

F. All chemical metering pumps shall be field calibrated in the presence of the ENGINEER at 20, 50, 75 and 100 percent of stroke and speed, and six sets of calibration curves shall be provided.

G. Tests on all pumps are to be conducted at point of discharge at selected strokes and speeds to confirm repeatability of settings.

3.4 MANUFACTURER'S FIELD SERVICES

A. Refer to Section 01650, Starting of Systems/Commissioning, Section 01660, Testing, Adjusting and Balancing, and Section 01670, Operational Demonstration.

B. The manufacturer shall check and approve the installation during construction and prior to initial operation. Prior to initial start-up, a written statement shall be provided by the manufacturer stating the equipment has been installed by the CONTRACTOR in accordance with the Drawings, Specifications and manufacturer's shop drawings and is ready to be placed into operation. The manufacturer shall test operate the system in the presence of the ENGINEER and shall verify the equipment

conforms with the specified requirements. The manufacturer shall re-visit the job-site as often as necessary until all deficiencies are corrected and the installation and operation is satisfactory to the ENGINEER. As a minimum this shall include two trips and a minimum of 16 hours per trip.

C. The manufacturer shall provide training of plant operation and maintenance personnel in accordance with the requirements of Section 01690, Instruction of Operations Personnel.

END OF SECTION

SECTION 11308
SODIUM HYDROXIDE FEED EQUIPMENT

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope :

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install the sodium hydroxide feed system complete and operational with all motors, control equipment, day tank scale and accessories as shown and specified.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the sodium hydroxide feed system.

C. Related Sections:

1. Section 09800, Special Coatings
2. Section 11300, Chemical Feed Equipment - General.
3. Section 11302, Diaphragm Chemical Metering Pumps
4. Section 13202, Polyethylene Chemical Tanks
5. Sections 15, Piping.
6. Section 15100, Valves and Appurtenances.
7. Division 16, Electrical.
8. Division 17, Instrumentation and Control.

1.2 QUALITY ASSURANCE

A. Comply with the requirements of Section 11300.

1.3 SUBMITTALS

A. Comply with the requirements of Section 11300.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with the provisions of Section 11300.

PART 2 PRODUCTS

2.1 SERVICE CONDITIONS

A. The sodium hydroxide feed system shall be designed to meet the following requirements:

1. Material Fed: Sodium hydroxide solution delivered at 25%, specific gravity 1.28.

2. Design Conditions:
   a. Raw Feed Points: North and South raw water headers at Pump Building
      1.) Total Flow Rates: Max: 42 GPH, Min: 2 GPH
      2.) Discharge Pressure: <100 psig .
   b. Intermediate Feed Point: Filtered water conduits at Flocculation/Settling Building
      1.) Total Flow Rates: Max: 42 GPH, Min: 2 GPH
      2.) Discharge Pressure: <100 psig .

2.2 DETAILS OF CONSTRUCTION

A. General
   1. The CONTRACTOR shall furnish and install diaphragm chemical metering pumps and drives, with all accessories, fittings, appurtenances, specialty items and all supports and anchors required for complete and operating metering pumping systems.
   2. All parts and mechanisms shall be amply proportioned for all stresses that may occur during fabrication, shipping, erection, and intermittent or continuous operation. All units shall be constructed such that dismantling and repairing can be accomplished without difficulty.
   3. All anchoring hardware shall be statinless steel type 316.

B. Performance
   1. The pumping units shall operate without surging, cavitation, vibration, or excessive noise over the operating speed range.
   2. Pumping system vibration shall not exceed the acceptable field vibration limits given in the standards of the Hydraulic Institute.
   3. All wetted surfaces of the metering pumps and appurtenances shall be suitable for continuous exposure to the chemical being pumped. The pumping units shall be provided in accordance with the table below. The materials of construction are listed based on the compatibility information provided by one of the named manufacturers. The CONTRACTOR shall submit compatibility data from the manufacturer being supplied to confirm the materials of construction.

C. Pumping units shall perform to meet the feed rate as described in part 2.1 of this Section.

D. Construction
   1. The chemical feed pump is to be of the hydraulically balanced diaphragm type, wherein a volume-measuring piston reciprocates within a cylinder and causes hydraulic oil to deflect a flat diaphragm. A diaphragm actuated, cartridge design hydraulic performance valve shall function to replenish hydraulic fluid as required, thus realigning the diaphragm to a precision controlled

start point for each stroke. The pump shall be able to withstand closed suction or discharge valves without damage to the internals of the pump. Peristaltic tube, peristaltic hose, and progressing cavity pumps shall not be accepted.

2. Pumps shall be mechanical lost motion type flow control where a cam driven by the worm gear actuates a reciprocating piston to drive the hydraulically actuated diaphragm. Pumps utilizing hydraulic bypass lost motion shall not be accepted.
3. The pump shall include a hydraulics diagnostics package which shall provide instant visual indications of normal hydraulic operations, system over-pressure, diaphragm integrity and proper oil level. The hydraulic bypass valve shall be externally accessible for easy adjustment.
4. Pump shall be equipped with a manually actuated hydraulic purge valve that can be used to validate air-free hydraulics, or so that diaphragm integrity can be easily verified without pump disassembly.
5. The pump shall be designed to full metric compliance and is available with English or Metric process connections of threaded or flanged design. If flanges are required, they shall be of one-piece construction integral to the tie bar assembly. Flanges that are threaded into the existing threaded connections are not acceptable.
6. The metered liquid will enter the reagent head at the bottom and exit at the top through gravity seating ball-type valves. These three-component valves shall be free-seating type with valve seats having knife-edge contact and will be 4-point guided to accurately control vertical and sideward movement. Spring-loaded check valves will not be acceptable. Valve and seat will be individually replaceable and sealed by o-ring or flat gasket. Valve assemblies will not incorporate any threading other than the process pipe connection. Valves must be serviceable without removing piping. Cartridge valve assemblies are not acceptable.
7. The chemical metering head shall include a four-bolt tie bar design which resists connection forces and helps promote leak-free performance. Suction and discharge connection forces and moments shall be available from the pump manufacturer when requested by the customer.
8. The diaphragm shall be a PTFE faced composite design with integral o-ring. The diaphragm shall be capable of sealing under full head-bolt torque limits without stressing the diaphragm. Pumps with diaphragms having separate o-rings shall not be permitted as the potential for over-tightening is present and the risk of leakage is high. Pumps with process end dish plates or contour plates are not acceptable.
9. Manual capacity adjustment by changing piston stroke length from 0 to 100% shall be accomplished while idle or operating. An auto-lock system for the manual (handwheel) stroke length control mechanism shall be provided, as standard, to prevent drift.

Pumps without locking handwheels will not be accepted. Pumps with auxiliary locks on the handwheel shall not be accepted, as the potential for user error is great. The large, handwheel shall be pressed down and shall provide detented indication of stroke length adjustment with resolution of ±0.1%.

10. The pump shall incorporate non-vented gearbox and eccentric designs to protect the pump from the ingress of water, dirt, sand or other debris. A rotary type lip seal arrangement shall positively seal and separate the two oils of the gearbox and the eccentric box. A reciprocating seal will be unacceptable. The gearbox shall be filled with heavy duty gear oil and the eccentric box shall be filled with a hydraulic oil to provide the best environment of operation for the hydraulic system. The hydraulic oil may be substituted with "off the shelf" food grade oils where required by the customer.
11. The worm and eccentric shaft shall be supported by ball bearings for long life. The eccentric shaft shall be a non-axially loaded, one piece design. The main input speed reduction shall be accomplished via a precision cut DYNALLOY gear and hardened steel worm shaft.
12. The pump shall be provided with a C-face motor, able to be mounted in one of three positions -- vertically, 45 degree angle or horizontally, dependent upon the space constraints. The C-face motor mounting arrangement shall eliminate the exposure to rotating couplings. Coupling enclosure must be totally enclosed and part of the motor mounting assembly. The motor shall be capable of operating in a clockwise or counterclockwise direction without impact on pump performance or components.
13. Pump design shall be modular type to allow for easy access to, and interchangeability of, assemblies or components. The gear reduction unit shall be capable of being mounted on either side of eccentric box.
14. Pumps shall have the ability to be duplexed in either in-line or opposed configurations.
15. The pump shall have a five-year drive train warranty.
16. The pump shall be capable of pumping with a net positive suction head available as low as 3 psia.
17. The pump shall have the ability to be hydrostatically tested in the actual installation at 1.5 times the rated pressure of the pump to ensure a safe environment.
18. Manufacture and model
    a. Pulsafeeder, Model 25HL
    b. Or equal

E. Controller

1. The pump controller shall feature manual pump speed control with a minimum turndown of 1000:1. Metering pump control shall be accomplished through the combined use of AC inverter technology and intermittent motor actuation (IMA) technology.

Published turndown ratings utilizing both stroke length and stroke speed to accomplish the above required turndown will not be considered. Furthermore, pumps requiring belts and pulleys to achieve the specified turndown range will not be accepted. An inverter duty motor shall be included and closed loop speed feedback will be integrated into the pump controller. The pump controller shall be the METERING PUMP CONTROLLER (MPC) as designed and manufactured by Pulsafeeder Incorporated, A Unit of IDEX Corporation.

2. The MPC shall be supplied with a removable handheld keypad and liquid crystal display (LCD) for ease of viewing and manipulating. The handheld shall have 6 feet of cable connecting it to the base mounted unit as standard. Optionally, the handheld may be mounted up to 1000 feet away from the metering pump for optimum flexibility and consolidation of controls with other pumps and systems. A controller with a non-removable keypad shall not be accepted.
3. The pump controller shall be integrally mounted in a NEMA 4X enclosure under the specified pump for maximum space savings. The controller enclosure shall be sealed independently from the bottom of the pump gearbox and shall have a double wall of protection from pump oil or chemical leakage into the electronics. Controllers utilizing the bottom of the pump to seal the controller enclosure shall not be accepted.
4. Cooling of the base mounted controller shall be by natural convection only and shall not employ the use of internal cooling fans.
5. The MPC shall display the calibrated flow of the pump in units of flow on the LCD. The calibrated flow display will include that of the stroke length position as well. Controllers displaying only RPM or strokes per minute (SPM) will not be accepted.
6. The MPC shall have the ability to automatically compensate for manual adjustments made to the stroke length of the pump, while displaying the new flow rate on the LCD. A re-calibration of the pump due to a stroke length change in normal operation is not acceptable. Any controller requiring such a re-calibration under these conditions will not be approved.
7. The controller shall employ a motor with no brushes. An AC inverter duty motor shall be used with the metering pump controller. This motor shall be available in either NEMA or IEC frame. Motors with brushes, such as DC permanent magnet motors, will not be accepted. Controllers utilizing only IEC motors will not be accepted.
8. The controller shall utilize a security code for protection against unauthorized use.
9. The MPC shall have a pump stroke and flow totalizer for data acquisition.
10. The pump controller shall not only be supplied but be designed and manufactured by the metering pump manufacturer.

11. The electrician shall have the flexibility to use the compression fit cable connections supplied with the controller or use the NPT conduit connection on the enclosure simply by removing the compression fitting to expose the NPT. Controllers utilizing MNPT connections that are integrally molded into the housing will not be accepted.
12. Functionality should include the following.
    a. Turndown: 300:1 with a steady state accuracy of +/- 2%.
    b. Inputs:
        1.) Digital: The MPC shall have (2) two digital inputs to perform two of the following functions simultaneously:
            a.) On/off control of metering pump
            b.) Level input from supply tank
            c.) External pacing – Pulse input
            d.) Leak detection of the metering pump
    c. Outputs:
        1.) Digital: The MPC shall have (2) two digital outputs to perform two of the following functions simultaneously:
            a.) Triggering an external relay due to a fault condition
            b.) On/Off status
            c.) Pulse output – Indication each time the pump strokes
    d. Calibration: The controller should include an on board program for signal and flow calibration.
    e. Input Voltage: The customer supplied voltage will be either 115VAC or 230VAC single phase for either 50 or 60 HZ.
    f. Motor Requirements: The commercially available motor shall be selected and supplied by the manufacturer of the pump controller. Either 115V AC or 230V AC single phase power can be supplied to the controller.
13. Standard Features, Pump controller should include the following features:
    a. AC motor speed control with speed and stroke length feedback
    b. Manual stroke length control
    c. Keypad that can be mounted on the pump or up to 1000' away from the pump
    d. Back-lit 2 line extended temperature 16 character LCD display
    e. NEMA 4X enclosure
    f. Two digital inputs
    g. Two digital outputs
    h. Self diagnostics

F. Injector:
    1. Type: Schedule 80 CPVC

2. Location: Install injectors as indicated on the Drawings Filtered Water Conduits.
3. Extension Length Into Pipe: 20-inches.
4. Injection Quill Diameter: 1-inch.

G. IBC Tote Bin Scale:

1. IBC tote bin scale shall be platform scale of hydraulic cell type, sized to accept a circular sodium hydroxide day tank that is 50 inches in diameter as indicated on the Drawings.
2. Cell shall be of the temperature stable, rolling diaphragm type. Load plate shall be able to tilt to 4° without affecting accuracy.
3. Dial:
   a. Wall-mounted panel in the sodium hydroxide day tank area as indicated on the Drawings.
   b. Dial diameter shall be 12-inches and read 0-8,000 lbs., with provision for tare adjustment.
   c. Dial shall be temperature stable and with damper installed to prevent shock damage.
   d. Accuracy shall be 1/2 of 1% (min.).
   e. Provide complete with hose, hose quick disconnects, and 4-20 mA transmitter with required power supply feed into dial for remote transmission of day tank contents to the Sodium Hydroxide Feed System Control Panel.
   f. Transmitter and other components for the dial and scale assembly shall wall-mounted with the dial.
   g. Flexible hose shall lead from hydraulic cell to dial.
4. Scale Frame: The scale shall be furnished with an FRP frame designed to support tanks as specified in these Specifications. The scale frames shall tilt up for cleaning. The FRP frames shall be vinylester based and shall be designed so as to minimize the frame heighths. The frames shall be triangular in shape and shall be designed to fit on the concrete tank pads shown on the Contract Drawings. The load cells shall be positioned between the concrete and the frames, at the corners of the frames. FRP splash guard boxes shall be included with the frames to provide a degree of protection for the load cells. The frames shall be designed by the load cell manufacturer and shall be done so in strict accordance with the various tank manufacturers so as to assure the proper amount of support area for tank bottom weight distribution.
5. The weigh scale shall be coated with a corrosion resistant paint per Section 09900.
6. Manufacturer:
   a. Force Flow Equipment, Model ~~50-DR40TB~~ 54 DR50TB 4000-1 ADD 2
   b. Or equal.

H. Anti-siphon Valve:
   1. Valve designed to prevent siphoning where discharge pressure may drop below suction pressure.
   2. Pressure Rating: 150 psi.
   3. Capacity: Meet or exceed maximum pumping capacity of metering pumps.

PART 3 EXECUTION

3.1 INSPECTION

A. Comply with the provisions of Section 11300.

3.2 START-UP AND TEST

A. Comply with the provisions of Section 11300.

END OF SECTION

SECTION 11302
DIAPHRAGM CHEMICAL METERING PUMPS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope :

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install diaphragm chemical metering pumps, metering pump control panels housing SCRs, equipment control panels and appurtenances complete and operational as shown and specified.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with diaphragm chemical metering pumps.

C. Related Sections:

1. Division 1, General Requirements.
2. Division 3, Concrete.
3. Division 5, Metals.
4. Section 09900, Painting.
5. Section 11000, Equipment General Provisions.
6. Division 15, Mechanical.
7. Division 16, Electrical.
8. Division 17, Instrumentation and Control.

1.2 QUALITY ASSURANCE

A. Comply with Section 11000, Equipment General Requirements, and the additional requirements below.

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

1. American Society for Testing and Materials.
2. National Electric Code.
3. Standards of National Electrical Manufacturers Association.
4. Institute of Electrical and Electronic Engineers.
5. American Gear Manufacturers Association.
6. American National Standards Institute.
7. ASTM A 48, Gray Iron Castings.
8. ASTM A53, Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
9. ASTM A276, Stainless Steel Bars and Shapes.
10. ASTM A283, Low and Intermediate Tensile Strength Carbon Steel Plates.

11. ASTM A320, Alloy Steel Bolting Materials for Low Temperature Service.
12. ASTM A743, Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
13. ASTM B584, Copper Alloy Sand Castings for General Applications.

C. All equipment provided under this Section shall be obtained from a single supplier or manufacturer who, with the CONTRACTOR, shall assume full responsibility for the completeness of the system. The supplier or manufacturer shall be the source of information on all equipment furnished regardless of the manufacturing source of that equipment.

1.3 SUBMITTALS

A. Comply with Section 11000, Equipment General Requirements, and the additional requirements below.

B. Shop Drawings: Comply with requirements of Section 01300, Submittals and the additional requirements below: Submit for approval the following:

1. Complete fabrication, assembly, foundation, and installation drawings.
2. Pump curves, and operation, maintenance and storage instructions.
3. Detailed specifications and data covering materials used.
4. Pump and motor assemblies.
5. Parts, devices and other accessories forming a part of the equipment furnished, shall be submitted for review for each separate pumping unit.
6. Manufacturer's literature, illustrations, specifications and engineering data including: dimensions, materials, size, weight, performance data and curves showing overall pump efficiencies, required net positive suction head, allowable suction lift, number of strokes per minute, flow rate, head, brake horsepower, motor horsepower and speed.
7. Shop drawings showing fabrication, assembly, installation and wiring diagrams. Wiring diagrams shall conform to JIC Standards.
8. Certified pump design points shall be provided. These points shall show number of strokes per minute, head, flow, horsepower, NPSH required, NPSH available for piping layout shown on the Contract Drawings, efficiency and current at all design points.
9. Complete layout and dimensions of SCR control panels, and metering pump local control panels, in accordance with the submittal requirements outlined in Division 17.
10. Data showing heat gain and sizing of panel cooler, if a cooler is used in the SCR panel.
11. Provide protective coating data as specified in Section 09900.
12. A letter from the diaphragm chemical metering pump manufacturer stating that the SCR controllers furnished and installed by the diaphragm chemical metering pump manufacturer, and the

diaphragm chemical metering pumps specified herein are totally compatible and will successfully operate under the operating load conditions and all other operating characteristics provided by the control package specified and/or shown in the Contract Documents.

13. Nameplate schedule for SCR control panel and pump local control panels.

C. Field Test Results: Provide field test report in accordance with Part 3.3 of this Section.

D. Operation and Maintenance Data:

1. Comply with Section 11000, Equipment General Requirements, and the additional requirements below.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with Section 11000, Equipment General Requirements.

1.5 WARRANTY

A. Comply with Section 11000, Equipment General Requirements, and the additional requirements below.

B. The CONTRACTOR shall obtain from the manufacturer a warranty for all diaphragm chemical metering pumps, controls, and appurtenances for 1 year from the date of Substantial Completion.

C. During the warranty period, the CONTRACTOR shall provide the services of a trained manufacturer's representative to make all adjustments, repairs, and replace all defective equipment at no cost to the OWNER.

D. The CONTRACTOR shall include all costs incurred by the manufacturer, including travel and expenses, under the terms of the warranty.

PART 2 PRODUCTS

2.1 GENERAL

A. The CONTRACTOR shall furnish and install diaphragm chemical metering pumps and drives, with all accessories, fittings, appurtenances, specialty items and all supports and anchors required for complete and operating metering pumping systems.

B. All parts and mechanisms shall be amply proportioned for all stresses that may occur during fabrication, shipping, erection, and intermittent or

continuous operation. All units shall be constructed such that dismantling and repairing can be accomplished without difficulty.

C. All anchoring hardware shall be C-276 Hastelloy.

D. Provide factory assembled metering pump skids, as noted.

2.2 PERFORMANCE

A. The pumping units shall operate without surging, cavitation, vibration, or excessive noise over the operating speed range.

B. Pumping system vibration shall not exceed the acceptable field vibration limits given in the standards of the Hydraulic Institute.

C. All wetted surfaces of the metering pumps and appurtenances shall be suitable for continuous exposure to the chemical being pumped. The pumping units shall be provided in accordance with the table below. The materials of construction are listed based on the compatibility information provided by one of the named manufacturers. The CONTRACTOR shall submit compatibility data from the manufacturer being supplied to confirm the materials of construction.

D. Pumping units shall perform according to the following parameters:
   1. The pumping units shall be able to perform in the temperature range of 30 to 120 °F.
   2. The pumping units shall have disc style diaphragms. No tube diaphragms will be allowed.
   3. Speed control shall be automatic by SCR with DC drive, minimum turndown 10:1.
   4. Stroke adjustment shall be remote or local manual, minimum turndown 10:1. Remote adjustment is accomplished by conversion of an operator inputted chemical dose to stroke setting or as specified in Division 17.
   5. The number of strokes per minute (spm) shall be in the range of 30 to 140 spm at maximum delivery. Manufacturers proposing units with a higher stroke rate must submit certified calculations showing that the pumping units have the capability of operating at the specified flows without cavitation. Any modifications to piping and system layouts to provide more available net positive suction head are the responsibility of the CONTRACTOR.

E. Pumps shall operate at their maximum output with a maximum Net Positive Suction Head Required of 9.0 psia.

F. Pumping units shall also meet the requirements of the following table:

Service	Sodium Hypochlorite	Sodium Hypochlorite	Alum[1]	Hydrofluosilicic Acid[1]	Phosphoric Acid[1]
Pump Designation	SHC- P-1,2,3[2]	SHC-P-4,5[2]	[-]	[-]	[-]
Specific Gravity (@60°F)	1.08	1.08	1.33	1.23	1.33
No. of Pumps	3	2	3	2	2
Nominal Pump Capacity, gph[3]	199	317	79	19	17
Design Pressure (psig)	100	100	100	100	100
Pump Head Material	PVC	PVC	PVC	PVC	PVC
Minimum Horsepower, hp	1-1/2	1-1/2	1-1/2	3/4	3/4
Nom. Inlet Size (NPT), in.	2-1/2	2-1/2	1	1/2	1/2
Nom. Outlet Size (NPT), in.	2-1/2	2-1/2	1	1/2	1/2

[1] Pumps are furnished only, OWNER is responsible for pump replacement/connection and control integration.
[2] Provide skid system per paragraph 2.3.D.
[3] Pump Capacity can vary by + 10% of maximum capacity in accordance with manufacturer's standard product.

2.3 DETAILS OF CONSTRUCTION

A. Metering Pumps:

1. All metering pumps shall be positive displacement, disk-style diaphragm, hydraulically actuated, specifically designed and constructed for the service described in Parts 2.2 and 2.3 of this Section. The pump drive mechanism shall transmit a reciprocating action to a piston operating in the hydraulic reservoir. The piston's forward movement shall transmit a hydraulic force against a diaphragm. The disc diaphragm for the primary element shall completely isolate the product pumped from the piston and pump mechanism. The piston shall hydraulically move a flat disc diaphragm alternately forward and backward using hydraulic oil. The displacement shall take in the chemical being pumped through a suction check valve on the suction stroke of the piston and discharge a like amount of chemical through a discharge check valve on a forward or discharge stroke.
   a. Three automatic valves shall keep the entire system hydraulically balanced for trouble free operation. The make-up valve shall permit the flow of replacement oil from the reservoir to the area between the plunger and the diaphragm. The bypass valve shall release oil and terminate the hydraulic pumping action when the oil ahead

of the plunger is under excess pressure from accidental line stoppage. A separate bleeder valve shall automatically and continuously release any entrained air or oil vapors to maintain a "hard" hydraulic system.

2. Pumps shall be equipped with automatic external stroke adjustment with manual override and scale indicator where indicated on the Contract Drawings and noted in the instrumentation specifications. All others shall be manually stroke controlled with a scale indicator. Adjuster shall be calibrated from 0 to 100 percent, and shall be operable while the pump is idle or running. Stroke length indicator shall have at least 100 increments of adjustment. The pumps shall have an accuracy such that, once calibrated, knowledge of the actual speed and stroke length will allow for simple calculation of the flow to within 1 percent of set point.
   a. All SCR controllers shall be as specified herein. All SCRs furnished under this Section shall be of the same manufacturer and furnished by a single supplier. The diaphragm chemical metering pump manufacturer shall furnish and install SCR controllers as required for the diaphragm chemical metering pumps, and shall assume unit responsibility for the SCR controllers furnished for the diaphragm chemical metering pumps, and for the pump motors, drives, and controls as shown and specified in the Contract Documents. The diaphragm chemical metering pump manufacturer shall provide a letter with their submittal stating that all control elements and features as shown and specified in the Contract Documents have been configured into the SCR controller, and that the respective motors and drives will successfully operate with the SCR controller over the speed range and all other operating characteristics as shown and specified in the Contract Documents.
3. Provide built-in make-up, bypass, and bleeder valves. Valve materials shall be of materials recommended by the manufacturer for the chemical service listed.
4. Pump diaphragms shall be suitable for the chemical service listed.
5. Provide ball-type or disc-type inlet and outlet check valves of materials recommended by the manufacturer for the chemical service listed.
6. Pump and motor shall be provided mounted to a common steel base rated for corrosive duty and coated with vinylester paint system.

B. SCR Control Panels:
   1. General:
      a. The metering pump manufacturer shall furnish SCR control panels which shall be constructed as shown on the drawings, and as specified herein and in Division 17.

b. The SCR control panels shall be constructed with speed controllers of open-chassis design which shall be mounted in the panel.

c. The metering pump manufacturer shall accept unit responsibility for the SCR control panels and shall supply the control panel in accordance with the general provisions specified in Division 17 and the panel construction requirements specified in Sections 17650 of the Special Provisions. The metering pump manufacturer may assign the responsibilities of panel fabrication to another party or elect to fabricate the control panel using the pump manufacturer's own facilities and resources. In either case, the metering pump manufacturer shall demonstrate that the party fabricating the control panel meets or exceeds the experience requirements stipulated in Division 17.

2. SCR Speed Controllers:

a. Each chemical metering pump scheduled for variable speed features shall be furnished with a non-reversing SCR speed controller for purposes of varying the pump speed which in turn shall vary the output capacity of the pump.

b. Each SCR controller shall accept 120V AC or 240V, single phase input power as shown on the Drawings.

c. Each SCR controller shall have the following:

1.) A suitably sized main power disconnect switch with external handle for purposes of manual electrical shutdown of the enclosure.

2.) Each SCR speed controller shall have adjustments for maximum and minimum speed, IR drop (load) compensation, torque control and torque slope control (current limit).

3.) Each SCR speed controller shall be furnished with a tachometer/armature feedback signal. Tachometer feedback signal shall provide for one percent speed regulation with 95 percent load change or better.

4.) SCR speed controllers shall provide a minimum of 10:1 speed range.

5.) The speed of each chemical metering pump shall be controlled as described in Section 17600.

6.) Manufacturer: SCR Speed Controllers shall be as manufactured by: Reliance Electric, Inc., or equal.

3. DC Motors:

a. DC motors shall be of the permanent magnet type rated for continuous duty.

b. The maximum base speed of the motors shall be 1750 rpm.

c. Motors shall be totally enclosed and shall operate without excessive heating at 10 percent speed.

d. The motor shall have a controllable speed range from 10 to 100 percent.

e. DC motors shall be 90VDC for metering pumps less than 2 HP and shall be 180 VDC for motors 2 Hp and greater.
f. Motors shall have winding insulation suitable for operation in ambient temperatures from 0 to 40°C.
g. Motors shall be C-face mount.
h. Motors shall be furnished with a tachometer generator mounted to the motor for monitoring speed. The tachometer feedback signal shall be wired to the SCR speed controller and shall provide for 1 percent speed regulation with 95 percent load change or better.
i. Motors shall have a service factor of 1.0.
j. Motors shall have shielded bearings lubricated for the lifetime of the motor.
k. Motors shall be furnished with epoxy treated armatures and temperature sensing thermostats with automatic reset capability.

4. Manual Motor Starters:
   a. Each SCR shall be furnished and installed with a separate manual motor starter which shall serve as a single point for deenergizing both the pump motor and the power to the metering pump control panel for each pump.
5. Metering Pump Stroke Controls:
   a. The metering pumps designated in the schedule shall be equipped with an electronic operator mounted directly to the metering pump housing which shall permit local manual and remote manual adjustment of the metering pump stroke from each metering pump local control panel. Remote manual adjustment is accomplished by conversion of an operator inputted chemical dose.
   b. Power requirements for electronic operators 115 VAC / 60 Hz / single phase.
      1.) Maximum Power Requirement: 23 watts dynamic.
      2.) Pump Response for 0-100% change in input signal: 60 seconds.
   c. 120V AC power to the electronic operator for stroke control shall be provided from the Control Power Transformer (CPT) within the metering pump control panel.
6. Panel Accessories:
   a. Provide two spare fuses for each SCR chassis.
   b. Provide a side-mounted panel air conditioning unit sized to match the ultimate total heat load generated by the internal components and the external heat load absorbed through the surface of the panel. If the room air conditioning system is not in operation and the ambient temperature in the control room is 90°F, the air conditioning unit shall be sized to maintain the internal temperature of the metering pump control panel at 104°F.
      1.) The panel air conditioning unit shall be a Hoffman Series B with adjustable thermostat for panel

temperature regulation. The air conditioning unit shall be provided with a condensate drain connection, tubing clamp, and tubing of sufficient length to convey condensate to the outside wall of the chemical building. One spare air filter shall be provided.

c. Furnish and install lamicoid nameplates below each SCR chassis to identify the respective metering pump being controlled.

d. Furnish two spare SCR units to match each size of SCR installed.

7. Interlocks: Relays, timers, and appurtenances shall be provided for interlocks for the metering pumps of each chemical feed system as necessary.

C. Metering Pump Local Control Stations:

1. Each metering pump shall be furnished with a local control station housed within a stainless steel NEMA 4X enclosure as specified in Section 17650, Control Panels and Enclosures. Non-metallic enclosure is not acceptable for this application.
2. Each control panel shall include the following devices:
   a. LOCAL/OFF/REMOTE Selector Switch.
   b. Pump Speed Control Potentiometer with a 10-turn, locking dial.
   c. Pump Stroke Control Potentiometer Dial.
   d. Pump Speed Indicator (0-100%).
   e. Pump Stroke Length Indicator (0-100%).
   f. High pressure RESET pushbutton wired to relays/timers located at the SCR control panel.
   g. Three pole circuit breaker for each pump motor power and control circuits.
   h. One CPT for the control devices for each motor and stroke motor power.
3. Speed and stroke length indicators shall be provided with a minimum scale length of 3-1/2 inches.
4. The control panels shall provide dry contacts for indication of LOCAL/REMOTE status at the PLC.
5. The control panels shall provide 4-20 mA analog signals for indication of speed and stroke at the PLC.
6. With the LOCAL/REMOTE switch in the LOCAL position:
   a. The pump will run and potentiometers located at the metering pump control panel shall be enabled for local control of stroke and speed.
7. With the LOCAL/REMOTE switch in the REMOTE position:
   a. The PLC will provide analog control signals for pacing pump stroke and speed.
   b. The metering pump control panel will provide a discrete input to the PLC to indicate "REMOTE" operation.

8. Panel Nameplates: Furnish black lamicoid nameplates in each local control panel for each device.

D. Skid Systems

1. Chemical feed pumps and appurtenances noted in the Section 2.2.F table shall be completely assembled, mounted, calibrated, tested, and delivered to the site on a single skid. Components to be mounted on the skid are as indicated on the drawings and shall include metering pumps, calibration columns, piping, valves, piping accessories (pulsation dampeners, back pressure valves, pressure relief valves, Y-strainers and pressure gauges etc. as detailed in the drawings), and wiring integral to the skid. The chemical metering pump manufacturer shall be responsible for providing the complete skid package and shall be responsible for all equipment, valves and piping within the skid boundary. Skid systems manufactured by anyone other than the metering pump manufacture will not be accepted.
2. Chemical feed skids shall be constructed fiberglass reinforced plastic (FRP) (vinylester fire-rated fiberglass required) with adequate supports for all equipment and piping. All framing and support shall be constructed from 2" X 2"X 1/4" FRP tubing with all connections / joints enforced with solid FRP core. Skid deck shall be constructed of pultruded FRP grating and shall be supported with 4-inch FRP I-beam providing sufficient ground clearance so that the feed system can be moved via forklift. All pumps for each feed location shall be installed on one common feed system. The joining together of multiple single or dual pump feed systems for the purpose of supplying a feed system with two or more pumps shall not be accepted. Materials such a polypropylene, polyethylene, stainless steel or PVC will not be acceptable for skid base, deck and backer. All piping / accessory support shall be from skid base or rear panel. Piping / accessory support from above is not acceptable. Skid shall include a polypropylene drip pan with drain pipe connection. Contractor to pipe drain into nearest chemical sump.
3. All suction pipe shall be sloped at a gradient of not less than 1/8 inch per foot of pipe with the low point at the pump suction connection.
4. For PVC piped systems, clear PVC piping shall be used between the Y-Strainer and pump suction valve. This will allow a visual inspection of the liquid in the injection line during operation. Additionally, clear PVC piping shall be used from the pressure relief valve back to the suction piping to allow visual verification of relief flow.
5. All PVC piping and fittings shall be schedule 80 and readily available locally. Special machined fittings/blocks that are not of standard manufacture will not be accepted.
6. Feed system piping shall include an air bleed/flush connection on the suction and discharge of each pump. The bleed/flush

connections should be located on the interior of the pump isolation valves to allow for all lines to be purged of air after the bulk tank is filled and allow the pump to be flushed prior to maintenance being performed.

7. The chemical feed system design shall be such that the wetted end of the pump is orientated at the open end of the framework for easy access. All motor driven pumps shall be arranged with the pump wet-end facing the open end of the feed system. Systems designed with the wet end of the pump facing the back wall or the side of the skid shall not be acceptable. Systems designed without the pump mounted control interface facing the top or front open end of the skid shall not be accepted.
8. Each pump shall be provided with one discharge pulsation dampener. The pulsation dampener shall be located 12" or closer to the pump discharge.
9. Each pump shall be provided with one backpressure valve.
10. One calibration column per pump shall be supplied.
11. All components of the skid-mounted system (pumps, piping and controls) shall be factory pressure tested with water prior to shipment. Certification of factory testing shall be included in installation, operation and maintenance manuals.
12. The metering pumps shall use unions on the suction and discharge of the pump in order to allow removal of the pump without disturbing the suction or discharge piping.
13. The metering system shall incorporate 2" liquid filled gauges on the discharge of each pump. Each gauge shall be protected by a glycerin filled gauge protector that is capable of operation from 0 to 200 psig. The discharge gauge shall be 0-200 psig. The casings of the gauge shall be stainless steel and accuracy shall be 2% or better. Gauge assemblies shall incorporate diaphragm seal and a ½" connection on the liquid side of the gauge isolator.
14. Reference 17620 for Pressure Indicating Switch. Provide one Switch on the discharge of each metering pump and incorporate signal into control panel.
15. All piping accessories shall be securely fastened to the frame or supported with stand-offs. The use of steel bands or strapping shall not be acceptable.

2.4 APPURTENANCES

A. Pulsation dampeners shall be furnished and installed on each chemical pump discharge line as indicated on the Contract Drawings, and as specified herein, and on suction lines when shown on the Contract Drawings. The dampeners shall be air charged, diaphragm type, complete with valved air charge connection and pressure gauge graduated for 0 to 100 psi. The dampeners shall be manufactured and supplied by the pump manufacturer.

1. The pulsation dampeners shall be sized to allow no more than 5.0 percent discharge pressure fluctuation. The bladder and lower

housing of the pulsation dampeners shall be fabricated of materials recommended by the manufacturer.

2. Pulsation dampeners shall be furnished with four extra-long bolts at 90 degrees to one another for mounting to the dampener support brackets.

B. Pressure (safety) relief valves shall be furnished and installed on each pump discharge line as shown on the Contract Drawings and as specified herein. Relief valves shall be supplied by the pump manufacturer, and shall be sized for each specific application as shown on the Contract Drawings, as specified herein, and as approved by the pump manufacturer. Relief valves discharge shall be piped back to the product tank.

1. The safety relief valves shall be fabricated of PVC. Valves shall be field-adjustable, and shall initially be set ten psi higher than the discharge pressure of the respective pumps.

C. Backpressure valves shall be furnished and installed on each pump discharge line as shown on the Contract Drawings and as specified herein.

1. Backpressure valves shall be supplied by the pump manufacturer, and wetted parts shall be fabricated of materials compatible with the process liquid. Size of the valves shall be as shown on the Contract Drawings and approved by the pump manufacturer. Backpressure setting shall be field adjustable between a range of 0 to 150 psi. Initial setting shall be 50 psi for each installation.

D. Calibration columns shall be furnished on the suction side of pumps or pumping systems as shown on the Contract Drawings and as specified herein. Calibration columns shall be supplied by the pump manufacturer.

1. Calibration columns shall be sized to provide volume equal to a minimum of 30 seconds of chemical storage at the maximum rated pump flow. Columns shall be clear, with marked graduations. Gradations shall be in milliliters, centiliters, and deciliters, as appropriate for the volume for flows under 120 gph. For flows over 120 gph, provide marked graduations in gallons and tenths of gallons. Materials of construction shall be plastic of a type compatible with the pumped liquid. Calibration column overflow lines shall be piped back to the product tank.

E. Pressure Gauges – Follow Paragraph 2.3.D.13. Reference 17620 for Pressure Indicating Transmitter/Switch.

2.5 SPARE PARTS AND MAINTENANCE MATERIALS

A. Comply with Section 01750, Spare Parts and Maintenance Materials, and additional requirements below:

B. The CONTRACTOR shall provide the following spare parts for each size of metering pump in each material used for that pump size to maintain chemical compatibility:

1. Diaphragm.
2. Complete set of ball check valves and seats.
3. Complete set of valve o-rings.
4. Pump head gasket.
5. Automatic bleed valve.
6. A full years' supply of all lubricants.

2.6 NAMEPLATES

A. Each pump and motor shall be furnished with a stainless steel nameplate securely mounted to the body of the equipment. As a minimum, the nameplate for the pumps shall include the following:

1. Equipment number.
2. Manufacturer's name and model number.
3. Serial number.
4. Rate flow capacity.
5. Head.
6. Horsepower.
7. Speed.
8. Armature voltage.
9. Armature amps.
10. Field voltage.
11. Field amps.
12. Power and service factors.
13. Any other pertinent data.

2.7 PAINTING

A. Pumps shall be finish painted by the manufacturer with his best grade finish paint system in accordance with Section 09900. For the sodium hypochlorite, phosphoric acid and hydrofluosilicic acid, use a vinyl ester paint system. Color shall be as approved by the ENGINEER. If any damage to the paint system occurs, the equipment shall be repainted as directed by the ENGINEER.

B. All gears, bearing surfaces, machined surfaces and other surfaces which are to remain unpainted shall receive a heavy application of grease or other rust-resistant coating. This coating shall be maintained during storage and until the equipment is placed into operation.

2.8 MANUFACTURER

A. Provide metering pumps of the product and manufacturer as listed below:

1. Pulsafeeder, Inc., PulsaFeeder 7440
2. Milton Roy, Milroyal B

3. Or equal

PART 3 EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

B. Prior to installation, the CONTRACTOR shall provide for one site visit and up to 4 hours of time on-site by the manufacturer's representative to provide the following services:

1. Ensure that the equipment shipped to the job site has been handled according to manufacturer's recommendations and has arrived in good working order.
2. Ensure that all equipment has been stored and protected according to the manufacturer's recommendations.

3.2 INSTALLATION

A. Install in a manner and to the tolerances recommended by the equipment manufacturer

B. Set anchor bolts in accordance with approved manufacturer's drawings.

3.3 START-UP AND FIELD TEST

A. Refer to Section 01650, Starting of Systems/Commissioning, Section 01660, Testing, Adjusting and Balancing, and Section 01670, Operational Demonstration.

B. After the completion of installation, each pumping unit shall be field tested to demonstrate compliance with the performance requirements as specified.

C. Testing procedures shall duplicate as nearly as possible the conditions of operation and shall be selected to demonstrate that the equipment is operational and free from damage. Each control device, item of mechanical, electrical and instrumentation equipment and control circuits shall be considered in the testing procedures to demonstrate that the equipment has been properly services, aligned, dynamically balanced, connected, calibrated, and adjusted prior to operation.

D. CONTRACTOR shall verify through the testing that the units operate satisfactorily, without over heating or over loading of motors, and are free

from excessive vibration or noise at operating pressure and capacity and at rated speed.

3.4 MANUFACTURER'S FIELD SERVICES

A. Refer to Section 01650, Starting of Systems/Commissioning, Section 01660, Testing, Adjusting and Balancing, and Section 01670, Operational Demonstration.

B. The manufacturer shall check and approve the installation during construction and prior to initial operation. Prior to initial start-up, a written statement shall be provided by the manufacturer stating the equipment has been installed by the CONTRACTOR in accordance with the Drawings, Specifications and manufacturer's shop drawings and is ready to be placed into operation. The manufacturer shall test operate the system in the presence of the ENGINEER and shall verify the equipment conforms with the specified requirements. The manufacturer shall re-visit the job-site as often as necessary until all deficiencies are corrected and the installation and operation is satisfactory to the ENGINEER.

C. The manufacturer shall provide training of plant operation and maintenance personnel in accordance with the requirements of Section 01690, Instruction of Operations and Maintenance Personnel. Training shall be provided to four separate groups, each at a separate time and day.

END OF SECTION

Crown Chemical Systems Upgrade
and Miscellaneous Improvements Project

ENERGY EFFICIENCY – HVAC EQUIPMENT SELECTION

SUMMARY

- The Crown Chemical Systems Upgrade and Miscellaneous Improvements Project will include the Heating, Ventilation, and Air Conditioning (HVAC) systems using energy efficient equipment. The following equipment includes variable frequency drives: Direct-Fired Makeup Air Units, Air Handling Units and Fans to reduce energy consumption and provide improved interior air quality.

BACKGROUND

- The project included the installation of sodium hypochlorite storage. Sodium hypochlorite will degrade in elevated temperatures. Previously un-ventilated spaces now require ventilation.
- The project includes a new ductless heat pump/air conditioner to provide heat and cooling to a remodeled space that was previously unoccupied.

RESULTS

- The makeup air unit, air handling units, and exhaust fans were all specified with VFDs to vary the air flow from summer temperatures to winter temperatures. Standard units would instead use two speed motors.
- The heat pump/air conditioner was specified with a SEER rating of 19, which is approximately 46% more efficient than the government-mandated minimum SEER rating of 13.

BENEFITS

- The selected Direct-Fired Makeup Air Units, Dehumidifier, Air Handling Units and Fans will require less electricity than single speed systems at the lower winter air flow rates.
- The heat/pump air conditioner will require less energy than the standard air conditioner, saving approximately 583 kW*hr per year.

Brown AND Caldwell

By: John Fitch | Checked By: Tony Blanc | Project No.:137038

Date: 12 Dec 2011 | Date Checked: 13 Dec 2011 | Calc No.:-

Project:Crown Chemical and Miscellaneous Improvements | Subject:Anticipated Wash Water Reduction

PURPOSE/OBJECTIVE

Estimate the amount of enegry saved by HPU-1 basewd on it's rated SEER value.

CALCULATIONS

$AC_{size} := 24000 \frac{BTU}{hr}$ Air conditioner size

$Days := 125 \frac{day}{yr}$ Typical cooling season - 125 days

$Hours := 8 \frac{hr}{day}$ Typical AC usage in hours per day during the cooling season

$Energy_{Annual} := AC_{size} \cdot Days \cdot Hours$ Annual energy input into the room for cooling

$Energy_{Annual} = 2.4 \times 10^{7} \cdot \frac{BTU}{yr}$

Power Consumption

$SEER_{min} := 13 \frac{BTU}{W \cdot hr}$ Government mandated minimum SEER rating

$Power_{SEERmin} := \frac{Energy_{Annual}}{SEER_{min}}$

$Power_{SEERmin} = 1.846 \times 10^{3} \cdot kW \cdot \frac{hr}{yr}$ Power required for 24,000 BTU/hr AC with 13 SEER rating

$SEER_{rated} := 19 \frac{BTU}{W \cdot hr}$ SEER rating of proposed AC

$Power_{SEERrated} := \frac{Energy_{Annual}}{SEER_{rated}}$

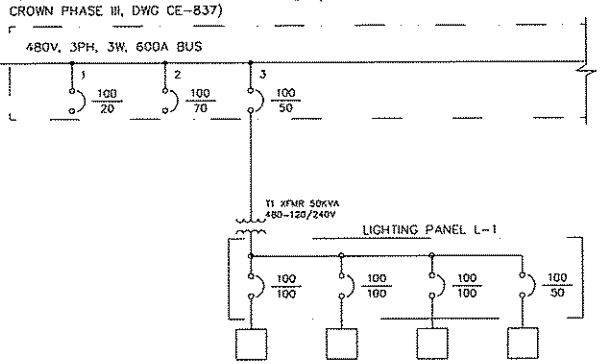
$Power_{SEERrated} = 1.263 \times 10^{3} \cdot kW \cdot \frac{hr}{yr}$ Power required for 24,000 BTU/hr AC with 19 SEER rating

$Savings := Power_{SEERmin} - Power_{SEERrated}$

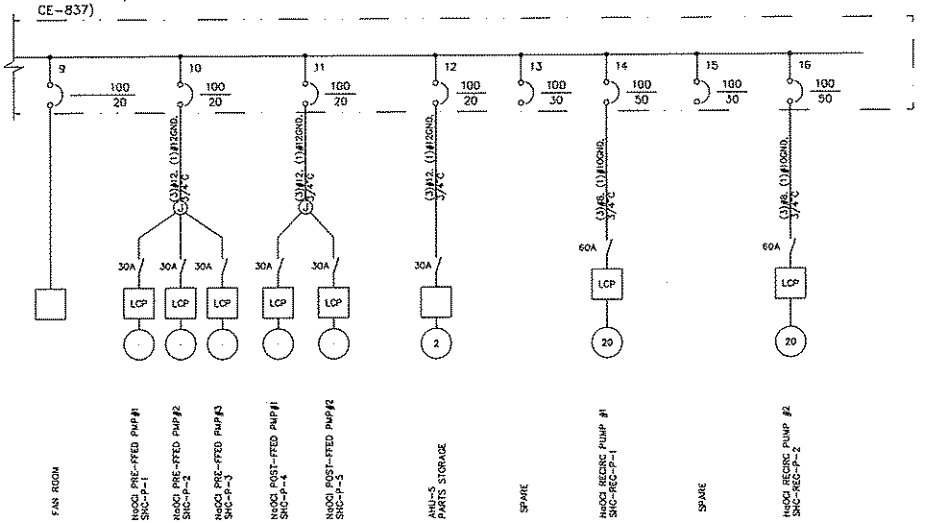
$Savings = 582.996 \cdot kW \cdot \frac{hr}{yr}$ Power savings provided by the more efficient air conditioner

ADMIN & CHEM BLDG. POWER PANEL P-1A#2 (FIELD NOTES 10-21-03, CROWN PHASE III, DWG CE-837)

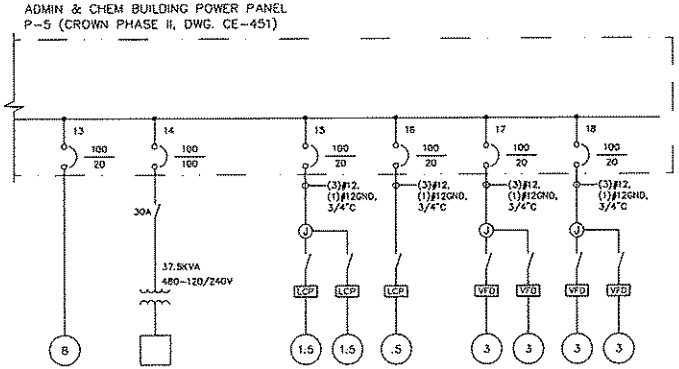
480V, 3PH, 3W, 600A BUS



ADMIN & CHEM BUILDING POWER PANEL P-3 (CROWN PHASE III, DWG. CE-837)



ADMIN & CHEM BUILDING POWER PANEL P-5 (CROWN PHASE II, DWG. CE-451)



CONFORMED TO CONTRACT

WARNING 0 1/2 1 IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

REVISIONS			
NO.	DATE	REV.	BY
1	10-8-10	ADD. 2	KNH

CROWN WATER WORKS PLANT
CHEMICAL SYSTEMS UPGRADE AND MISCELLANEOUS IMPROVEMENTS PROJECT
ADD-2

DEPARTMENT OF PUBLIC UTILITIES
DIVISION OF WATER
CLEVELAND, OHIO

SUBJECT: ELECTRICAL
ADMINISTRATION BUILDING
ONE-LINE DIAGRAM 2

BROWN AND CALDWELL
CLEVELAND, OHIO

STATE OF OHIO — EPC P. CAMPBELL 74424 — REGISTERED PROFESSIONAL ENGINEER

DRAWN BY: CJR | SCALE: NTS | SHEET NO. E-21
DESIGNED BY: EPC | CWD NO. 110070
CHECKED BY: | ISSUE DATE: 12/10/10

Ohio Drinking Water Assistance Fund
Drinking Water State Revolving Fund (DWSRF)
Green Project Reserve Information Form

Ohio Environmental Protection Agency
Division of Drinking and Ground Waters

Water Efficiency (W)

PWS Name: City of Cleveland - Crown Water Works Plant PWSID: 1801212

Project Name: Crown Chemical Systems Upgrade and Miscellaneous Improvements Project PPL #: (Assigned by Ohio EPA)

Total Est. Project Cost: $10,808,600 Total Est. GPR Amount: $65,000

Project Summary:
This project will be installing filter bed expansion and backwash water turbidity monitors to optimize and reduce the water consumption during filter washing cycles (backwash water).

Water Main Replacement
Water main material/length to be replaced
Est. total system water lost due to breaks and leaks
Est. water loss from pipe being replaced
Total annual production
Number of breaks recorded in past 24 months for the area to be replaced
Est. annual water savings
Est. annual costs savings
Other efficiencies to be gained by the replacement? (reduced head and therefore less energy loss in an upstream pump station, etc.)

Meter Installation/Replacement ○ Original Installation ○ Replacement
Reason for replacement
Est. annual water savings
Est. annual costs savings

Business Case Narrative (Calculate water saving improvements and costs savings):

See attached business case narrative.

Attach Supporting Documentation

☐ Engineering Project Planning Documents ☐ Water/Energy Efficiency Determination (Ohio EPA)

☐ Public Water System Records ☒ Other: Vendor documentation

Crown Chemical Systems Upgrade
and Miscellaneous Improvements Project

WATER EFFICIENCY – FILTER BED EXPANSION MONITORING EQUIPMENT

SUMMARY

- The Crown Chemical Systems Upgrade and Miscellaneous Improvements Project will include the purchase and installation of filter bed expansion monitoring equipment to monitor the degree of filter bed expansion (fluidization) during filter cleaning (backwashing).

BACKGROUND

- The existing rate of flow of filter wash water is determined by theoretical values of filter media expansion, which is affected by water temperature.
- The existing duration of filter backwashing is pre-set at a conservative length to ensure complete cleaning.

RESULTS

- The project will include the purchase and installation of filter bed expansion monitors / backwash water turbidity monitors to control backwash rate of flow and to monitor wasted backwash water turbidity.

BENEFITS

- The filter bed expansion monitoring equipment will control the main filter backwash rate of flow control valve to provide the exact amount of wash water needed to expand the media to the recommended level. The actual rate of flow required to expand the filter media to the manufacturer's recommended level can be either more or less than the value plants use based on theory. If the plant is not providing a great enough flow rate, the filter does not get sufficiently clean and filter run-times decrease, increasing the number of backwash cycles and therefore wasting water. If the plan is providing too much wash water flow, the plant is wasting water directly and in danger of losing filter media through the backwash water troughs.
    - A similar installation from a plant also owned by the same utility has shown a reduction in wash water use after the installation of the expansion monitors. For the months September through December, wash water use prior to bed expansion monitoring was approximately 2.7% of the plant's production. Wash water use for the same four months with bed expansion monitoring was reduced to 2.0% of the plant's water production. Applying the same reduction (approximately 26%) to Crown Water Works' average daily wash water use, results in an anticipated wash water savings of 156,000 gallons per day.
    - At a plant production cost of approximately $3.50/1000, the plant would save $1,250 per day in operating costs.
- The optional turbidity monitor included with the filter bed expansion sensors will allow the plant to record wasted wash water turbidity to determine the proper duration of washing for sufficient cleaning based on trended turbidity data. Too short or too long of a washing cycle will lead to wasted water in the same manner as too little or too great a flow rate of the wash water.

CONCLUSION

- The installation of filter bed expansion monitors with the optional turbidity sensors will optimize the filter washing cycle and reduce the overall amount of wash water required for filter cleaning.

Brown AND Caldwell

By: John Fitch | Checked By: Tony Blanc | Project No.:137038

Date: 12 Dec 2011 | Date Checked: 13 Dec 2011 | Calc No.:-

Project:Crown Chemical and Miscellaneous Improvements | Subject:Anticipated Wash Water Reduction

PURPOSE/OBJECTIVE

Estimate the amount of wash water that will be saved by monitoring filter bed expansion during backwashing. Use data from Morgan WTP (same owner, same raw water source).

CALCULATIONS

Morgan Data

$WW_{pre} := 2.7\%$ Prior to monitoring, Morgan WTP used 2.7% of it's water production on washing filters

$WW_{after} := 2.0\%$ After monitoring, Morgan WTP used 2.0% of its's water production on washing filters

$WW_{reduction} := \frac{(2.7\% - 2.0\%)}{2.7\%} = 25.926 \cdot \%$ Water use reduction was about 26%

Crown Data

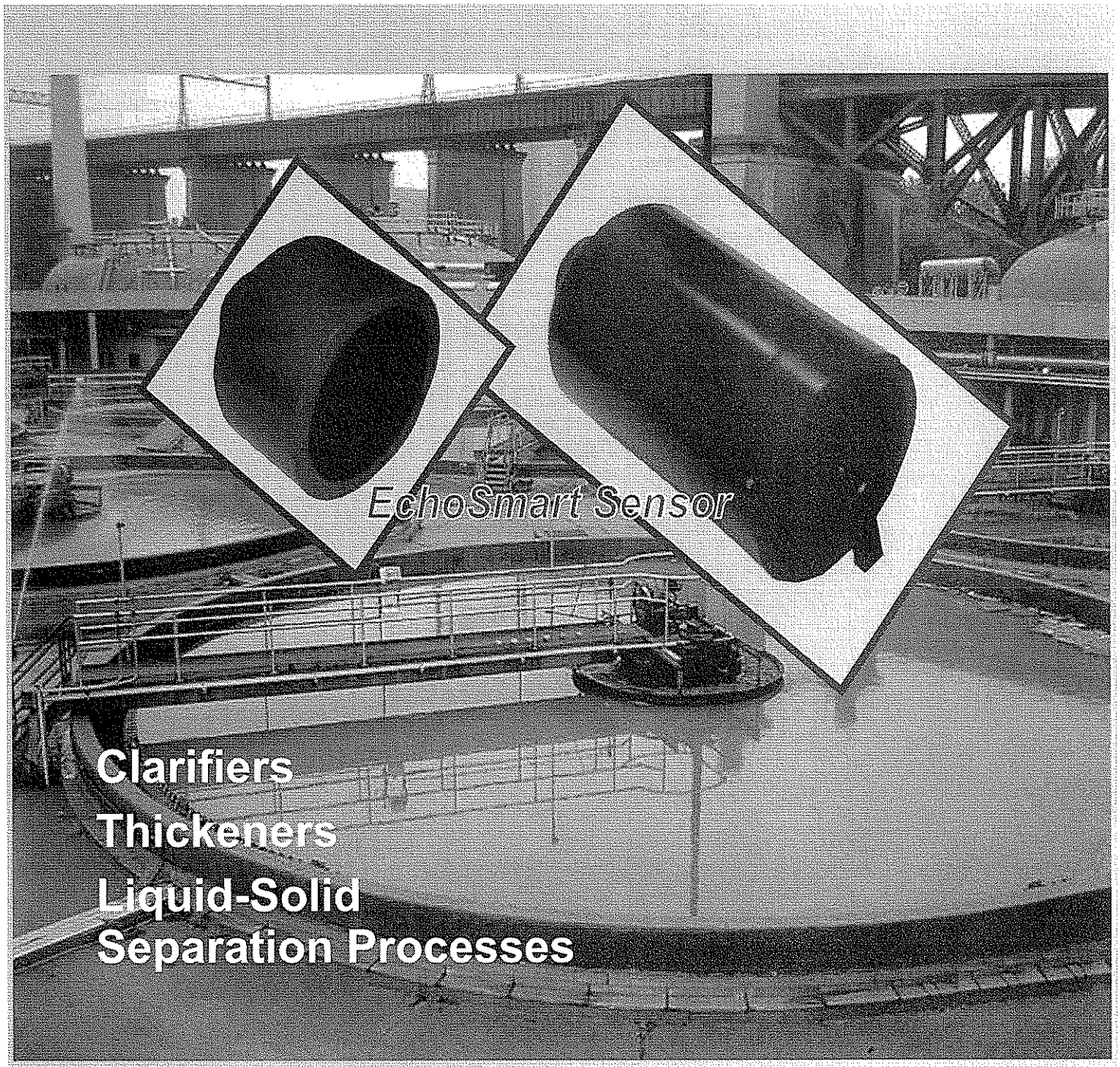
$WW_{avg} := 599226 \frac{gal}{day}$ Current wash water use at Crown for months of Sep-Nov, 2011 is about 600,000 gallons per day.

$WW_{estimated} := WW_{avg} \cdot WW_{reduction}$

$WW_{estimated} = 1.554 \times 10^{5} \frac{gal}{day}$ Estimated water savings is about 156,000 gallons per day.

EchoSmart™

Interface Level Analyzers



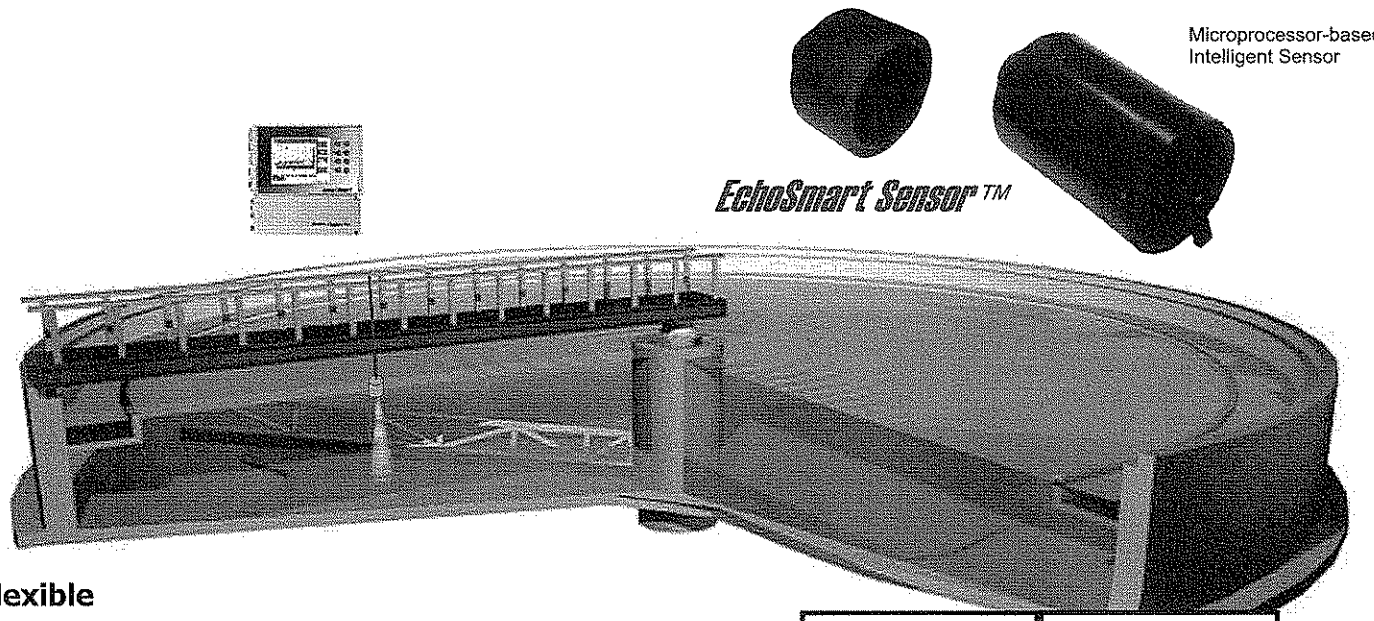
www.sludgelevel.com

Entech Design, Inc.

Smart

EchoSmart Sensors generate and process the ultrasonic signal for real-time measurement and maximum flexibility. No "big ticket" auxiliary analyzers are required.

tracking algorithms developed exclusively by Entech, independently field tested and confirmed by performance across the US and around the world.



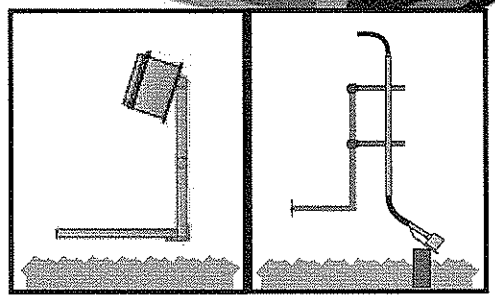
Flexible

Complete Stand-Alone Instrument Options

- EchoSmart Sensor with full-function EchoSmart Controller
- EchoSmart Sensor with EchoSmart Power Supply Unit
  (remote programming by EchoSmart Console Program)

EchoSmart Networks (See Opposite Page)

- Field Interconnect up to 128 EchoSmart Sensors
- RS-485 or Ethernet Local Networks
- Integrated ZigBee Compliant RF Network



Friendly

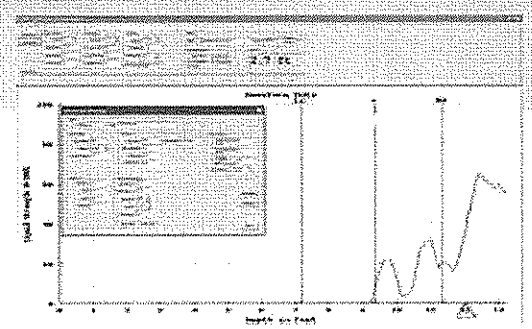
Easy to set-up, easy to operate and easy to secure consistent, reliable, trouble-free measurements - that's user-friendly, and that's EchoSmart!

- Large display with intuitive "Page Fill" screens for quick entry of parameters
- Soft Key operation with Help Prompts for all settings
- Automatic Initialization and Automatic Gain for easy quick start and uninterrupted operation
- Easily accessible USB port for quick download of measurement trends to standard flash memory

Operate any EchoSmart Sensor with any Controller on the Network, so you don't have to run all over the plant to check measurements or verify the status of instruments.

EchoSmart Console Program™

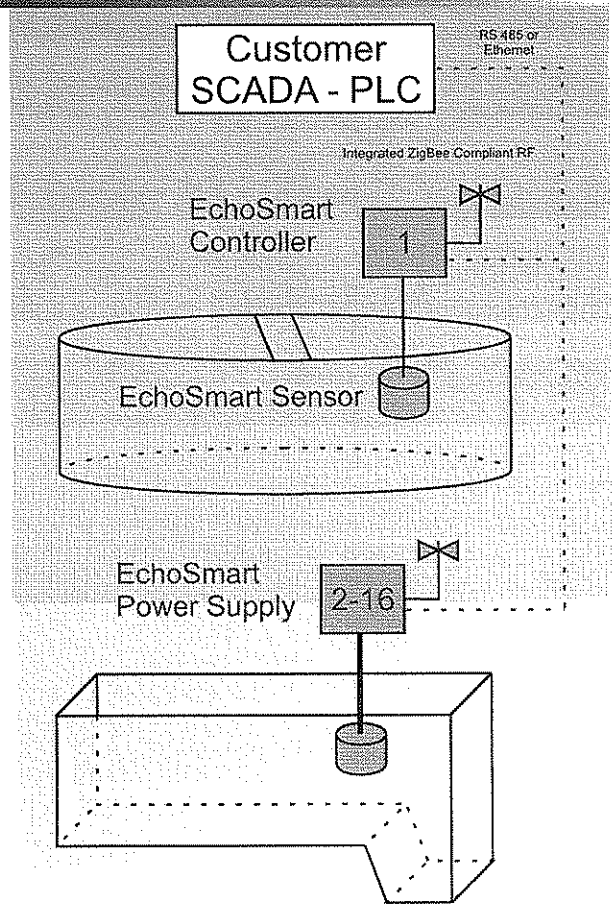
The Console Program enables the operation and control of all networked sensors from a PC or laptop computer. With the EchoSmart Console Program, all programming, monitoring and control functions are available at the data acquisition and control console.



EchoSmart™ Interface Level Analyzer

EchoSmart Network™

An EchoSmart Network consists of 2-128 EchoSmart Sensors interconnected in a wired or wireless field network. RS-485 and Ethernet options are available for wired networks. However, fully integrated ZigBee Compliant RF networking is the clear choice for plants that want to take advantage of tremendous cost savings in reduced cabling and piping costs.



Features

Up to 16 EchoSmart Sensors can be networked with a single EchoSmart Controller for convenient operation and significant cost reduction.

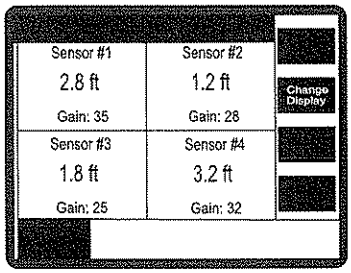
EchoSmart Networks allow plant personnel to take full control of all EchoSmart Sensors from any Controller.

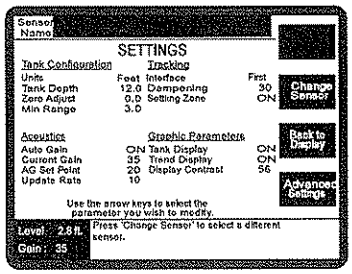
ZigBee Compliant RF with self-healing mesh technology provides trouble-free communication while eliminating unnecessary piping and cabling costs. (Internal, fully integrated two-way radio with embedded internal antenna. Self-healing mesh technology eliminates line of sight interference)

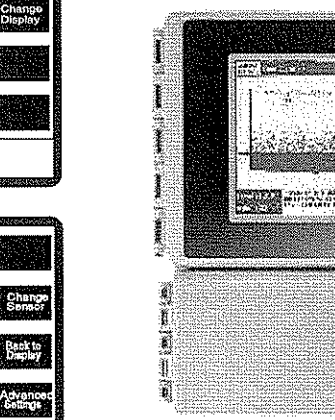
No special programming is required to put an EchoSmart Network in operation. (Integrating the field network to the customer data acquisition and controls is via RS-485, Ethernet, or 4-20mA Analog, including HART Protocol)

EchoSmart Console Program allows complete operation of the network by the plant's data acquisition PC or a laptop computer.

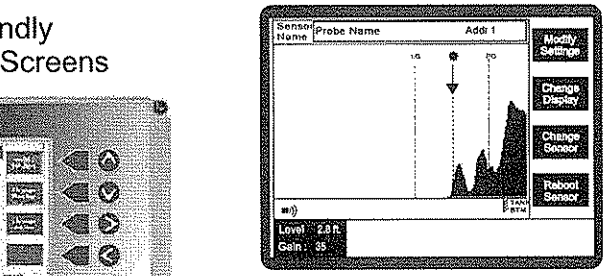
User Friendly
Informational Screens

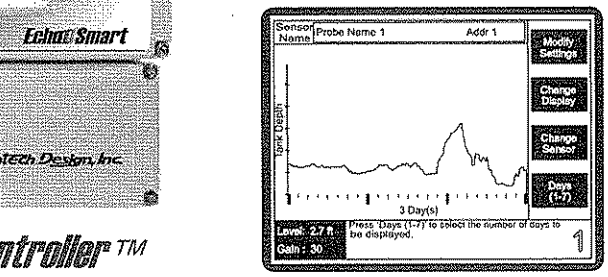






EchoSmart Controller™





EchoSmart™ Specifications

Smart Sensor

Measuring Principle
Underwater acoustic

Range
1.0 to 32 ft. (0.305 to 10.0 m)

Resolution
0.12 in. at 10.0 ft. (3.05 mm at 3.05 m)

Accuracy
0.1 ft at 10.0 ft. (035 m at 3.05 m)

Operating Temperature
34 to 125°F (1 to 52°C)

Power Requirement
15VDC, 20W

Measurement Interval
Adjustable

Sensor Mounting
Fixed location or flexible assembly

Calibration
Factory calibrated
Sound speed field adjustable

Sensor Construction
PVC and epoxy
Self-cleaning Wiper Sensor, silicon wiper (Optional)

Dimensions
Standard Sensor: 2.44 x 2.95 in (6.2 x 7.5cm)
Wiper Sensor: 5.75 x 2.95 in. (14.6 x 7.5 cm)

Weight
Standard Sensor: 2.25 lb (1.02 kg)
Wiper Sensor: 2.75 lb (1.25 kg)

Certifications
CE

Controller

Ambient Conditions
Operation: -40° to +140°F (-40° to +60° C)

Power Requirements
100 to 240 VAC, 50/60 Hz - 1A
Power 45 W (fused)
Optional: 24VDC

Display
Graphical backlit monochrome screen
Resolution: 320 x 240 pixels
Viewing Area: 2.6 x 3.45 in (92 x 122 mm)

Communications

RS-485 Serial Port (Screw terminal connector)

RS-232 DTE Serial Port (Male DB9 connector)

Ethernet - RJ45 connector (Optional)

USB Port (Type A Host)
USB Service Port (Type B Device)

(2) 4-20mA Output (Screw terminal connector)
HART Communication (Optional)
(1) Level Measurement
(1) Turbidity (Optional)

Integral ZigBee Compliant RF Module (Optional)
Outdoor LOS Range: up to 3.0 miles
Self-healing mesh network
Embedded F Internal Antenna
Approvals: FCC Part 15.247, Industry Canada

Relays (Optional)
Four relays: 10A @ 250 VAC, 10A @ 30VDC

Network Communication
RS-485, Ethernet, or Integral ZigBee Compliant RF (Optional), Network up to 128 sensors in a local area network

Memory Backup
All user settings are retained indefinitely in memory (non-volatile, EEPROM)

Mounting Configurations
Surface and pipe mounting

Enclosure
NEMA 4X, IP65, Polycarbonate ABS enclosure

Dimensions
9.25 x 9.0 x 4.5 in (235 x 229 x 115 mm)

Weight
Approximately 3.0 lb (1.36 kg) depending on configuration

Certifications
CE

Power Supply Unit

Ambient Conditions
Operation: -40° to +140°F (-40° to +60° C)

Power Requirements
100 to 240 VAC, 50/60 Hz - 1A
Power 20 W - 0.5A
Optional: 24VDC

Communications

RS-232 DCE Serial Port (Male DB9 connector)

RS-485 Serial Port (Screw terminal connector)

(2) 4-20mA Output (Screw terminal connector)
(1) Level Measurement
(1) Turbidity (Optional)

Integral ZigBee Compliant RF Module (Optional)
Outdoor LOS Range: up to 3.0 miles
Self-healing mesh network
Embedded F Internal Antenna
Approvals: FCC Part 15.247, Industry Canada

Network Communication
RS-485 or Integral ZigBee Compliant RF (Optional)

Mounting Configurations
Surface and pipe mounting

Enclosure
NEMA 4X, IP65, Polycarbonate ABS

Dimensions
7.125 x 7.125 x 2.375 in (181 x 181 x 61 mm)

Weight
Approximately 1.5 lb (0.68 kg) depending on configuration

Certifications
CE

Represented by:

Entech Design, Inc.
315 S. Locust St.
Denton, TX 76201
(940) 898-1173

Entech Design, Inc.

Optimizing Filter Backwashing

By Mike Murphy
Bergren Associates, Inc.

Optimum filter performance has become a critical component of surface water treatment. For conventional and direct filtration systems, LT1ESWTR requires the combined filter effluent turbidity be less than or equal to 0.3 NTU's for 95% of the readings taken each month. At no time may the readings exceed 1 NTU. As regulations change and filtration is pushed toward the lower limits of turbidity measurements, excellent filter operations with optimum backwashing techniques are needed.

Backwashing filters is a necessary and important part of the filtration process regardless of the type of filters. Producing a high quality, low turbidity water requires having clean media, free of cracks and mud balls. Many problems associated with filtration can be traced back to delayed or inadequate backwashing. In order to optimize filter performance, proper filter backwashing is required.

During the backwash, filter media is fluidized and expands as a result of reverse water flow. The rate of flow is controlled to optimize cleaning while preventing media washout. Most filter backwash procedures are based on predetermined backwash flow rates. Achieving proper backwash flow rates is critical. Water flowing at too high a rate can result in the loss of filter media, while a flow rate that is too low will not adequately clean the media.

Proper backwashing requires adequate filter bed expansion. Adequate expansion means the entire filter media is fluidized and all individual particles are suspended. In order to properly clean the filter, the media grains must be agitated together violently to remove sticky floc and calcium carbonate buildup. Media suspension helps with the cleaning of the filter and assists with even re-stratification of the filter bed.

Insufficient filter bed expansion results in poor filter cleaning and can lead to numerous filtration problems. Some of these include sensitivity to hydraulic surges or flow changes, shortened filter run times and eventually mud ball and crack formations. All of these problems can increase the likelihood of a breakthrough in turbidity, increase the potential for breakthrough of water born disease causing organisms, and increase operational costs.

Studies and filter design specifications generally suggest that the media should be expanded in the range of 20 to 50% of the total expandable media. The proper backwashing rates and percent of filter bed expansion should be determined by the type of filter media, grain size and its uniformity coefficients. These are important factors which must be determined when establishing proper filter backwashing procedures. Percent bed expansion is calculated by dividing the inches of the expansion media by the inches of expandable media.

Filter media expansion during backwashing is influenced by a number of factors. The primary factor is the backwash flow rate. There are many factors which influence the plants ability to maintain the proper flow rate. Backwash pump wear, valve problems, piping head losses, and varying levels in backwash water holding tanks are some of the factors that may influence backwash flow rates.

Water temperature also has a significant effect on the backwashing waters ability to properly fluidize and expand the filter bed. Cold water has a higher viscosity, and therefore can fluidize or expand the filter bed easily. At higher water temperatures a higher backwash flow rate to achieve the same percentage expansion is required. This becomes a critical factor when trying to establish proper backwash flow rates at your facility. Correction factors are often applied to compensate for varying water temperatures. A temperature change of 15° C may result in the necessity to alter backwashing flow rates by as much as 25%

Many times plant operators will determine the adequacy of their filter backwash by observing the turbidity of the backwash wastewater. As the backwash cycle ends the water becomes clear and it is assumed that the filter has been adequately backwashed. However, if the bed is not properly expanded and fluidized, trapped floc can remain in the filter media. It is for this reason that visual observation is not enough. The only way to know if the bed is being properly expanded is to measure the bed expansion.

There are a number of devices that can be used to measure filter bed expansion. Most of these involve inserting a temporary measuring device into the filter during backwashing. These may consist of disks or floats, graduated tubes or other means of capturing and measuring the media at its

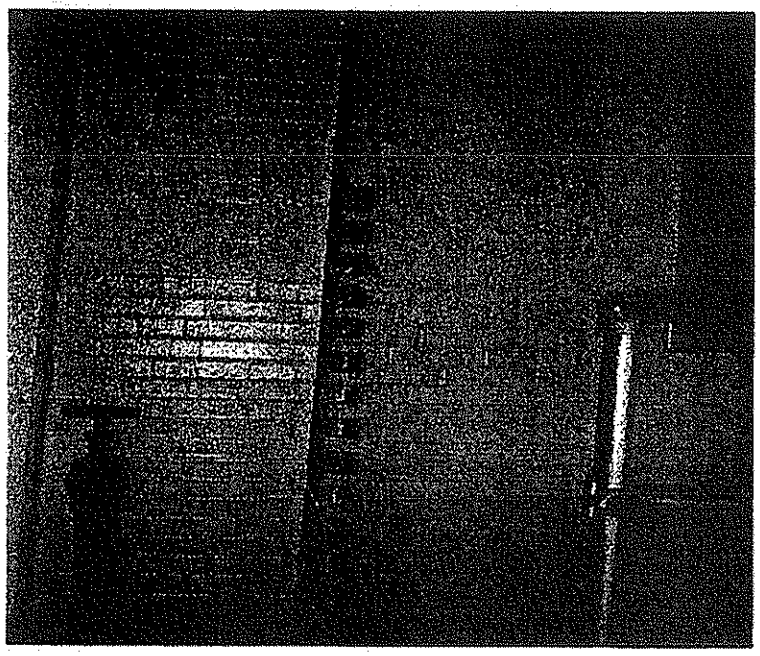
highest expansion level. Depending on the device used, the level of accuracy, and additional labor required to perform the test will vary.

There is also an automated alternative to manual measurement of filter bed expansion. This instrument utilizes underwater acoustic technology to determine the height of the filter bed both during the filtration process and during backwashing. With this instrument every backwash can be measured and the proper bed expansion achieved. The guess work of determining influences such as varying water temperatures, tank levels, pump performance, piping headloss, etc. is eliminated since you are measuring the bed expansion with every filter backwash.

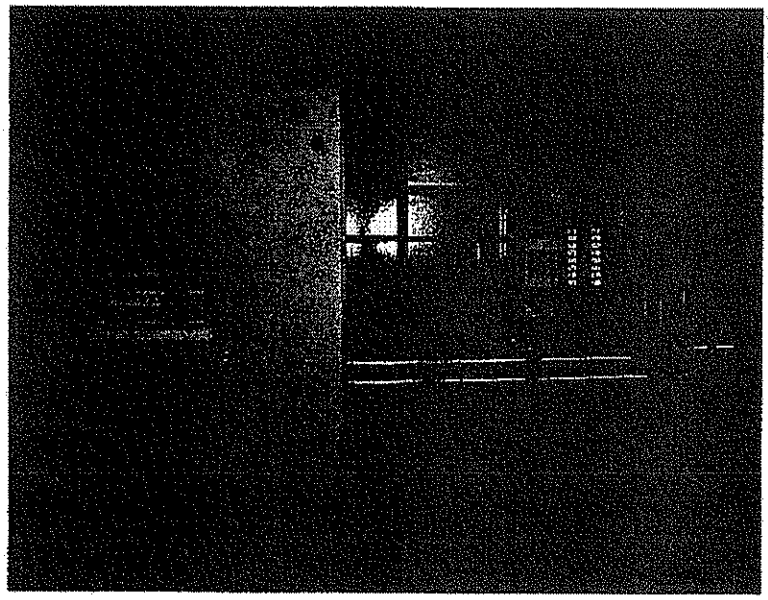
Measuring bed expansion with every backwash assures proper backwashing which will prevent media loss due to excessive backwash rates, reduce backwash water usage, reduce mud ball formation and filter media cracking, and promote even media re-stratification. Consistent proper backwashing can also extend filter run times, directly reducing operating costs.

The City of Warren elected to install automated filter bed expansion analyzers as part of their recent plant upgrades. The instruments were tied into their SCADA system so that they could be utilized to monitor bed expansions and aid in the control of the automated filter backwash process. During the high rate backwash step of the backwash process the bed expansion monitor signal is used to open or close the filter backwash flow rate valve. This automated control results in the proper bed expansion during every backwash regardless of water temperature, varying tank levels, piping headlosses, etc.

Warren's Plant Superintendent, Mr. Vince Romeo, has found the use of the automated filter bed expansion instruments very helpful. "They take the guess work out of filter backwashing; with it you are sure you are getting a proper backwash". Through the use of the units, the City has seen a savings in backwash water, minimized loss of filter media, and achieved better overall filter performance.

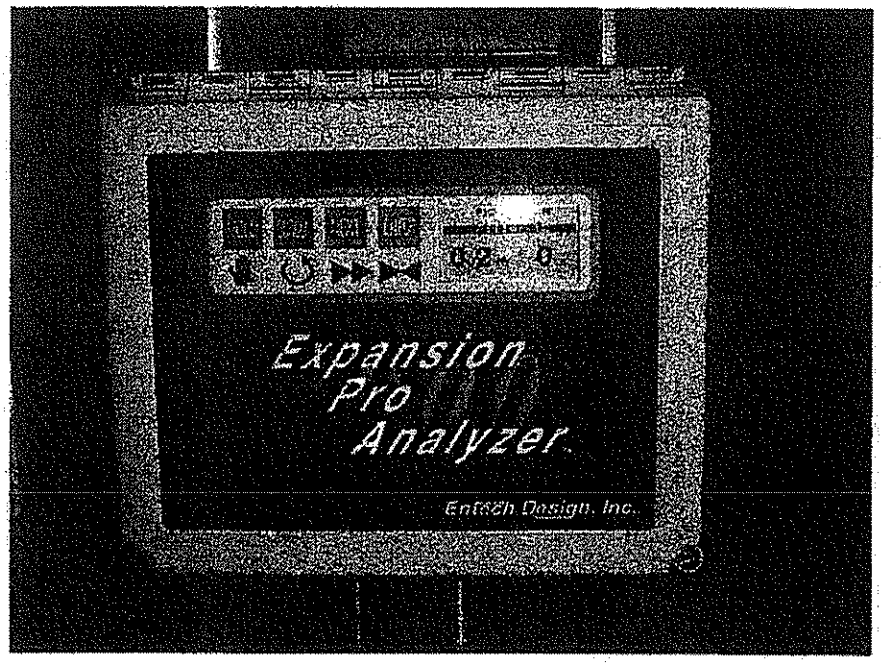


Manual Tool Filter Bed Expansion Measuring



Filter Expansion Control Automatic Bed Monitor

Expansion Pro Analyzer 2000 – Entech Design, Inc.



Ohio Drinking Water Assistance Fund
Drinking Water State Revolving Fund (DWSRF)
Green Project Reserve Information Form

Ohio Environmental Protection Agency
Division of Drinking and Ground Waters

GREEN PROJECT RESERVE FORM

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Listed below are the four categories of projects that comprise the GPR. For each category, there are corresponding pages that must be completed and submitted with this cover page. Attach additional pages as necessary. Please check the **category or categories** that are applicable to your project.

- ☐ **Green Infrastructure (G)** (pages 3-4)
- ☐ **Energy Efficiency (E)** (pages 5-7)
- ☑ **Water Efficiency (W)** (pages 8-10)
- ☐ **Other Environmentally Innovative Activity (O)** (pages 11-13)

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PWS Name: Village of Albany PWSID: 0500003

Project Name: Waterline Replacement PPL #: 126/127
(Assigned by Ohio EPA)

Total Est. Project Cost: $3,900,900 Total Est. GPR Amount: $900,000.00

Completed by:

Name: Gary Silcott Title: Senior Associate
(Please print)

Signature: [signature] Date: 10/4/11

For Ohio EPA use only:

Loan Number (if applicable): F539096-0004 Eligible GPR Amount $: 900,000.00

Eligible GPR Categories: W Evaluated by/Date: [signature] 12/20/11

Loan Award Date (if applicable): May 31, 2012

Date Business Case Posted on webpage (if applicable): June 5, 2012

Ohio Drinking Water Assistance Fund
Drinking Water State Revolving Fund (DWSRF)
Green Project Reserve Information Form

Ohio Environmental Protection Agency
Division of Drinking and Ground Waters

Water Efficiency (W)

PWS Name: Village of Albany PWSID: OS00003

Project Name: Waterline Replacement PPL #: 126/127
(Assigned by Ohio EPA)

Total Est. Project Cost: $3,860,900 Total Est. GPR Amount: _____

Project Summary:
CONSTRUCTION OF ~53,500 FEET OF 3"–8" PVC C900 WATER LINE TO REPLACE THE EXISTING WATER DISTRIBUTION SYSTEM WITHIN THE VILLAGE OF ALBANY.

Water Main Replacement	
Water main material/length to be replaced	53,500
Est. total system water lost due to breaks and leaks	30% = 9,090,687 GAL
Est. water loss from pipe being replaced	30% = 9,090,687 GAL
Total annual production	30,266,000
Number of breaks recorded in past 24 months for the area to be replaced	10
Est. annual water savings	9,090,687
Est. annual costs savings	$30,389
Other efficiencies to be gained by the replacement? (reduced head and therefore less energy loss in an upstream pump station, etc.)	

Meter Installation/Replacement	○ Original Installation ○ Replacement
Reason for replacement	N/A ALL METERS HAVE BEEN REPLACED WITHIN THE LAST 5 YEARS
Est. annual water savings	
Est. annual costs savings	

Business Case Narrative (Calculate water saving improvements and costs savings):

THE PROJECT WILL SAVE THE VILLAGE APPROXIMATELY $30,000 ANNUALLY BY ELIMINATING THE SYSTEM WATER LOSS.

$30,000 x 30 yr loan term = $900,000 cost savings

Attach Supporting Documentation

☐ Engineering Project Planning Documents
☐ Water/Energy Efficiency Determination (Ohio EPA)
☑ Public Water System Records
☐ Other: _____

Village of Albany

DATE	WATER PURCHASED	WATER SOLD	WATER LOSS	% WATER LOSS	INCOME LOSS
01/20/09-02/20/09	2,563,000	1,939,609	623,391	24.33%	$ 1,714.33
02/20/09-03/20/09	1,985,000	1,277,544	707,456	35.64%	$ 1,945.51
03/20/09-04/20/09	2,209,000	1,716,696	492,304	22.29%	$ 1,506.45
04/20/09-05/20/09	2,116,000	1,574,170	541,830	25.61%	$ 1,658.00
05/20/09-06/19/09	2,209,000	1,819,300	389,700	17.65%	$ 1,192.49
06/19/09-07/20/09	2,326,000	1,820,947	505,053	21.72%	$ 1,545.47
07/21/09-08/20/09	2,302,000	1,751,824	550,176	23.90%	$ 1,683.54
08/21/09-09/20/09	2,313,000	1,914,310	398,690	17.24%	$ 1,220.00
09/21/09-10/20/09	1,899,000	1,531,230	367,770	19.37%	$ 1,125.38
10/21/09-11/20/09	2,127,000	1,820,947	306,053	14.39%	$ 936.53
11/21/09-12/21/09	2,193,000	1,650,840	542,160	24.73%	$ 1,756.60
12/22/09-01/20/10	2,323,000	1,593,000	730,000	31.43%	$ 2,365.20
01/21/10-02/19/10	2,267,000	1,598,760	668,240	29.48%	$ 2,165.10
02/20/10-03/19/10	2,318,000	1,696,170	621,830	26.83%	$ 2,027.17
03/20/10-04/20/10	2,295,000	1,695,290	599,710	26.14%	$ 1,943.06
04/21/10-05/20/10	2,135,000	1,684,800	450,200	21.09%	$ 1,458.65
5/21/10-6/21/10	2,805,000	1,865,670	939,330	33.49%	$ 3,071.61
6/22/10-7/20/10	2,555,000	1,603,190	951,810	37.26%	$ 3,083.87
07/21/10-08/20/10	2,759,000	1,802,580	956,420	34.67%	$ 3,098.80
08/21/10-09/20/10	2,616,000	1,813,200	802,800	30.69%	$ 2,601.08
09/21/10-10/20/10	2,148,000	1,715,510	432,490	20.14%	$ 1,401.27
10/21/10-11/19/10	2,423,000	1,657,550	765,450	31.60%	$ 2,480.06
11/20/10-12/20/10	2,317,000	1,739,860	577,140	24.91%	$ 1,869.94
12/21/10-01/20/11	2,439,000	1,761,040	677,960	27.80%	$ 2,264.39
01/21/11-02/21/11	2,370,000	1,835,160	534,840	23.00%	$ 1,786.37
02/22/11-03/21/11	1,874,000	1,548,730	325,270	17.36%	$ 1,086.41
03/22/11-04/20/11	2,017,000	1,643,530	373,470	18.52%	$ 1,247.39
04/21/11-05/23/11	2,555,000	1,851,480	703,520	27.54%	$ 2,349.76
05/24/11-06/20/11	2,736,000	1,998,850	737,150	26.95%	$ 2,462.09
06/21/11-07/20/11	3,014,000	1,669,620	1,344,380	44.61%	$ 4,490.23
07/21/11-08/19/11	3,058,000	2,101,143	956,857	32.12%	$ 3,280.21
08/20/11-09/19/11	2,939,000	1,602,160	1,336,840	45.49%	$ 4,465.05
09/20/11-10/20/11	2,415,000	1,711,870	703,130	29.12%	$ 2,348.45
10/21/11-11/21/11	2,532,000	1,711,870	820,130	32.39%	$ 2,739.23
Last 12 months	**30,266,000**	**21,175,313**	**9,090,687**	**30%**	**$ 30,389.52**

GREEN PROJECT RESERVE FORM

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- ☐ **Green Infrastructure (G)** (pages 3-4)
- x☐ **Energy Efficiency (E)** (pages 5-7)
- ☐ **Water Efficiency (W)** (pages 8-10)
- x☐ **Other Environmentally Innovative Activity (O)** (pages 11-13)

PWS Name: Spencerville Water PWSID: 0201312

Project Name: Water Treatment Plant Improvements PPL #: _____
(Assigned by Ohio EPA)

Total Est. Project Cost: 3,300,000 Total Est. GPR Amount: $1,104,032

Completed by:

Name: Michael Kravtsov, P.E. Title: Vice President
(Please print)

Signature: _____ Date: 2-29-12

For Ohio EPA use only:

Loan Number (if applicable): _____ Eligible GPR Amount $: _____

Eligible GPR Categories: _____ Evaluated by/Date: _____

Loan Award Date (if applicable): _____

Date Business Case Posted on webpage (if applicable): _____

Energy Efficiency (E)

PWS Name: Spencerville Water PWSID: 0201312

Project Name: Water Treatment Plant Improvements PPL #: _____
(Assigned by Ohio EPA)

Total Est. Project Cost: $ 3,300,000 Total Est. GPR Amount: $ 37,800

Project Summary:
1. Provide a new motor with VFD to High Service Pump #3
2. Install new energy efficient windows, roof and siding at the High Service Pumps Building

Pump Facilities

Age of existing pumps or pumping facilities	50
Existing pump/motor efficiency rating, if known	77%
New pump/motor efficiency rating	83 %
Estimated annual electrical savings	40,000kW *0.07=$ 2800
Estimated annual cost savings	0.07 *40,000= $2800

Business Case Narrative: (Calculate energy efficiency improvements and costs savings.)
1. Installation of a new motor with VFD $ 15,000
2. Improvements to the High Service Pump Building makes it green and cost $ 20,000

Attach Supporting Documentation

☐ Engineering Project Planning Documents ☐ Water/Energy Efficiency Determination (Ohio EPA)

☐ Public Water System Records ☐ Other: _____

Environmentally Innovative (O)

PWS Name: Spencerville Water PWSID: 0201312

Project Name: Water Treatment Plant Improvements PPL #: _____
(Assigned by Ohio EPA)

Total Est. Project Cost: $ 3,300,000 Total Est. GPR Amount:$1,066,232

Project Summary:

1. Use of draft aerator for iron oxidation/
2. Provide "Plug and Play" Containerized Water Treatment system with NF membranes. Installation of a system will minimize environmental impact of the construction in comparison with construction of a building.
3.Reduction of THM and HAA5 formation precursory will reduce chlorine demand and improve safety factor for drinking water.

Business Case Narrative:

1. Aerator cost $ 15,000
2. Chlorine demand for iron oxidation (2.5 mg/l *1.25)*1.08= $1,232
3. Minimizing construction environmental impact (trucks gas, etc.) $50,000
4. Public Health Hazards Reduction NF Treatment (illuminate THM and HAA5 violation) $1,000,000

Attach Supporting Documentation

☐ Engineering Project Planning Documents

☐ Water/Energy Efficiency Determination (Ohio EPA)

☐ Public Water System Records

☐ Other: _____

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- X **Water Efficiency (W)** (pages 8-10)
- ☐ **Other Environmentally Innovative Activity (O)** (pages 11-13)

PWS Name: Greater Cincinnati Water Works PWSID: 3102612

Project Name: Race Street Water Main Replacement PPL #: _____
(Assigned by Ohio EPA)

Total Est. Project Cost: $2,750,000 Total Est. GPR Amount: $226,500

Completed by:

Name: Carel Vandemeyden Title: Chief Engineer
(Please print)

Signature: _____ Date: 2/1/2012

For Ohio EPA use only:

Loan Number (if applicable): _____ Eligible GPR Amount $: _____

Eligible GPR Categories: _____ Evaluated by/Date: _____

Loan Award Date (if applicable): _____

Date Business Case Posted on webpage (if applicable): _____

Ohio Drinking Water Assistance Fund
Drinking Water State Revolving Fund (DWSRF)
Green Project Reserve Information Form

Ohio Environmental Protection Agency
Division of Drinking and Ground Waters

Water Efficiency (W)

PWS Name: Greater Cincinnati Water Works PWSID: 3102612

Project Name: Race Street Water Main Replacement PPL #: (Assigned by Ohio EPA)

Total Est. Project Cost: $2,750,000 Total Est. GPR Amount: $226,500

Project Summary: This project replaces 7,074 feet of old cast iron water main in the GCWW distribution system along Race Street. The water main dates back to the early 1900's. The existing 10-inch diameter water main is being replaced with new 12-inch water main. There have not been a significant number of main breaks, but because the water main is over 100 years old, it is eligible for GCWW's water main replacement program.

Water Main Replacement	
Water main material/length to be replaced	7,074 feet of cast iron water mains
Est. total system water lost due to breaks and leaks	5,480 MG (2010 real losses estimate)
Est. water loss from pipe being replaced	Unknown
Total annual production	47,593 MG (2010)
Number of breaks recorded in past 24 months for the area to be replaced	none
Est. annual water savings	2.96 MG/year
Est. annual costs savings	$8,400/year
Other efficiencies to be gained by the replacement? (reduced head and therefore less energy loss in an upstream pump station, etc.)	N/A

Meter Installation/Replacement	○ Original Installation ○ Replacement
Reason for replacement	
Est. annual water savings	
Est. annual costs savings	

Business Case Narrative (Calculate water saving improvements and costs savings):
The water main to be replaced is over 100 years old. Because the City of Cincinnati is doing a major roadway improvement project on Race Street, GCWW decided to replace this aging infrastructure as a pro-active step before excessive water main breaks start occurring. It is GCWW's experience that after a major road project, these old water mains are compromised and will experience higher rates of leaks and breaks. Of the real system losses, the majority of the main breaks tend to occur on cast iron water mains. Assuming that 75% of the water main leaks and breaks are on cast iron mains, then 4,110 MG/yr of real losses (5,480 x 0.75 = 4,110 MG/yr) would be attributable to cast iron water mains. GCWW has approximately 1,857 miles of cast iron water mains, so the average annual water losses per mile of cast iron water main are 2.21 MG/mile/yr (4,110 MG/1,857 miles). Since this project has 1.34 miles of water main (7,074/5,280 = 1.34 miles), the estimated future water losses are 2.96 MG/year. This could be avoided by replacing the cast iron water main now. At a commodity cost of $2.13/CCF, the estimated savings in year 1 could be $8,400 per year. Over the 20 year loan period, assuming an average 3% annual rate increase, the total estimated savings would be $226,500.

Print Form

Ohio Drinking Water Assistance Fund
Drinking Water State Revolving Fund (DWSRF)
Green Project Reserve Information Form

Ohio Environmental Protection Agency
Division of Drinking and Ground Waters

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- ☐ **Energy Efficiency (E)** (pages 5-7)
- ☒ **Water Efficiency (W)** (pages 8-10)
- ☐ **Other Environmentally Innovative Activity (O)** (pages 11-13)

PWS Name: Carrollton Village PWS PWSID: OH1000012

Project Name: 2nd Street NW Waterline Replacement PPL #: _____ (Assigned by Ohio EPA)

Total Est. Project Cost: 191,950 Total Est. GPR Amount: ~~191,950~~ $183,780

Completed by:

Name: John Rice, P.E. (Please print) Title: Project Engineer

Signature: _____ Date: 3-2-2012

For Ohio EPA use only:

Loan Number (if applicable): _____ Eligible GPR Amount $: _____

Eligible GPR Categories: _____ Evaluated by/Date: _____

Loan Award Date (if applicable): _____

Date Business Case Posted on webpage (if applicable): _____

Ohio Drinking Water Assistance Fund
Drinking Water State Revolving Fund (DWSRF)
Green Project Reserve Information Form

Ohio Environmental Protection Agency
Division of Drinking and Ground Waters

Water Efficiency (W)

PWS Name: Carrollton Village PWS PWSID: OH1000012

Project Name: 2nd Street NW Waterline Replacement PPL #: _____ (Assigned by Ohio EPA)

Total Est. Project Cost: 191,950 Total Est. GPR Amount: ~~191,950~~ $183,780

Project Summary:
Project will involve replacing approximately 1,426 lineal feet of 6" diameter cast iron water main with 6" diameter PVC water main, and approximately 812 lineal feet of predominantly metal water service piping with polyethylene plastic water service piping. Project will also include replacement of 15 valves and 3 hydrants and will include new curb stops for all water services (36 total) being replaced. Part of the water main being installed will be done by directionally drilling under railroad tracks.

Water Main Replacement		
Water main material/length to be replaced	PVC Plastic, AWWA C-900	1,426 lineal feet
Est. total system water lost due to breaks and leaks	48,500 gpd	
Est. water loss from pipe being replaced	343 gpd	
Total annual production	177 MG	
Number of breaks recorded in past 24 months for the area to be replaced	No recorded breaks in past 24 months; two occurred just prior	
Est. annual water savings	0.225 MG	
Est. annual costs savings	$6,126 (Based on current rates)	
Other efficiencies to be gained by the replacement? (reduced head and therefore less energy loss in an upstream pump station, etc.)	N/A	

Meter Installation/Replacement	○ Original Installation ○ Replacement
Reason for replacement	N/A
Est. annual water savings	N/A
Est. annual costs savings	N/A

Business Case Narrative (Calculate water saving improvements and costs savings):
Average daily usage is approximately 0.485 MGD, and there is estimated to be 10% loss system-wide. The entire distribution system is approximately 201,700 lineal feet, so the 1,426 lineal feet of this project is approximately 0.7% of the distribution system. The estimated loss from the pipe being replaced is 343 gpd, which is 0.125 MG annually. Based on the current water rate of $0.005/gallon, this results in annual cost savings of approximately $626 for water usage due to daily loss. Based on a pipe break occurring every year and the loss of water from each break being 100,000 gallons, the annual loss of water due to breaks is $500. Based on the cost to repair a break of $5,000, the annual cost savings is $5,000. The total annual cost savings is the sum of the water saved from daily loss, water saved from loss due to breaks, and the cost of repairing breaks. The total annual cost savings is $6,126. Calculations are attached.

$6,126 x 30 yr term = $183,780

Attach Supporting Documentation

- ☑ Engineering Project Planning Documents
- ☐ Water/Energy Efficiency Determination (Ohio EPA)
- ☐ Public Water System Records
- ☐ Other: _____

Village of Carrollton, Ohio
2nd Street NW Waterline Replacement
Calculation of Water Loss and Cost Savings

Estimated Water Loss in Distribution System	
Average Daily Usage	0.485 MGD
Estimated water Loss	10%
Daily water loss	48,500 gpd
Estimated Normal Water Loss in Pipe Being Replaced	
Length of Pipe to be Replaced	1,426 l.f.
Length of entire distribution system	201,700 l.f.
Percentage of distribution system being replaced	0.707%
Normal water loss from pipe being replaced	343 gpd
Estimated Cost of Normal Water Loss	
Current water rate	$0.005 per gallon
Cost of normal water loss along pipe being replaced:	**$626 per year**
Estimated Water Loss in Pipe Being Replaced due to Breaks	
Water loss per waterline break	100,000 gallons
Water breaks per year in pipe being replaced	1
Annual water loss due to waterline breaks	100,000 gallons
Current water rate	$0.005 per gallon
Cost of water loss in pipe being replaced due to breaks:	**$500 per year**
Cost to repair each break	$5,000 each
Cost to repair breaks :	**$5,000 per year**
TOTAL COST SAVINGS BY REPLACING WATERLINE:	**$6,126 per year**

Ohio Drinking Water Assistance Fund
Drinking Water State Revolving Fund (DWSRF)
Green Project Reserve Information Form

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GREEN PROJECT RESERVE FORM

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- ☐ **Green Infrastructure (G)** (pages 3-4)
- ☐ **Energy Efficiency (E)** (pages 5-7)
- X **Water Efficiency (W)** (pages 8-10)
- ☐ **Other Environmentally Innovative Activity (O)** (pages 11-13)

PWS Name: Greater Cincinnati Water Works PWSID: 3102612

Project Name: Elm Street Water Main Replacement PPL #: _____ (Assigned by Ohio EPA)

Total Est. Project Cost: $1,746,000 Total Est. GPR Amount: $164,000

Completed by:

Name: Carel Vandermeyden (Please print) Title: Chief Engineer

Signature: _____ Date: 2/1/2012

For Ohio EPA use only:

Loan Number (if applicable): _____ Eligible GPR Amount $: _____

Eligible GPR Categories: _____ Evaluated by/Date: _____

Loan Award Date (if applicable): _____

Date Business Case Posted on webpage (if applicable): _____

Ohio Drinking Water Assistance Fund
Drinking Water State Revolving Fund (DWSRF)
Green Project Reserve Information Form

Ohio Environmental Protection Agency
Division of Drinking and Ground Waters

Water Efficiency (W)

PWS Name: Greater Cincinnati Water Works PWSID: 3102612

Project Name: Elm Street Water Main Replacement PPL #: _____ (Assigned by Ohio EPA)

Total Est. Project Cost: $1,746,000 Total Est. GPR Amount: $164,000

Project Summary: This project replaces 5,112 feet of old cast iron water main in the GCWW distribution system along Elm Street. The water main dates back to the early 1920's. The existing 16-inch diameter water main is being replaced with new 12-inch water main. Since 2000, there have been 5 repairs on this water main due to joint failure or corrosion. This suggests that the water main is near the end of its useful service life.

Water Main Replacement	
Water main material/length to be replaced	5,112 feet of cast iron water main
Est. total system water lost due to breaks and leaks	5,480 MG (2010 real losses estimate)
Est. water loss from pipe being replaced	Unknown
Total annual production	47,593 MG (2010)
Number of breaks recorded in past 24 months for the area to be replaced	5 water main repairs since 2000; 1 water main repair in the last 24 months
Est. annual water savings	2.14 MG/year
Est. annual costs savings	$6,100/year
Other efficiencies to be gained by the replacement? (reduced head and therefore less energy loss in an upstream pump station, etc.)	N/A

Meter Installation/Replacement	○ Original Installation ○ Replacement
Reason for replacement	
Est. annual water savings	
Est. annual costs savings	

Business Case Narrative (Calculate water saving improvements and costs savings):
The water main to be replaced is over 90 years old, and is starting to experience breaks. Because the City of Cincinnati is doing a major roadway improvement project on Elm Street, GCWW decided to replace this aging infrastructure as a pro-active step before more excessive water main breaks start occurring. It is GCWW's experience that after a major road project, these old water mains are compromised and will experience higher rates of leaks and breaks. Of the real system losses, the majority of the main breaks tend to occur on cast iron water mains. Assuming that 75% of the water main leaks and breaks are on cast iron mains, then 4,110 MG/yr of real losses (5,480 x 0.75 = 4,110 MG/yr) would be attributable to cast iron water mains. GCWW has approximately 1,857 miles of cast iron water mains, so the average annual water losses per mile of cast iron water main are 2.21 MG/mile/yr (4,110 MG/1,857 miles). Since this project has 0.97 miles of water main (5,112/5,280 = 0.97 miles), the estimated future water losses are 2.14 MG/year. This could be avoided by replacing the cast iron water mains now. At a commodity cost of $2.13/CCF, the estimated savings in year 1 could be $6,100 per year. Over the 20 year loan period, assuming an average 3% annual rate increase, the total estimated savings would be $164,000.

Ohio Environmental Protection Agency
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PWS Name: Put-in-Bay PWSID: 6203311

Project Name: Water Intake/Water Treatment Plant Imp. PPL #: 130 (Assigned by Ohio EPA)

Total Est. Project Cost: $1,120,104 Total Est. GPR Amount: $275,859

Completed by:

Name: Steve Wonderly, P.E. (Please print) Title: Vice President

Signature: Steve R Wonderly Date: 01/03/2012

For Ohio EPA use only:

Loan Number (if applicable): _____ Eligible GPR Amount $: _____

Eligible GPR Categories: _____ Evaluated by/Date: _____

Loan Award Date (if applicable): _____

Date Business Case Posted on webpage (if applicable): _____

Ohio Drinking Water Assistance Fund
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Division of Drinking and Ground Waters

Energy Efficiency (E)

PWS Name: Put-in-Bay PWSID: 6203311

Project Name: Water Intake/Water Treatment Plant Imp. PPL #: 130
(Assigned by Ohio EPA)

Total Est. Project Cost: $1,120,104 Total Est. GPR Amount: $275,859

Project Summary:

The Village of Put-in-Bay owns and operates a .430 mgd surface water treatment facility. Water production during summer periods has increased up to .540 mgd which exceeds the treatment facility's Ohio EPA approved rated capacity. Ohio EPA has recently issued a draft Findings and Orders which is currently being negotiated. The primary findings were related to WTP exceedence of the approved capacity for 24 days during July of 2010 and 12 days in August. A Water Supply and Treatment Study was completed and submitted to Ohio EPA on December 10, 2010. The project will include a new raw water intake, raw water pumping, two new 8-foot diameter multi-tech treatment trains, along with a backwash and high service pumping. The estimated construction cost is $1,036,771 which includes contingency.

Pump Facilities

Age of existing pumps or pumping facilities	12 years (2000)
Existing pump/motor efficiency rating, if known	Averages 75% pump and 92% for motor
New pump/motor efficiency rating	Averages 82% pump and 92% for motor
Estimated annual electrical savings	140,760 KWH
Estimated annual cost savings	$14,076

Business Case Narrative: (Calculate energy efficiency improvements and costs savings.)

The water treatment improvements will include the replacement of the raw water pumps, Multi-Tech Raw Water Booster Pumps, Multi-Tech Backwash Pumps, high service pumps along with a new pumping application for backwash water transfer. The pump replacement will provide better wire to water efficiency and at the same time provide increased pumping capacity. The average wire to water efficiency will improve by approximately 6.4% and the estimated annual KWH savings is at 140,760. The attached estimated electrical costs for the existing water treatment plant and water treatment plant improvements take into consideration that daily water treatment will be reduced from an average of 12 hours a day to 8 hours per day. This will be possible due to the replacement of one of the 4' diameter Multi-Tech Treatment Units with two 8' diameter units. It should also be noted that Variable Frequency Drives will be included as part of the pump replacement which should result in additional reduced electrical costs during lower production periods. The attached summary of wire to water efficiency estimates a 20 year electrical savings at $281,520.

Attach Supporting Documentation

☐ Engineering Project Planning Documents ☐ Water/Energy Efficiency Determination (Ohio EPA)

☐ Public Water System Records ☑ Other: Calculation worksheets

EXISTING WATER TREATMENT PLANT IMPROVEMENTS
PUT-IN-BAY, OHIO
ESTIMATED ELECTRICAL COSTS
JOB NO. 1911-055

1. Raw Water Pumps

- Two 300 gpm each at 15 hp
- 15 hp x 12 hours/day x 365 days/year x .746 KWH ÷ 63% efficiency = 77,797 KWH/year x $0.10/KWH = $7,780/year
- Wire to water efficiency - pump at 68.5% and the motor at 91.7% = 63%

2. Multi-Tech Raw Water Booster Pumps

- Four 75 gpm each at 7.5 hp
- Four units x 7.5 hp each x 12 hours/day x 365 days/year x .746 KWH ÷ 75.5% efficiencies = 129,833 KHW/year x $0.10/KWH = $12,983/year
- Wire to water efficiency = pump at 83% and the motor at 91% = 75.5%

Note: One of the new 8' diameter Multi-Tech units will produce the same volume of potable water as four of the 4' diameter units.

3. Multi-Tech Backwash Pumps

- One 500 gpm at 40 hp
- 40 hp x 2 hours/day x 365 days/year x .746 KHW ÷ 66% efficiency = 33,005 KWH/year x $0.10/KWH = $3,300/year
- Wire to water efficiency = pump at 70.3% and the motor at 94.2% = 66%

Note: The 4' diameter units required more backwashes due to high production during peak flow conditions.

4. High Service Pumps

- One 200 gpm at 15 hp
- 15 hp x 12 hours/day x 365 days/year x .746 KWH ÷ 71% efficiency = 69,031 KWH/year x $0.10/KWH = $6,903/year
- Wire to water efficiency = pump at 78% and the motor at 91.4% = 71%

Total estimated annual electrical costs for the above-listed equipment to be replaced in the Phase 2 water treatment plant improvements is $30,966.

WATER TREATMENT PLANT IMPROVEMENTS
PUT-IN-BAY, OHIO
ESTIMATED ELECTRICAL COSTS
JOB NO. 1911-055

1. Raw Water Pumps

- Two 600 gpm each at 20 hp
- 20 hp x 8 hours/day x 365 days/year x .746 KWH ÷ 74% efficiency = 58,874 KWH/year x $0.10/KWH = $5,887/year
- Wire to water efficiency - pump at 80% and the motor at 92.5% = 74%

2. Multi-Tech Raw Water Booster Pumps

- Two 300 gpm each at 15 hp
- 15 hp each x 8 hours/day x 365 days/year x .746 KWH ÷ 75.5% efficiencies = 24,669 KHW/year x $0.10/KWH = $2,467/year
- Wire to water efficiency = pump at 83% and the motor at 91% = 75.5%

3. Multi-Tech Backwash Pumps

- Two 1,000 gpm at 60 hp
- 60 hp x 1 hours/day x 365 days/year x .746 KHW ÷ 77.5% efficiency = 21,080 KWH/year x $0.10/KWH = $2,108/year
- Wire to water efficiency = pump at 82% and the motor at 94.5% = 77.5%

4. High Service Pumps

- Two 600 gpm at 20 hp
- 20 hp x 8 hours/day x 365 days/year x .746 KWH ÷ 74% efficiency = 58,874 KWH/year x $0.10/KWH = $5,887/year
- Wire to water efficiency = pump at 80% and the motor at 92.5% = 74%

5. Submersible Backwash Water Transfer Pumps

- One 1,000 gpm at 15 hp
- 15 hp x 1 hour/day x 365 days/year x .746 KWH ÷ 75.5% efficiency = 5,410 KWH/year x $0.10/KWH = $541/year
- Wire to water efficiency = pump at 83% and the motor at 91% = 75.5%

Total estimated annual electrical costs for the above-listed treatment improvements is $16,890. Item No. 5, Backwash Water Transfer Pumps is a new and additional pump that will be installed.

The water treatment improvements will reduce on average the daily operations from 12 hours per day to 8 hours per day.

SUMMARY OF WIRE TO WATER EFFICIENCY AND ANNUAL ELECTRICAL COSTS					
Existing WTP	Wire to Water Efficiency	Estimated Annual Cost	WTP Improvements	Wire to Water Efficiency	Estimated Annual Cost
Raw Water Pumps	63%	$7,780	Raw Water Pumps	74%	$5,887
Multi-Tech Booster Pumps	75.5%	$12,983	Multi-Tech Booster Pumps	75.5%	$2,467
Multi-Tech Backwash Pumps	66%	$3,300	Multi-Tech Backwash Pumps	77.5%	$2,108
High Service Pumps	71%	$6,903	High Service Pumps	74%	$5,887
----	----	----	Backwash Pump	75.5%	$541
TOTAL		$30,966			$16,890

The estimated 20 year electrical savings based on $0.10/KWH is as follows:

Existing WTP	$30,966 x 20 years =	$619,320
WTP Improvements	$16,890 x 20 years =	$337,800
TOTAL ESTIMATED SAVINGS		$281,520

OHIO WATER SUPPLY REVOLVING LOAN ACCOUNT

PROJECT COST INFORMATION

APPLICANT: Village of Put in Bay

PROJECT NAME: Water Treatment Plant and Intake Improvements

WSRLA PROJECT COST BREAKOUT			WSRLA LOAN	OTHER SOURCES
ADMINISTRATIVE EXPENSES (Legal Fees, etc.)				
CONSTRUCTION MANAGEMENT				
	Engineering	6,165		
	O&M Program			
	Start Up Services			
	Performance Certification			
	Total	6,165	$ 6,165.00	
PROJECT INSPECTION/ Construction Observation				
CONSTRUCTION (List the number of contracts and the estimated costs)				
	Contracts	Estimated Costs		
	Kirk Bros.	889,408		
	Anderzack-Pitzen	93,579		
	Total	982,987	$ 982,987.00	
EQUIPMENT				
OTHER (Specify): (Land or Force Accounts should be listed as other costs)				
SUBTOTAL			$989,152.00	
CONTINGENCY (5% of the above Project Cost)			$ 47,619.00	
PLANNING COSTS*				
DESIGN COSTS* (see above breakdown)			$ 83,333.49	
ESTIMATED CAPITALIZED INTEREST				
TOTAL			$1,120,104.49	

* If loan is for planning/design efforts use estimated costs

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- ☐ **Other Environmentally Innovative Activity (O)** (pages 11-13)

PWS Name: Village of Ottawa PWSID: 690071

Project Name: E. Main & S Oak Waterline and Village Wide Meter Replacement Project PPL #: 43
(Assigned by Ohio EPA)

Total Est. Project Cost: $1,154,396 Total Est. GPR Amount: $693,264

Completed by:

Name: Jason Phillips Title: Water Director
(Please print)

Signature: [signature] Date: 9/14/2011

For Ohio EPA use only:

Loan Number (if applicable): F5 390727-0008 Eligible GPR Amount $: 693,264.00

Eligible GPR Categories: W Evaluated by/Date: [signature] 12/28/11

Loan Award Date (if applicable): 12/8/11

Date Business Case Posted on webpage (if applicable): 12/29/11

Ohio Drinking Water Assistance Fund
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Water Efficiency (W)

PWS Name: Village of Ottawa PWSID: 690071

Project Name: E. Main & S Oak Waterline and Village Wide Meter Replacement Project PPL #: 43
(Assigned by Ohio EPA)

Total Est. Project Cost: $1,154,396 Total Est. GPR Amount: $693,264

Project Summary:
Replace 3,042 l.f. waterline on South Oak Street and
Replace 8,000 l.f. waterline on East Main Street and
Replace 2,069 water meters with new radio read meters to complete Village-wide replacement project

Water Main Replacement	
Water main material/length to be replaced	11,042 l.f. waterline to be replaced
Est. total system water lost due to breaks and leaks	2.5 – 3.0 mg
Est. water loss from pipe being replaced	0
Total annual production	In 2010 = 412.12 mg
Number of breaks recorded in past 24 months for the area to be replaced	8
Est. annual water savings	2.5 – 3.0 mg
Est. annual costs savings	
Other efficiencies to be gained by the replacement? (reduced head and therefore less energy loss in an upstream pump station, etc.)	

Meter Installation/Replacement	○ Original Installation X Replacement
Reason for replacement	Replace malfunctioning meters with radio read which will better capture water loss data
Est. annual water savings	20 – 35%
Est. annual costs savings	See cost savings below

Business Case Narrative (Calculate water saving improvements and costs savings):

$296,901.50 – cost of new meters
$7,847.89 x 20 = cost of water savings over 20 year period for South Oak Street = $156,957.80
$11,970.26 x 20 = cost of water savings over 20 year period for East Main = $239,405.20

Total $ 693,264.00

Attach Supporting Documentation

☐ Engineering Project Planning Documents ☐ Water/Energy Efficiency Determination (Ohio EPA)

☐ Public Water System Records X Other: _____