OPERATIONS AND MAINTENANCE MANUAL
GROUNDWATER TREATMENT FACILITIES #1 AND #2
SITE-WIDE GROUNDWATER AND CURRICULUM CENTER
SVE REMEDIAL ACTIONS
TUTU WELLFIELD SUPERFUND SITE
ST THOMAS, U.S. VIRGIN ISLANDS

Submitted to:

CDM Federal Programs Corporation
14 Wall Street, Suite 1702
New York, NY 10005

Submitted by:

Arrowhead Contracting, Inc.
10981 Eicher Dr.
Lenexa, Kansas 66219

February 2013

Revision 1

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Reviewed/

Concurred by: _____ Date: February 7, 2013

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Project Manager

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List of Acronyms

amsl	Above mean sea level
COC	chain-of-custody
CQCP	Contractor Quality Control Plan
CV	controlled variable
CVOC	chlorinated volatile organic compound
DCE	1,2-dichloroethene
DPNR	Department of Planning and Natural Resources
EPA	U.S. Environmental Protection Agency
EQ	Equalization
GAC	granular activated carbon
gpm	gallons per minute
GWTF	Groundwater Treatment Facility
HMI	Human-Machine Interface
I/O	inputs & outputs (PLC I/O)
KVA	kilovolt-ampere
MCL	maximum concentration limits
O&M	operations and maintenance
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
OIT	Operator Interface Terminal
P&ID	Process and instrumentation diagram
PCE	tetrachloroethene
PID	Proportional-Integral-Derivative
PLC	Programmable logic controller
ppm	parts per million
ppmv	parts per million by volume
RA	Remedial Action
scfm	cubic feet per minute at standard conditions
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
SVE	soil vapor extraction
TCE	trichloroethene
TDH	total discharge head

List of Acronyms (continued)

ug/L	micrograms per liter
UPS	Uninterruptible power supply
USEPA	U.S. Environmental Protection Agency
USVI	U.S. Virgin Islands
VAC	volts AC
VDC	volts DC
WAPA	Water and Power Authority
wc	water column

1.0 Introduction

This document presents Revision 1 of the Operations and Maintenance (O&M) Manual for facility operations at the Tutu Wellfield Superfund Site, located in St. Thomas, U.S. Virgin Islands (USVI). This is Revision 1 to the Final O&M Manual prepared during the Remedial Action (RA) (Arrowhead 2004). This revision was prepared by the United States Environmental Protection Agency (EPA) pursuant to Appendix B of the Site Transfer Agreement between the EPA and USVI. Currently, there are two groundwater facilities are operating at the site. The SVE and off-gas systems at Facility #1 have been shut down and were taken off-line in April 2006.

1.1 Document Organization

This manual is subdivided into the following sections:

- **Section 1.0 – Introduction** – In addition to presenting the outline for this O&M Manual, this section presents a list relevant supporting documents, a description of O&M subcontractor responsibilities, and a project directory.
- **Section 2.0 – Background Information and Overview** – This section presents general background information about the site and project, including the RA objectives, a summary of the design of each GWTF, and the requirements for O&M.
- **Section 3.0 – Control Systems Description** – This section provides a discussion of the control logic and functionality for each system, including the capabilities of each system's motor control center.
- **Section 4.0 – Initial Set-Up Procedures** – This section provides procedures for the initial set-up/start-up of each piece of equipment following installation.
- **Section 5.0 – Systems Operating Procedures** – This section presents the procedures for operating each GWTF once the equipment is installed and initial set-up is completed. The primary scenarios for startup, operation, and shutdown are covered.
- **Section 6.0 – Maintenance Procedures** – This section presents the general procedures for preventative maintenance and inspections to optimize the operation of each system. For more detailed maintenance information, readers are referred to the manufacturer-specific O&M literature contained in the appendices.
- **Section 7.0 – Inspection and Monitoring Procedures** – This section presents general procedures for inspection and monitoring of each system, as part of the routine O&M program.

- **Section 8.0 – Troubleshooting Guidelines** – This section presents general troubleshooting guidelines in the event of system failure or shutdown. For more detailed troubleshooting information, readers are referred to the manufacturer-specific O&M literature contained in the appendices.
- **Section 9.0 – Sampling and Monitoring Methods** – This section provides a general discussion of the sampling and monitoring activities that will be conducted during the O&M of each GWTF.
- **Section 10.0 – Health and Safety Guidelines** – This section provides a general discussion of the health and safety issues associated with the O&M of each GWTF.
- **Section 11.0 – Recordkeeping and Reporting** – This section presents the recordkeeping and reporting requirements applicable to long-term O&M.
- **Section 12.0 – References** – This section presents a list of references associated with this O&M Manual.

In addition to the text (described above), this manual contains relevant tables, drawings, and appendices. Appendices include:

- Appendices A – M, Q: manufacturer O&M literature and information for equipment associated with each GWTF, including preventative maintenance schedules, troubleshooting guidelines, and spare parts lists.
- Appendix N: manufacturer O&M literature for field sampling and monitoring equipment
- Appendix O: material safety data sheets (MSDSs) for the chemical additives
- Appendix P: predictive modeling data for the air stripper and off-gas treatment system
- Appendix R: relevant forms and logs to be used during O&M
- Appendix S: copies of the air and water discharge permits
- Appendix T: copies of the well construction diagrams for each groundwater extraction well

1.2 Supporting Documents

Sampling and monitoring activities are currently being performed in accordance with the site-specific Final Quality Assurance Project Plan (QAPP), April 2009 (CDM Smith, 2009).

1.3 O&M Staffing Plan

The staffing requirements for O&M include a project manager and operator. The following paragraphs summarize the responsibilities associated with each position. Upon transition of

ownership to the USVI, the USVI Department of Planning and Natural Resources (DPNR) or their subcontractor shall be fully responsible for preparing the staffing plan.

Project Superisor/Manager

- A supervisory position directing the overall operation, maintenance, monitoring, and management of groundwater treatment systems.
- In charge of developing plans and making sure that the plans are carried out. Supervise and direct on-site operation of treatment systems. Ensure competency and safety of operations. Ensure compliance with all permit requirements. In charge of approving all changes in treatment system operation. Perform other related administrative and management work, as required. Primary contact to the Contractor.

Operator

- A supervisory position directing and performing the day-to-day operations, maintenance, monitoring, and management of groundwater treatment systems.
- In charge of the day-to-day operation, maintenance, monitoring, sampling, and management of treatment systems, extraction well systems and associated facilities, attainment of effluent and air discharge requirements, record maintenance, reporting, waste disposal, and associated on-site operations. Intimately familiar with all permit regulations and enforcement requirements. Maintains accurate and orderly managed O&M records. Performs other related work including, administration, budgeting, and routine office duties, as required.

1.4 Project Directory

Table 1-1 presents a directory (addresses, telephone numbers, and contacts) of the key organizations, regulators, and property owners associated with the Tutu Wellfield O&M. Additionally, Table 1-2 is provided as a directory of the primary vendors, suppliers, and manufacturers of the process equipment and instrumentation.

2.0 Background Information and Overview

This section presents general background information about the site and project, including the RA objectives, a summary of the design of each GWTF, and the requirements for O&M.

2.1 Site Description

The Tutu Wellfield Superfund Site is located in the Anna's Retreat area, east of the city Charlotte Amalie on the island of St. Thomas, USVI. The site is situated within the upper Turpentine Run surface drainage basin. The basin, which covers approximately 2.3 square miles, trends roughly north-south and is bounded by steep slopes of the surrounding hills. The site contains a variety of commercial establishments, schools, churches, and residential units. The project covers of two areas of concern that are being implemented to remediate groundwater contaminated with chlorinated volatile organic compounds (CVOCs). The Northern Plume is upgradient, and is located below and adjacent to the Curriculum Center. The Southern Plume is downgradient and extends to the south of the Esso Tutu Service Station below O'Henry Dry Cleaners.

2.2 Remedial Action Objectives

The CVOCs found in groundwater at the site include trichloroethene (TCE), tetrachloroethene (PCE), 1,2-dichloroethene (DCE), and vinyl chloride. Total CVOC concentrations have exceeded 10 parts per million (ppm) in select groundwater samples. The objectives of the program are summarized as follows:

- Contaminated groundwater in the Northern Plume is extracted, treated, and discharged to surface water for the purpose of achieving:
  - Hydraulic control of and CVOC mass removal from the contamination source at the Curriculum Center property (GWTF #1)
  - Hydraulic control of and CVOC mass removal from the dissolved-phase plume that extends downgradient of the Curriculum Center, just to the south of the Esso Tutu Service Station and exceeds 100 ug/L total CVOCs (GWTF #2).

  Groundwater quality will improve in the Northern Plume area over time as a result of active CVOC mass removal within the capture zone areas of the GWTF extraction

systems, and in downgradient areas as a result of hydraulic CVOC source/plume control and natural attenuation processes.

- The soil remedy for the site, consisting of SVE at the Curriculum Center, was implemented concurrently with the groundwater remedial action. The two remedies were integrated to combine common components, such as the building enclosures and process controls. The soil remedy was completed in April 2006, at which point the SVE and off-gas system components were shut down.
- Contaminated groundwater in the Southern Plume will be allowed to naturally attenuate under closely monitored conditions.
- Changes in groundwater quality resulting from groundwater extraction and from natural attenuation will be closely monitored as part of the site-wide groundwater monitoring program to:
  - Confirm that Northern CVOC source and plume are being hydraulically controlled and that CVOC concentrations are decreasing in the aquifer over time
  - Confirm that the current Southern Plume area exceeding federal maximum concentration limits (MCLs) for drinking water is not expanding or moving beyond its current location and that CVOC concentrations are decreasing in the aquifer over time.
- The cleanup goals for aquifer groundwater quality at the site are the federal MCLs. Remedial system operation and/or site-wide groundwater monitoring will continue until these cleanup goals are achieved. Surface water and air discharges from GWTFs shall comply with locally permitted discharge criteria, as presented in Tables 2-1 and 2-2, respectively. Copies of the surface water discharge and air emissions permit equivalencies are provided in Appendix S.

2.3 GWTF Design Summary

Operations at GWTF #1 include groundwater extraction and treatment consistent with the RA objectives discussed in Section 2.2. The site layout for GWTF #1 is depicted in Drawing 2-1. GWTF #1 is designed to treat up to 60 gpm of groundwater from a network of three extraction wells (RW-6, RW-7, and RW-9; refer to Drawings 2-5 and 2-6). The SVE system at GWTF #1 is capable of extracting 130 scfm at –30 in. wc. SVE wells include SVE-1 and RW-7 (refer to Drawings 2-6 and 2-7). Extraction well RW-7 is a dual-phase well; it is designed and

constructed for both groundwater and soil vapor extraction. Extraction well construction logs are provided in Appendix T. The SVE and off-gas systems were shut down in April 2006.

The overall system design for GWTF #1 incorporates the following pieces of equipment:

- Three Grundfos Redi-Flo3 electric submersible well pumps (RW-6, RW-7, and RW-9)
- 1,000-gallon, cone-bottom equalization (EQ) tank, including a 55-gallon container with 200 lbs vapor phase granular activated carbon (GAC) (only in use when RW-6 is in operation and influent is passed through EQ tank)
- Two centrifugal transfer pumps (maximum flow rate 30 gpm @ 56 ft TDH)
- Two chemical feed systems [pH adjustment using muriatic acid and anti-scalant (sequesterant) addition], including metering pumps and chemical storage drums
- Two bag filters
- 6-tray, low-profile air stripper (rated for 5 – 80 gpm) and regenerative blower (rated at 350 scfm @ –75 in. wc), piped in an induced-draft configuration (refer to Appendix P for predictive modeling simulations and results)
- Air-to-air heat exchanger (aftercooler) **- currently in-line but not turned on as part of operations**
- Off-gas treatment system, consisting of one vapor phase GAC vessel (5,000 lbs capacity) and one potassium permanganate-impregnated vessel (7,000 lbs capacity)– **currently offline**
- Soil vapor extraction system, consisting of a regenerative blower (rated at 140 scfm @ –70 in. wc) and a 40-gallon moisture separator tank **– currently offline and moisture separator tank removed due to severe rusting**
- Appurtenances, including air inlet filters, discharge silencers, Y-strainers, vacuum breaker (anti-siphon), and sample ports
- Instrumentation, including temperature gauges, temperature switches, pressure gauges, pressure switches, flow meters, flow transmitters, and level switches
- Motor control centers (see below)

Drawing 2-3 depicts the equipment arrangement, building floor plan, and yard piping for GWTF #1. The air stripper, transfer pumps, and SVE system are located within the process building. This building is subdivided into process room and office. The office also houses the control panels and transformers. The EQ tank, off-gas treatment vessels, and heat exchanger are

mounted on concrete pads located outside and adjacent to the process building. Secondary containment for the EQ tank is provided via a concrete berm along the perimeter of the pad. Secondary containment for equipment located inside the building is provided by a concrete berm along the perimeter of the process room. The "treatment plant" is comprised of the process building, interior equipment, and pad-mounted equipment located outside the building.

Currently extraction well RW-7 is used as the primary extraction well, with RW-9 serving as a secondary well for use during periods of high groundwater elevations. Extraction well RW-6 is pumped once per week for about one hour until the well is pumped dry. Contaminated groundwater is pumped to the treatment plant via a network of underground aboveground yard piping (refer to Drawings 2-1 and 2-3). Underground piping and electrical conduit pass through pull boxes (Drawing 2-8) located between the process building and extraction well vaults (Drawings 2-5 through 2-7). The EQ tank and transfer pumps are currently bypassed under normal operating conditions, except during operation of RW-6. When the EQ tank is used, the influent is temporarily stored there prior to being transferred (by the centrifugal transfer pumps) to the air stripper. Scale inhibitor is injected upstream of the EQ tank. Muriatic acid is added in the air stripper sump for pH adjustment prior to discharge. The treated water from the air stripper is then discharged to a local storm sewer inlet (located approximately 300 ft west of the treatment plant; refer to Drawing 2-1). Contaminated vapors from the air stripper are no longer routed through the off-gas treatment system, but rather bypass the units which remain on site without media present in the vessels. The system was taken off-line in April 2006 because it was determined to no longer be necessary to meet the air permit requirements. The off-gas passes through the upstream heat exchanger (after-cooler) which no longer requires operation to maintain air temperatures. The treated air stream is discharged to the atmosphere through a stack mounted on the side of the process building. The SVE system which consisted of a moisture separator, particulate filter, regenerative blower and discharge silencer has been offline since 2006.

GWTF #2 (refer to Drawing 2-2) operations consist of groundwater extraction and air stripping. The influent CVOC concentrations have historically been below permitted air emissions limits, so off-gas treatment was not required for GWTF #2. GWTF #2 is designed to treat up to 30 gpm of groundwater from two extraction wells (RW-1 and RW-1S; refer to Drawing 2-5). Extraction well RW-1 has not been used as part of the remedy. The overall system design for GWTF #2 incorporates the following pieces of equipment:

- Two Grudfos Redi-Flo3 electric submersible well pumps
- 500-gallon cone-bottom equalization tank, including a 55-gallon container with 200 lbs vapor phase GAC **– currently offline and in storage**
- One centrifugal transfer pump (maximum flow rate 30 gpm @ 56 ft TDH)
- Two chemical feed systems (pH adjustment using muriatic acid and anti-scalant/sequesterant addition), including metering pumps and chemical storage drums
- Two bag filters
- 6-tray, low-profile air stripper (rated for 1 – 35 gpm) and regenerative blower (rated at 150 scfm @ –65 in. wc), piped in an induced draft configuration
- Appurtenances, including air inlet filters, discharge silencers, Y-strainers, vacuum breaker (anti-siphon), and sample ports
- Instrumentation, including temperature gauges, pressure gauges, pressure switches, flow meters, flow transmitters, and level switches
- Motor control centers (see below)

Drawing 2-4 depicts the equipment arrangement, building floor plan, and yard piping for GWTF #2. The treatment equipment, including the EQ tank, is located within the process building. Similar to GWTF #1, the building is subdivided into a process room and office/control room. Contaminated groundwater from each extraction well passes through a pull box as shown on Drawing 2-8. Only RW-1S has been operated as part of the remedy. The EQ tank and transfer pumps are currently bypassed. Influent groundwater is routed though the air stripper followed by direct discharge of the off-gas to the atmosphere through a stack mounted to the side of the building. Treated water from the air stripper is discharged to a local storm sewer inlet (located approximately 150 ft southwest of the treatment plant; refer to Drawing 2-2). A comprehensive equipment list for GWTF #2 is provided in Table 2-6.

The control systems for GWTF #1 and GWTF #2 are based on a 480-VAC control panel containing an Operator Interface Terminal (OIT), programmable logic controller (PLC), Grundfos® CU-300 pump controllers, autodialer, and associated 24VDC power supplies for DC input/output (I/O) circuits. The facility receives incoming power @ 208VAC, 3Ø from Water and Power Authority (WAPA) pole-mounted transformers. The electrical drop connects to a power meter mounted on the poles. Power is brought from the meter underground into each building where it is split in a wireway to feed a 100A 208VAC lighting distribution panel, P1,

and a 75KVA, 3Ø transformer that provides the 480VAC power necessary for the control panel. The control panel is equipped with its own 7.5KVA transformer to provide 240VAC single-phase power to the Grundfos® pump controllers and 120VAC power for the OIT, PLC and other equipment provided in the control panel. Details are provided in the electrical schematics (E-series drawings) from the set of as-built drawings. Section 3.1 provides further information regarding the control panel hardware and software. The overall control logic scheme is depicted graphically in P&ID diagrams, Drawings 2-9 through 2-13.

A standard nomenclature system was developed for the piping, valves, and sample ports at each GWTF. Drawings 2-14 through 2-18 identifies each pipe run, valve, and sample port according to this system. Tables 2-7 and 2-8 provide a comprehensive listing of each identifier, including a nomenclature abbreviation key.

2.4 O&M Requirements

This subsection summarizes the specified requirements for operations, maintenance, sampling and monitoring to be implemented by the O&M subcontractor.

2.4.1 Operations

The following are the operational requirements applicable to each GWTF:

- Operate all equipment, systems, processes, and appurtenances in accordance with the subcontract agreement, equipment manufacturer's specifications and O&M instructions, and the approved O&M Manual.
- Extract groundwater on a continuous basis to achieve hydraulic control of the groundwater CVOC plume at each treatment plant location, and treat groundwater in accordance with the permitted requirements for surface water and air discharges.
- Containerize, characterize, transport, and dispose of all process and sampling waste residuals at an approved waste disposal facility.
- Procure all equipment, spare parts, supplies, and services required for operation, maintenance, monitoring, and management of the treatment systems.
- Manage and maintain an inventory of equipment, spare parts, supplies, and tools required for continuous operation with minimal downtime.
- Monitor treatment system performance, permit compliance, and remedial progress by collecting specified samples and field measurements (refer to Section 9.0).

- Prepare operational records and maintain project files (refer to Section 11.0). Prepare and submit progress reports.
- Abide by all permits required to operate and report any non-compliant conditions to DPNR immediately.
- Optimize the use of process equipment and chemicals to minimize operational costs.
- Maintain treatment plant uptime in excess of 95% per quarter.
- Notify DPNR immediately of any system downtime greater than 24 hours or any non-compliance with discharge requirements.

2.4.2 Maintenance

The following are the maintenance requirements applicable to each GWTF:

- Provide routine, preventative, and corrective maintenance of the GWTFs, including all processes, equipment, controls, facilities, and appurtenances.
- Perform routine, preventative, and corrective maintenance of the GWTFs in accordance with the equipment manufacturer's specifications and this O&M Manual.
- Store all tools, spare parts, equipment, and supplies in an appropriate storage area at each GWTF. Manage the inventory and maintenance of such items to minimize downtime for maintenance.
- Maintain good housekeeping practices. Facilities shall be kept neat, organized, and litter-free. Clean and remove accidental spills.
- Containerize, characterize, and promptly dispose all wastes generated at the site, such as bag filters and tank sediment.
- Routinely inspect and maintain the physical condition of exterior facilities, equipment, and grounds as follows.

    - Fencing and locks shall be maintained, and repaired or replaced when necessary.
    - Vegetation shall be maintained in a manner that is consistent with the surrounding and cut when necessary.
    - Touch-up painting shall be performed as necessary to prevent corrosion or other damage associated with environmental exposure.
    - Well vaults shall be inspected for surface leaks; access hatch seals and grading shall be replaced/corrected when needed.

- Structural support systems, such as concrete footers, structural anchoring, and guy wires, shall be periodically checked for structural integrity and adjusted/repaired if necessary.
- Building openings and access ways, including doors, louvers, fans, air conditioners shall be periodically checked for leakage and structural integrity; adjust/tighten hardware, apply caulk, and replace weather stripping when needed.

2.4.3 Sampling and Monitoring

As part of the overall O&M of each system, sampling and monitoring activities will be conducted to evaluate the following:

- Treatment system compliance to confirm that permitted discharge requirements are being met for surface water and air discharges.
- Treatment system performance to confirm that hydraulic control is being maintained and that treatment systems are operating properly. Subcontractor shall monitor influent flow and water quality from extraction wells, drawdown and hydraulic control of groundwater, and unit process performance. Information shall be used to support decisions regarding adjustments to pumping rates, unit process operations, chemical dosage rates for the purpose of maximizing remedial performance and minimizing associated operational costs.
- Remedial progress by monitoring changes in source-area and site-wide groundwater quality, levels, and flow over time. This shall include the areas subjected to groundwater extraction and treatment and the area subjected to monitored natural attenuation. Information shall be compared against design assumptions and predictions regarding remedy performance, and it shall be used to refine such assumptions and predictions and the environmental monitoring program as more information is gathered.

The long-term O&M phase includes two primary sampling and monitoring programs:

- Performance and compliance monitoring
- Site wide groundwater monitoring

The following subsections present the general sampling and field measurement requirements for each program. The data quality objectives for performance and compliance monitoring and sitewide groundwater monitoring are presented in the site-specific QAPP (CDM Smith, 2009).

2.4.3.1 Performance and Compliance Monitoring

Performance and compliance monitoring will entail routine sample collection and field measurements to (1) verify that the treatment systems are performing as designed and (2) verify compliance with air emissions and surface water discharge permits (refer to Tables 2-1 and 2-2 and Appendix S). The minimum requirements for performance and compliance monitoring are specified in Table 2-9. All sampling and field measurements shall be performed in accordance with the site-specific QAPP (CDM Smith, 2009). Water and air/vapor samples that will be collected and/or monitored as part of long-term O&M performance and compliance monitoring include:

- Groundwater influent samples from each extraction well (VOCs)
- Treated water effluent samples (VOCs, TOC, and TSS)
- Air emissions samples from the stack at GWTF #1 (VOCs via Method TO-15)

In addition to water and air samples, operational parameters shall be recorded on a routine basis from process instruments, meters, and gauges, including the following:

- Extraction well water level
- Extraction well pump flow rate, pressure, and totalized flow
- Influent flow rate and totalized flow
- Air stripper influent flow rate and totalized flow
- Transfer pump(s) discharge pressure and flow rate
- Bag filter differential pressure
- Air stripper blower flow rate
- Air stripper blower vacuum, discharge pressure, and temperature
- Chemical injection rates
- Treated water effluent pH
- Other routine operating parameters (refer to Tables 5-1 and 5-2)

A comprehensive schedule for performance and compliance monitoring (during the first year of long-term O&M) is presented in Table 2-9.

2.4.3.2 Sitewide Groundwater Monitoring

During long-term O&M, groundwater samples and synoptic water level measurements will be collected from the sitewide network of groundwater monitoring wells. Groundwater samples will be collected on an annual basis. Synoptic water levels will be measured on a monthly basis.

Additionally, continuous water levels will be recorded from six groundwater monitoring wells using dedicated pressure transducers with datalogging capabilities. The requirements for sitewide groundwater monitoring are specified in Table 2-10. All sampling and water level measurements shall be performed in accordance with the site-specific QAPP (CDM Smith, 2009).

3.0 Control Systems Description

This section provides a discussion of the control system logic, programming, and functionality, including the capabilities of each system's control panel. The control logic scheme is depicted graphically on the P&ID diagrams, Drawings 2-9 through 2-13. Control ladder diagrams are included in Appendix I. It should be noted that the SVE and off-gas systems are currently offline.

3.1 Control Panels

The control panel is equipped with an Allen-Bradley VersaView 1500P 15-inch touch-screen OIT from which the on-site operator and remote users control and monitor all automated processes in the system (refer to Appendix I). The VersaView OIT is an industrial computer with a Windows XP® operating system, a CD-RW drive, 3-1/2 floppy drive, internal modem, keyboard, mouse, uninterruptible power supply (UPS) and several serial and USB ports for peripheral devices. The OIT is connected to an Allen-Bradley MicroLogix 1500® PLC located on a panel behind the OIT. Two 24VDC power supplies are provided in the control panel – one for analog I/O and the other for the discrete 24VDC circuits shown in the electrical schematics. The control panel also includes Grundfos® CU300 pump controllers used to control the speed (pumping rate) of each recovery well pump.

3.2 Control Logic Overview

The control systems for each GWTF are programmed with ladder logic to implement interlocks, control system processes, cycle process equipment, initiate local and remote alarms, and safely start up and shut down each system. The control interlocks are depicted graphically in the P&ID drawings (Drawings 2-9 through 2-13) and listed in Tables 3-1 (GWTF #1) and 3-2 (GWTF #2). ***It is important to understand that AUTO mode must be selected in order for the interlocks to function as designed. Any piece of equipment placed in MAN(ual) mode will have its control interlocks bypassed.***

The control interlocks begin to function automatically upon start up. Clicking the System START button on the MAIN screen first removes any previously existing stop commands, places all process equipment in AUTO mode, and then sequentially starts the following in order:

GWTF #1

- Air stripper blower, B-1
- Transfer pump, P-1 **– currently bypassed**
- Transfer pump, P-2 **– currently bypassed**
- Well pump, P-6
- Well pump, P-7
- Well pump, P-9
- Sequestering agent metering pump, M-2
- Muriatic acid metering pump, M-3

GWTF #2

- Air stripper blower, B-1
- Transfer pump, P-2 **– currently bypassed**
- Well pump, P-1**– currently unused**
- Well pump, P-1S
- Sequestering agent metering pump, M-2
- Muriatic acid metering pump, M-3

The systems can also be started by the START pushbutton on the front of the control panel.

The START sequence tests for sufficient water levels in the influent EQ tank and recovery wells. If these levels are above the low level shut-offs for each location, then the pumps will run. Well pump RW-6 is run manual mode. The pump runs until a low level condition (dry run alarm condition) is achieved. Upon reaching a low level condition, the CU300 recognizes high amp draws, and alarms out for a dry run condition. The pump is then turned off. The other well pumps (P-7, P-9, and P-1S) will automatically go into dynamic level control whereby a preset water table elevation is maintained using proportional-integral-derivative (PID) level controllers (refer to Section 3.4.3). In the event any of these levels gets out of control for any reason, high and low level interlocks are in place to cycle the pumps as necessary and prevent them from running dry.

The sequestering agent metering pump is interlocked with the recovery well pumps. At least one recovery well pump must be running for either of these pumps to run in AUTO mode. After starting, the speed of these pumps is controlled manually at the metering pump based on influent flow rates and the rate of fouling of the bag filters and the air stripper trays.

The muriatic acid metering pump is interlocked with the air stripper influent flow rate . A minimum flow rate of 5 gpm must be maintained in order for the muriatic acid metering pump to run in AUTO mode. After starting, the speed of this pump is controlled automatically by its PID controller to maintain the desired pH setpoint entered by the operator in the PID screen.

All upstream groundwater equipment is interlocked with the air stripper blower, B-1. The air stripper blower must be running in order for any pumps to run in AUTO mode. In the event of a normal shutdown in which the operator clicks the System STOP button, all upstream equipment will shut off immediately while the air stripper blower continues to run for 5 minutes in order to treat all water remaining on its trays.

In GWTF #1 the heat exchanger (**no longer in use**), HX-1, is interlocked (**no longer interlocked**) with both the air stripper blower (B-1) and the SVE blower (B-2) (**no longer in use**). The heat exchanger will not run in AUTO mode unless one of these blowers is running.

The air stripper blower and SVE blower in GWTF #1 have separate shutdown interlocks (**no longer in use)** listed in Table 3-1. One interlock in particular is shared between these two blowers – the heat exchanger high temperature switch, TSH-1625. In the event the heat exchanger fails or for whatever reason the air temperature leading to the off-gas treatment system exceeds 120 °F, each blower and the entire facility shuts down (**no longer applicable)**.

3.3 Control System Functionality Overview

The control system is designed for automatic, unattended operation after completing manual set-up tasks described in Section 4.0. The Human-Machine Interface (HMI) software running on the OIT provides graphical images of the processes and equipment associated with the facility. Graphical control panels are provided for each motor which include Windows® push buttons for START, STOP, AUTO and MAN(ual). System-wide START, STOP & RESET pushbuttons are also provided on the front of the control panel. All analog inputs used by the system are displayed in real-time, including groundwater influent flow rate and totalized gallons, recovery well water levels, chemical metering pump dosage rates, etc. All alarm conditions are displayed in their appropriate positions in the P&ID formatted MAIN screen and in an ALARM summary screen from which alarms are acknowledged by the operator. All I/O, including alarm conditions, is logged in database formatted (*.dbf) files, which can be downloaded to remote PCs and directly accessed with Microsoft Excel®. All alarm conditions cause autodialer callouts to a

select list of respondents via voice, fax or pager (refer to Section 3.5). Remote access is provided via PC-to-PC direct wireless modem communications using pcAnywhere® remote access software (refer to Section 3.6). This remote connection gives authorized remote callers full access to the OIT for control, monitoring and downloading data files.

3.4 Human-Machine Interface (HMI)

The HMI software running on the OIT provides the operator with a process control and monitoring workstation. It consists of a touch screen industrial computer mounted in the front of the control panel enclosure (located in the field office portion of each building) running Rockwell Automation's RSView32 Works software. The components of the configured software used by the operator include:

- Process control screens depicting all controlled processes in P&ID format
- Master System Start, System Stop and Reset buttons
- Pop-up motor control panels for starting, stopping and selecting modes of operation for individual motors
- PID controllers for controlling recovery well water levels and effluent pH
- Alarm display listing any current alarm condition
- Data logs for all integrated process and status variables
- Alarm logs listing all previous alarm conditions
- Trend screens depicting real-time and historical process data in "line graph" format

The HMI software starts automatically whenever power is applied to the OIT. The MAIN screen, described in Section 3.4.1, is the first to be displayed after power up. All other screens are accessed through an intuitive menu system of Windows® buttons using a touch screen pointer, mouse or finger. A detailed discussion of the features and functions of each of the HMI screens is provided in the ensuing subsections.

3.4.1 MAIN Screen

The MAIN screens shown in Figures 1 and 2 include all of the process equipment controlled by the PLC, analog and discrete I/O, and alarm conditions for the system. The functionality of this screen includes images of pumps and blowers that when clicked bring up the pop-up control panels depicted in Figures 3 and 4, plus each image is animated to indicate whether the motor is running. Each pop-up panel contains buttons for AUTO or MAN(ual) modes, START and STOP, and status indicators for the motors and buttons. Additional functionality is provided by real-time numerical displays of water table elevations in recovery wells, influent groundwater

flow rate, totalized influent gallons and effluent pH. To access the other HMI screens, the operator must click the SCREENS button at the top of the MAIN screen.

Figure 1 – MAIN Screen, GWTF #1

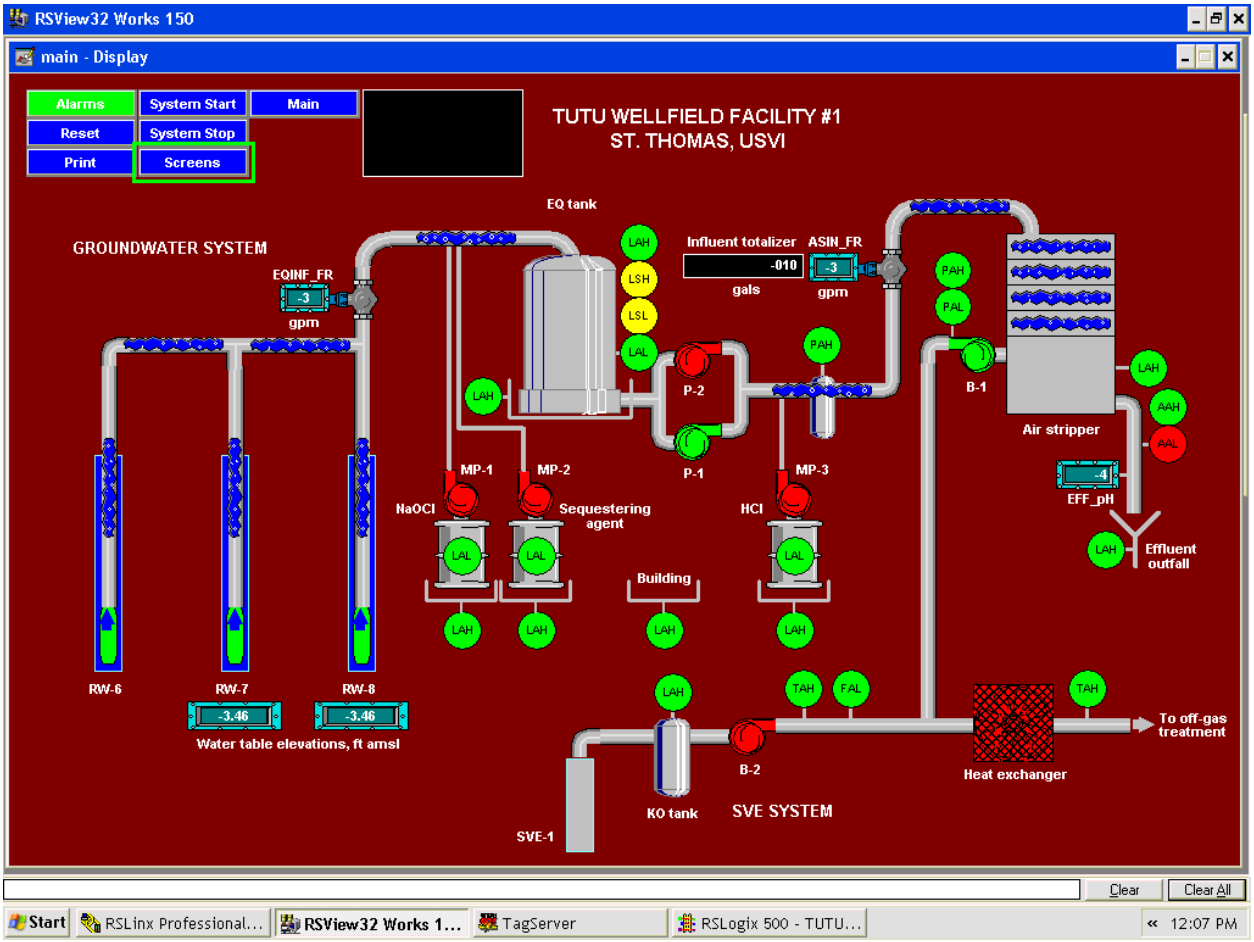


Figure 2 – MAIN Screen, GWTF #2

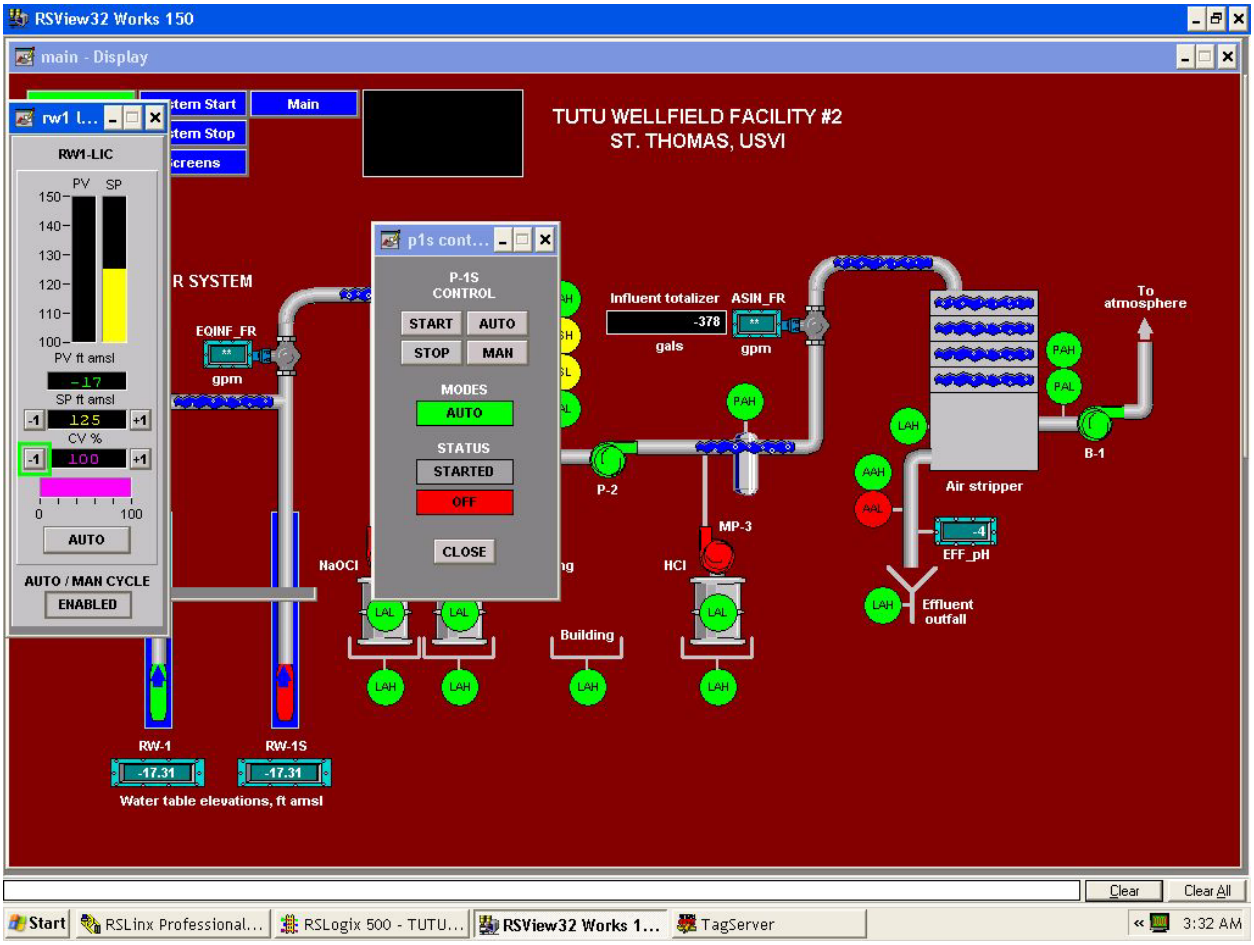


Figure 3 – MAIN Screen with Pop-Up Motor Control Panels, GWTF #1

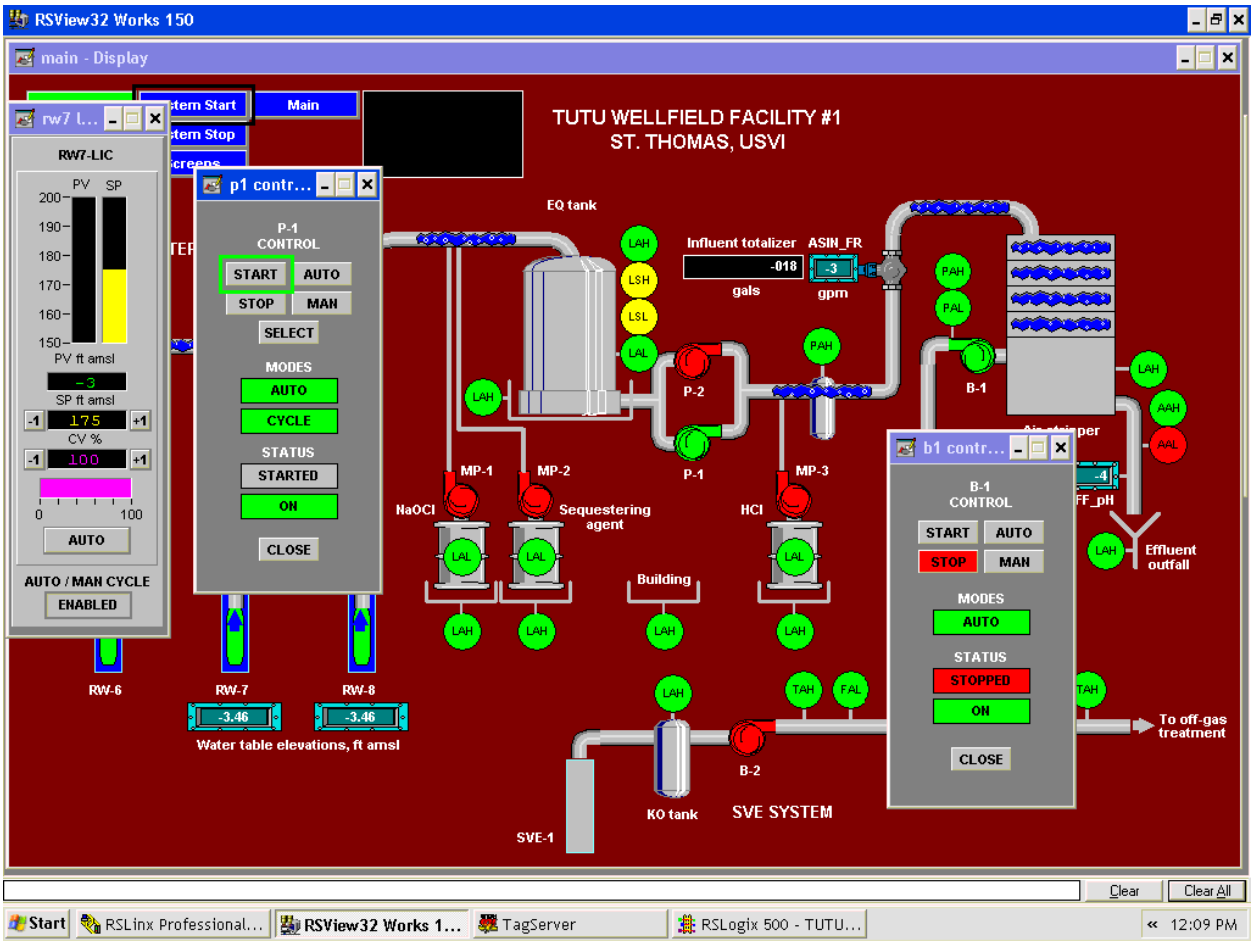
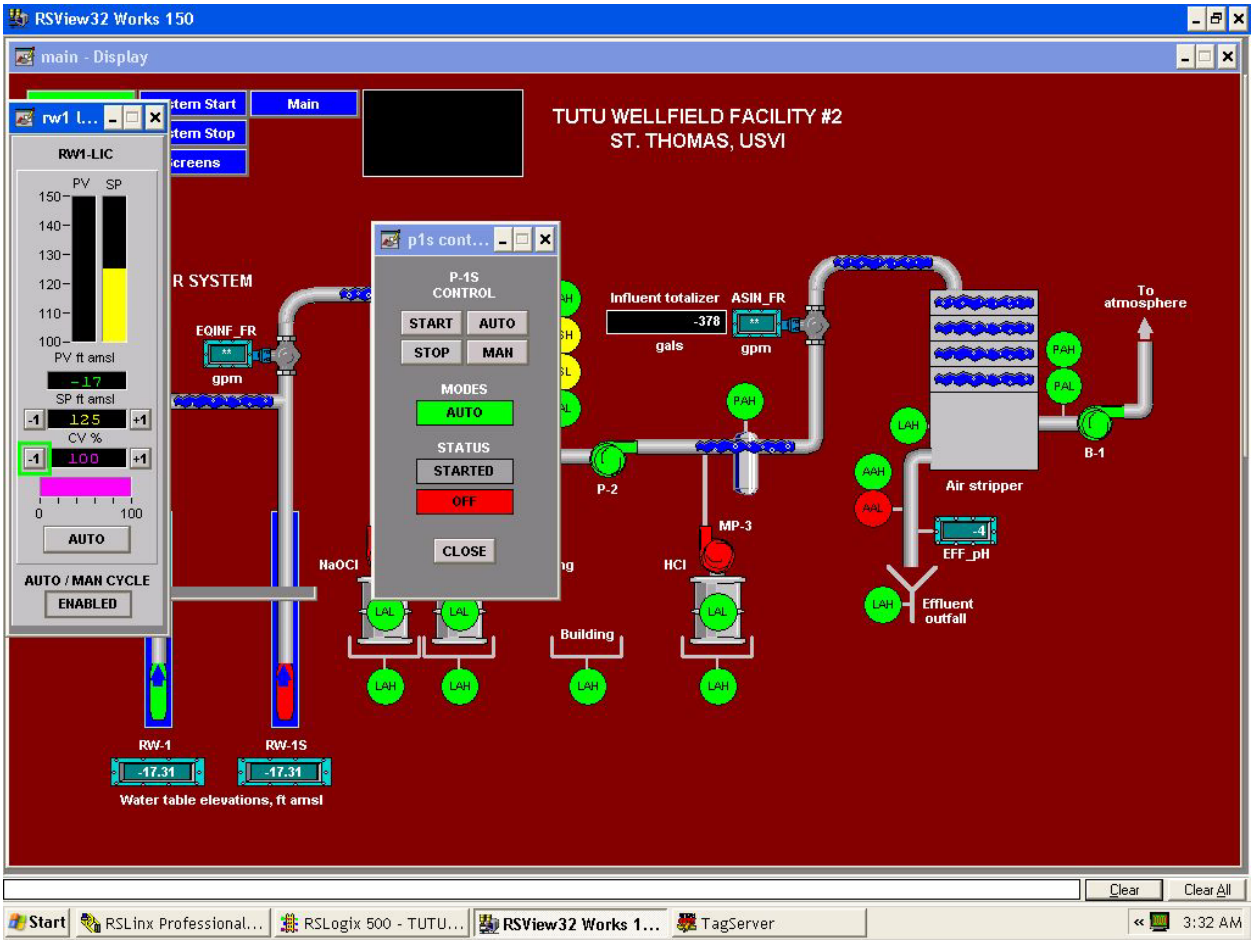


Figure 4 – MAIN Screen with Pop-Up Motor Control Panels, GWTF #2

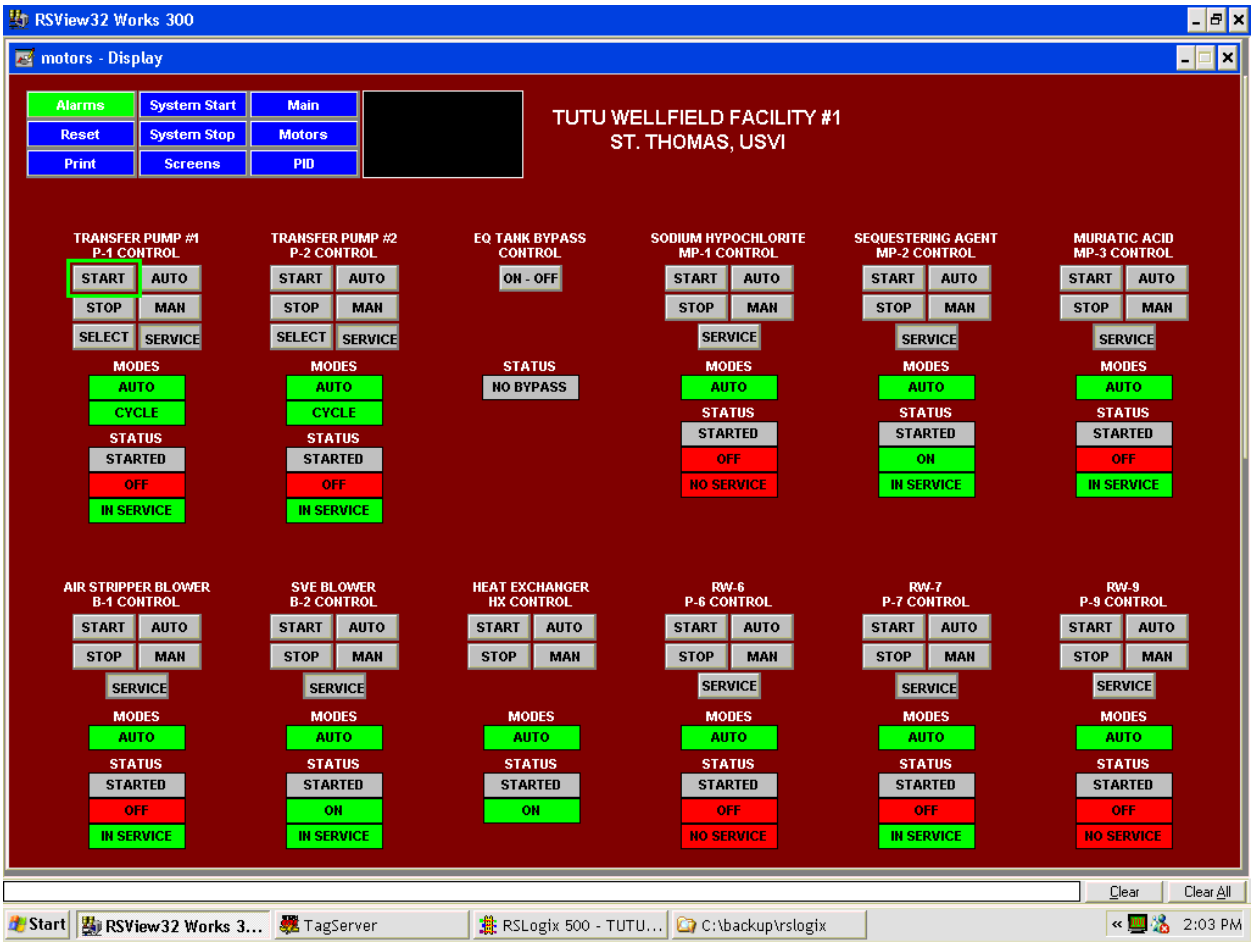


3.4.2 MOTORS Screen

The pop-up motor control panels accessed from the MAIN screen are all available on the MOTORS screen shown in Figures 5 and 6. The motor controls are configured to select AUTO or MAN(ual) modes of operation for each motor. In AUTO mode all control and safety interlocks are applied to the motor control circuits. Conversely, in MAN mode no interlocks are applied. The motor control panels also include status indicators for AUTO / MAN modes, START and STOP switch status, and the current ON / OFF status of the motor. When the operator initiates system start up by pressing the System START button available at the top of all HMI screens the PLC control program automatically places all motors in AUTO mode and then sequentially starts each piece of equipment beginning with the air stripper blower. When the operator stops the system with the System STOP button all motors except the air stripper blower are stopped immediately as though the operator had stopped each individual motor through its

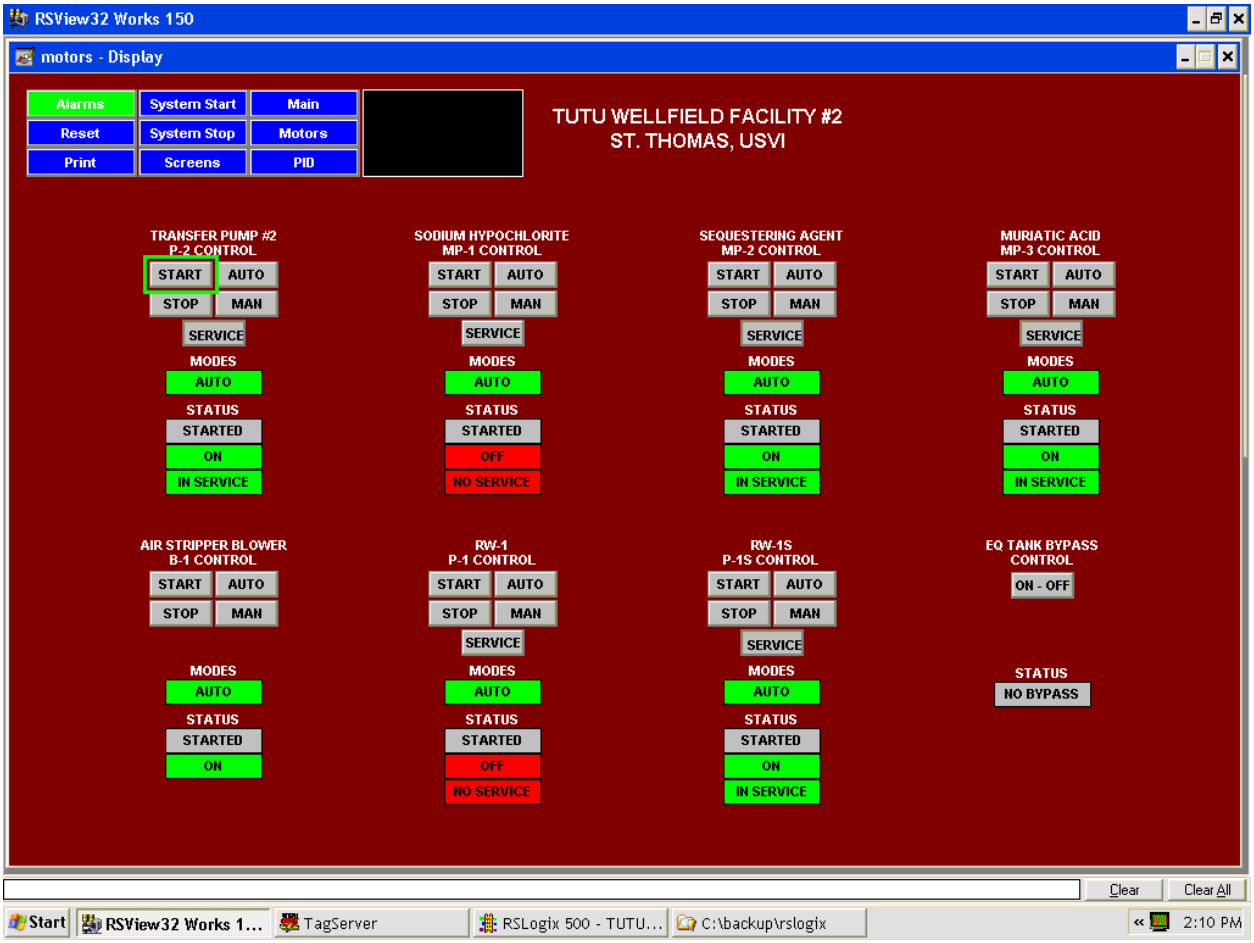
motor control panel. The air stripper blower is programmed to keep running for five minutes during a normal system shutdown using the System STOP button. All motors remain in AUTO mode at all times during startup and shutdown unless MAN modes are selected by the operator.

Figure 5 – MOTORS Screen, GWTF #1



The Motors screen includes a "BYPASS" button that allows the operator to bypass the equalization tank. In BYPASS mode, the recovery well pumps convey groundwater from the wells directly to the air stripper pre-filters – the transfer pumps are not used and are prevented from running. Pressing the BYPASS button causes the entire system to be shut down and placed in bypass mode. The system is then restarted as described in Section 5.0.

Figure 6 – MOTORS Screen, GWTF #2



3.4.3 PID Screen

The PID screen includes PID process controllers for recovery well water table elevation control and effluent pH control. (The term "PID" comes from the proportional-integral-derivative actions that a controller can make in response to an analog input, e.g., water table elevation.) Using water table elevation control as an example, the operator selects a setpoint for the water table elevation in feet amsl by touching or mouse-clicking repeatedly on the increment (+1) or decrement (-1) push buttons provided on either side of the setpoint numerical display on the level (PID) controller until the desired setpoint is displayed. If the PID controller is in AUTO mode the controller will automatically manipulate the speed of the recovery well pump through its analog output to the Grundfos® CU300 controller to achieve the setpoint water table elevation. Manual control of pump speed is provided by the controller by selecting MAN mode and

incrementing or decrementing the pushbuttons on either side of the controlled variable (CV) numeric display. The CV display is ranged from 0 – 100% which corresponds to a 4 – 20mA analog output signal to the controlled device, i.e., CU300 or effluent muriatic acid metering pump.

The PID controllers allow the operator to enable or disable automatic cycling of the controller between AUTO and MAN modes of operation. During normal operations PID controllers are cycled automatically (cycling enabled) between AUTO and MAN modes to maintain a constant controller output when the associated process equipment cycles off. For example, when water flow to the air stripper cycles off the muriatic acid metering pump must cycle off otherwise the PID controller would be making drastically different adjustments than before to accommodate the very different (and meaningless) process dynamics of trying to control pH in small volume of stationary water in a pipe. Whenever the water would begin to flow again the metering pump and pH controller would likely be too slow to react and effluent pH would go out of control. By automatically cycling to MAN mode when water flow stops the PID controller output will be exactly where it was just before the water flow stopped and therefore much closer to where it needs to be and pH control is maintained. The recovery well pumps equipped with PID level control are not expected to cycle off so in actual practice this feature will probably seldom be used on these controllers. But it might be desirable to disable this auto-cycling feature for the effluent pH controller during maintenance or calibration activities since it will otherwise be forced into MAN mode whenever it cycles off. The PID screen is shown below in Figures 7 and 8.

The PID action of the recovery well level controllers may be enhanced by enabling “Extra PID logic” by toggling the associated button below each controller. When enabled, this logic will reduce the degree of setpoint “overshoot” sometimes exhibited when the system is first started and the recovery well is drawn down, gradually at first, then rapidly as it nears the water table elevation setpoint.

Figure 7 – PID Screen, GWTF #1

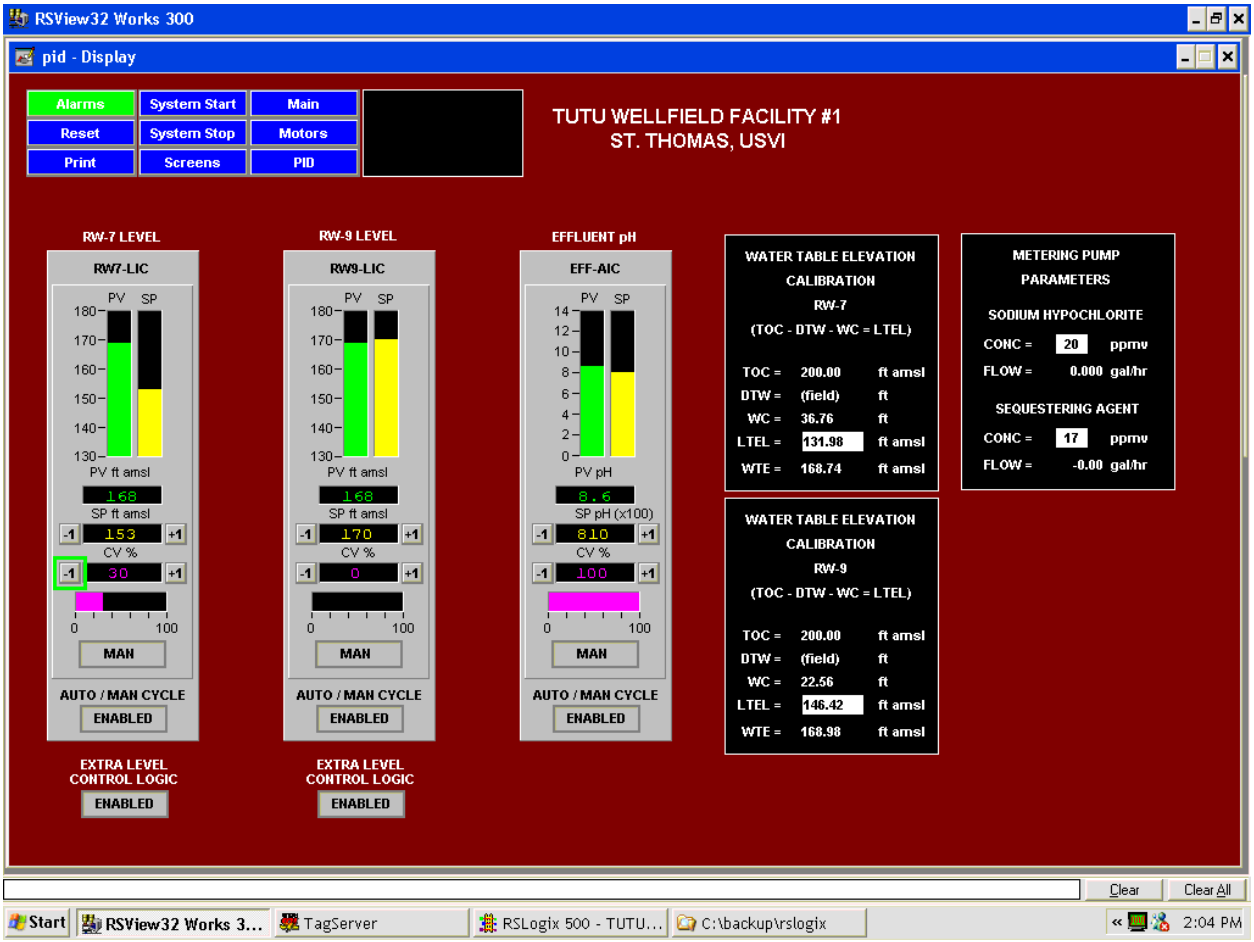
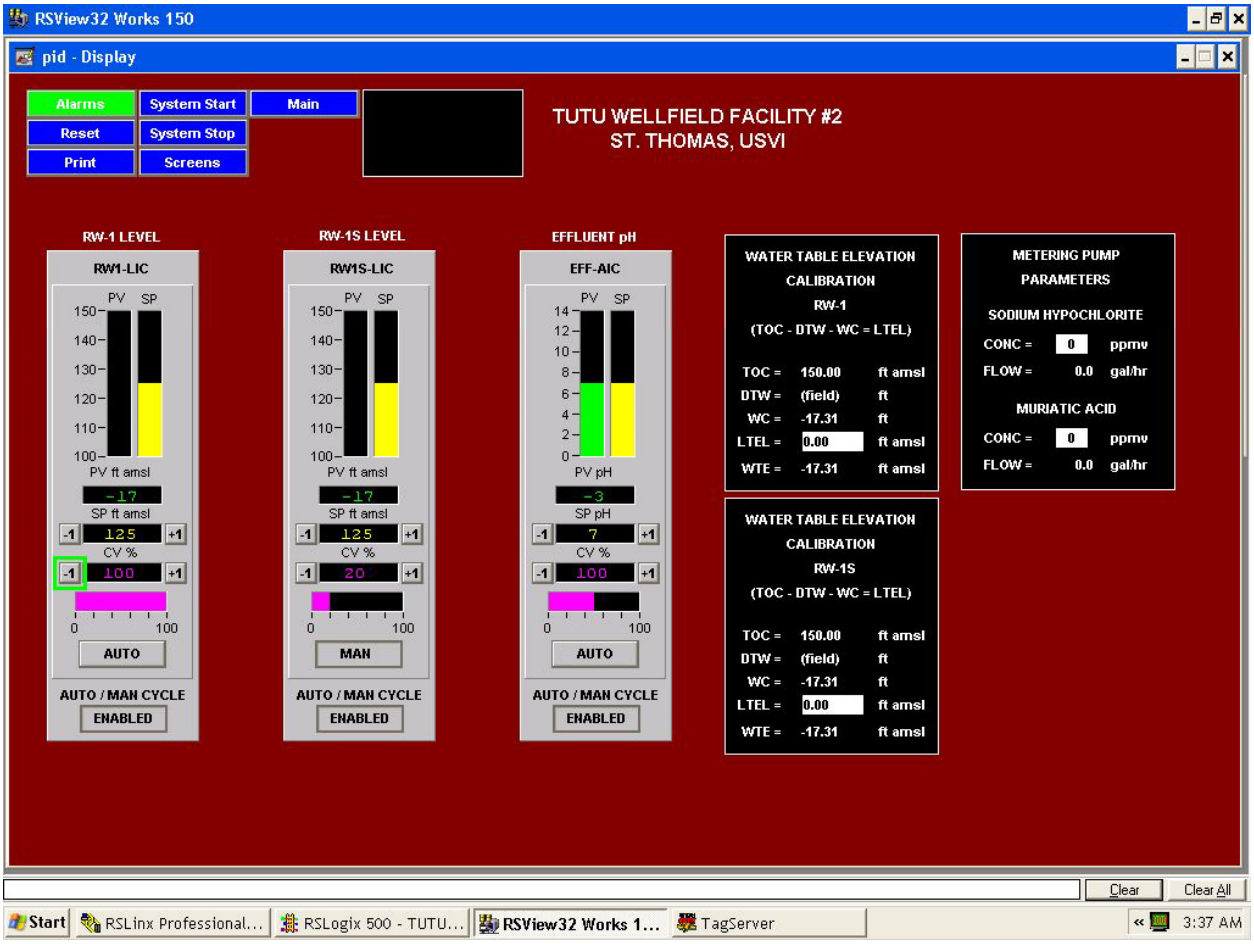


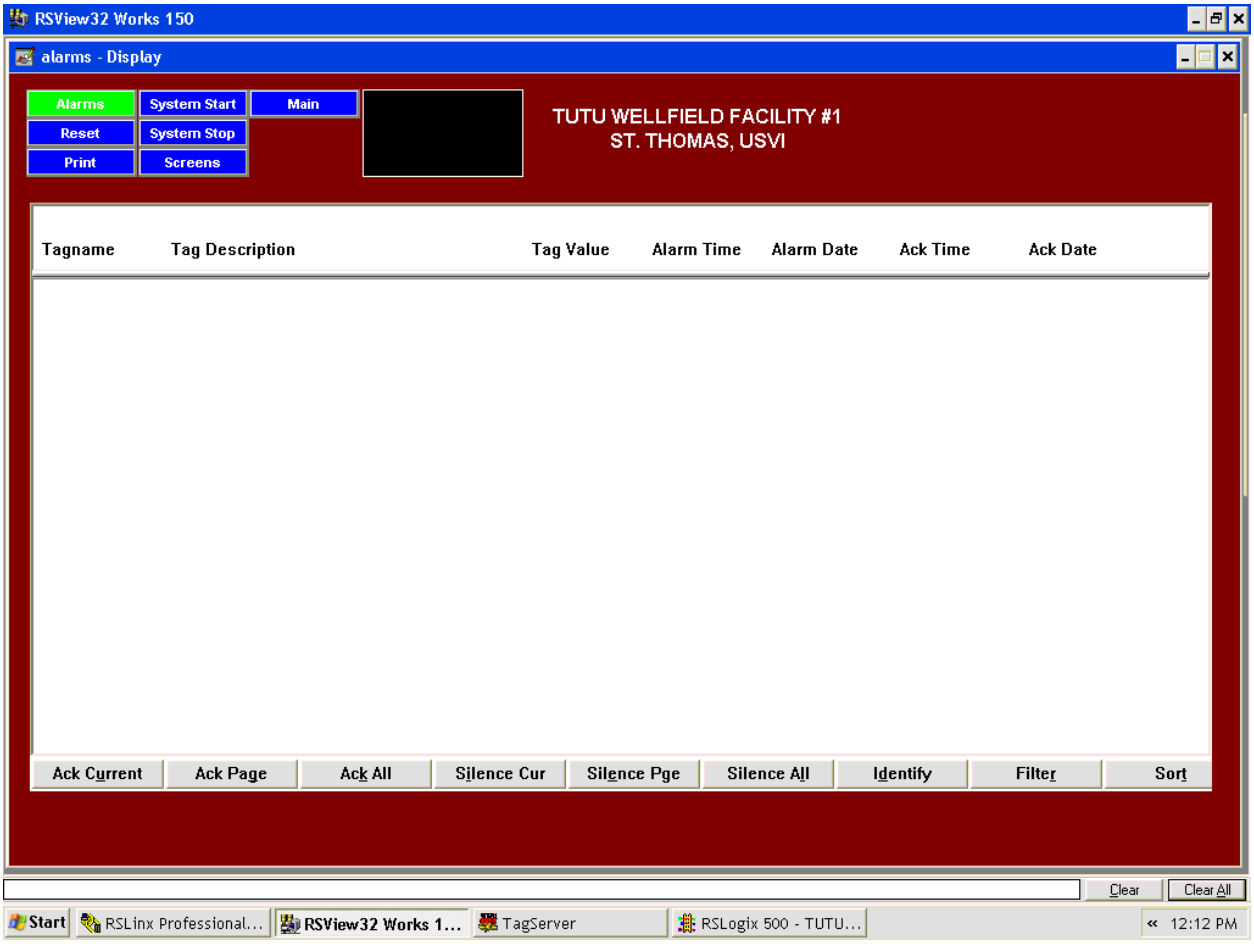
Figure 8 – PID Screen, GWTF #2



3.4.4 ALARMS Screen

The presence of an alarm condition is indicated on all HMI screens in the system when the ALARM button at the top of each screen is either flashing red or steady yellow. Flashing red ALARM buttons indicate new alarm conditions not yet acknowledged by the operator. Steady yellow ALARM buttons indicate existing alarm conditions not cleared or reset, but that have already been acknowledged by the operator. The normal state, i.e., no alarms, is indicated by green ALARM buttons, as shown in Figure 9 (representative of both GWTFs). Alarm conditions are identified and acknowledged by clicking the ALARM button on any screen that brings up the Alarm screen shown below. Alarms are acknowledged using one of the three acknowledge buttons provided at the bottom of the screen. Alarm conditions and other control interlocks are listed in Tables 3-1 and 3-2.

Figure 9 – ALARM Screen, GWTF #1



3.4.5 TREND Screens

A real-time trend screen, Figure 10, is configured for the combined influent and air stripper flow rates. Real-time flow rates from the most recent 2-hour period scroll across this screen from right to left. Real-time trend data is not cached when the HMI software (RSView32) is not running and therefore this trend will initially be empty of data when the program is started.

Historical trend screens have been configured for combined well influent and air stripper influent flow rates and recovery well water table elevations. These trend screens obtain data from the "pv" data log files and display 28 days of data over any given time period selected by the

Operator using the scroll backward and scroll forward buttons provided a the bottom of the screens. Figure 11 depicts the historical trend screen for GWTF #1.

Figure 10 – Real-Time TREND Screen, GWTF #1

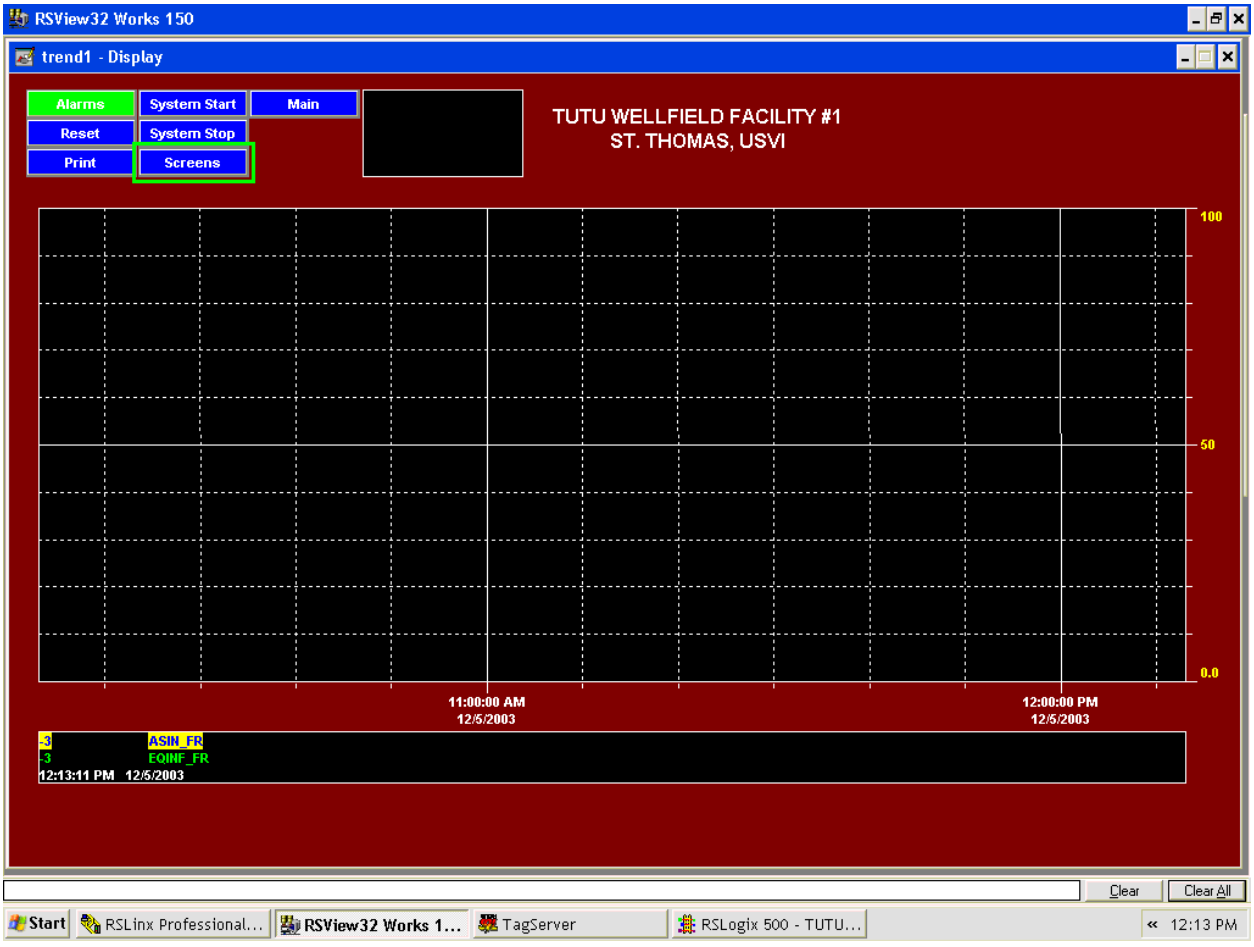
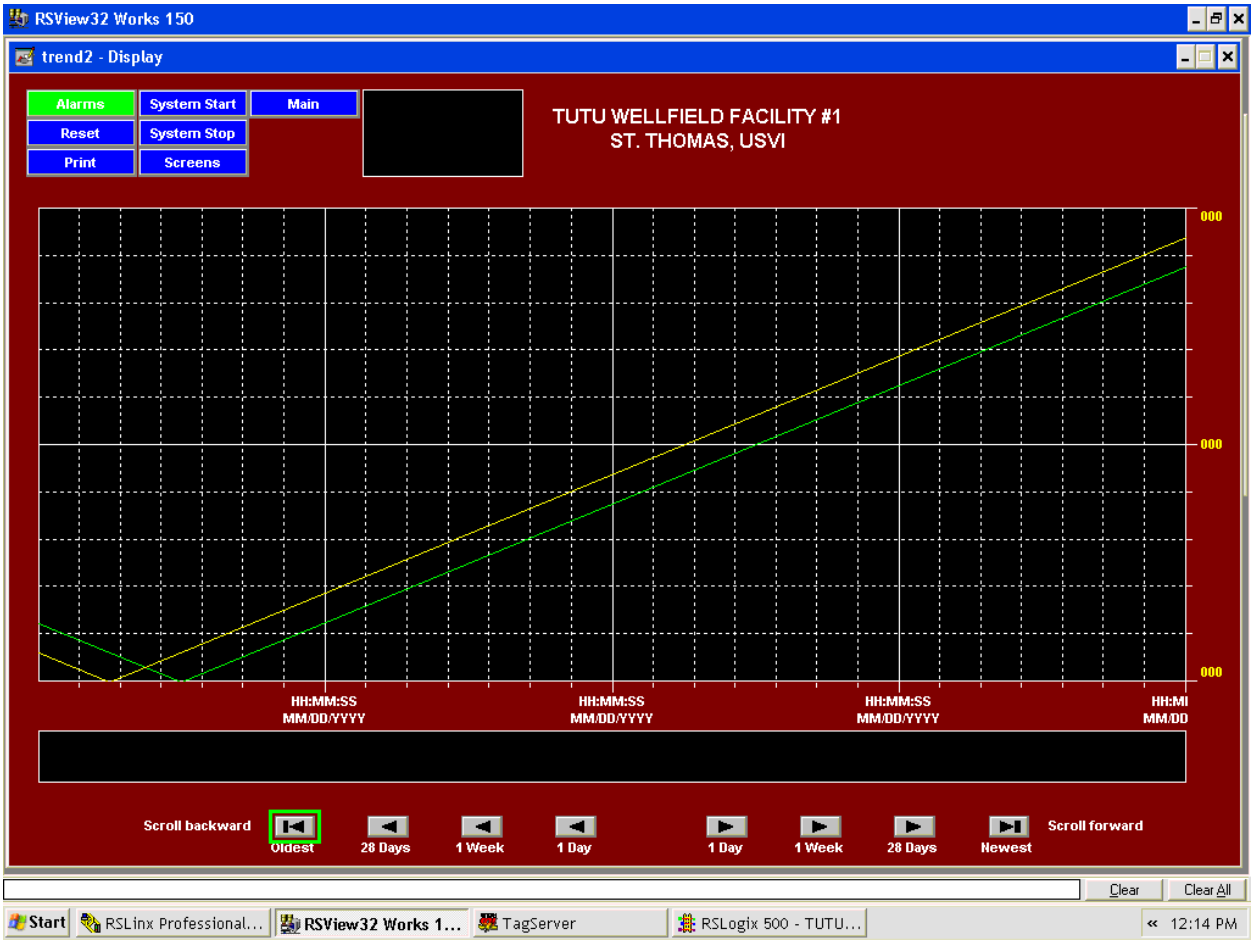


Figure 11 – Historical TREND Screen, GWTF #1



3.4.6 Data Logs

The HMI is configured to have two types of datalogs, i.e., one that contains analog process variables, or pv's, expressed in engineering units such as, psig, scfm, etc, and another that contains discrete status variables, or sv's, which indicate the on-off status of discrete inputs such as motors or switches. Process variables and status variables are created in the HMI by defining a "tag" and assigning a "tagname" to each source of data. Although defining tags and variables is not within the Operator's realm of responsibility, nor within the scope of this O&M Manual, the terms should be understood when examining data displayed or logged within the HMI. A complete listing of all tags defined in the HMI system is provided in Tables 3-3 and 3-4 for GWTF #1 and GWTF #2, respectively. These tables identify the type of tag (analog or discrete), tagname, tag description, whether it is included in the alarm log (discussed in the next section),

and whether it is included in the datalog. All analog tags are included in the "pv" datalog and all discrete tags (not included in the alarm log) are included in the "sv" datalog.

The pv datalog is an all-inclusive log that polls every process variable defined in the HMI once every 10 minutes. The sv datalog polls every status variable defined in the HMI whenever there is a change of status for any sv tag and at least once every 8 hours at a minimum regardless of status changes. All datalogs are generated in database format files, or *.DBF files.

Datalogs may be opened using Microsoft Excel® from the following folders on the C: drive of each OIT:

- c:\program files\rockwell software\rsview\tutu1\dlglog\pv1\
- c:\program files\rockwell software\rsview\tutu1\dlglog\sv1\
- c:\program files\rockwell software\rsview\tutu2\dlglog\pv2\
- c:\program files\rockwell software\rsview\tutu2\dlglog\sv2\

Operators and remote callers should first copy the target *.dbf datalog file to another folder or computer before opening the file in order to maintain the integrity of the original files located in the folders listed above. Each datalog file is based on a day of data beginning and ending at midnight. Datalog file names follow a date convention where, for example, "2003 12 01 0000 pv (Wide).DBF" would correspond to the pv file for December 1, 2003. There are actually two files created each day: One labeled "Wide" and the other labeled "Tagname." The data of interest to the Operator is always found in the files labeled "Wide." The other file is an index of tagnames of little or no use to the Operator or other users.

3.4.7 Alarm Logs

All system alarms in the HMI are displayed in the Alarm screen and copied to an alarm log that resembles the status variable log discussed previously. These log files are generated on a daily basis beginning at midnight using filenames corresponding to the file date exactly like the "sv" datalogs except having the filename suffix "al" instead of "sv", for example, 20031201AL.DBF corresponding to the alarm file generated on December 1, 2003. The database listing provided above indicates each of the tags that are configured as alarms under the column heading "Alarmed", where a "Y" next to a tag indicates that tag is so configured. The alarm log files may be found in the following folder:

- c:\program files\rockwell software\rsview\tutu1\almlog\
- c:\program files\rockwell software\rsview\tutu2\almlog\

3.5 Autodialer

A Phonetics Sensaphone 2000 alarm autodialer is installed in each control panel to notify remote personnel of conditions requiring attention prior to the next regularly scheduled site visit. Tables 3-1 and 3-2 provide a complete listing of alarm call-out conditions and associated autodialer channel numbers for GWTF #1 and GWTF #2, respectively. The autodialer is capable of calling voice lines, pagers and faxes. Email is an option but not currently configured. Voice calls include a pre-recorded message for the site location and each currently active alarm condition. Alarm call recipients are prompted to enter an acknowledgement code.

3.6 Remote Access

Remote access to each facility is accomplished via the internet using Symantec® pcAnywhere® software. Remote access procedures are discussed in pcAnywhere® help files. Setup depends on each remote caller's individual PC configuration but it can generally be described very simple. New callers must obtain a username and password from project management in order to gain access to the system, download data files and perform remote printing tasks. On-site access numbers are as follows:

GWTF #1

- Wireless modem static IP address – 166.136.143.26
- Autodialer – (340) 774-7297

GWTF #2

- Wireless modem static IP address –166.136.143.137
- Autodialer – (340) 774-7277

4.0 Initial Set-Up Procedures

This section provides procedures for the initial set-up and start-up of each piece of equipment following installation or a prolonged shutdown.

4.1 Control Panels

The control panel is powered from a 75 KVA 480VAC, 3-phase, 4-wire transformer. This transformer is powered from the 208VAC, 3-phase electrical service (WAPA) to each facility building. **WARNING** – Do not power the panel until this procedure is complete. Damage to the panel may result.

1. Switch the disconnect to the "OFF" position and open the inner door. Verify that the inner door disconnect is in the off position.
2. Switch on the main incoming power to the panel. (**CAUTION** - The disconnect now has power.)
3. Confirm that incoming power is 480 V on all three phases. If the incoming power has a "high leg" (a four wire delta system), measure the voltage from each leg to ground. It is critical that L1and L3 to ground be 120 volts. Power for the control panel is taken from either L1 or L3. If the high leg (usually L2, 208V) is wired in the L1 or L3 position, the panel may be damaged upon powering the system.
4. Record the following operating conditions on the initial set-up form provided in Appendix R:
   - L1 to ground
   - L2 to ground
   - L3 to ground
   - L1 to L2
   - L1 to L3
   - L2 to L3
5. Be sure that all circuit breakers are reset.
6. Close the inner door.
7. Turn the inner disconnect to the "ON" position. The panel should have power and the OIT should startup. Alarm lights may be lit on the OIT. If so, press the "RESET" button. If the alarms will not reset, refer to Section 5.2 for details.
8. Rotation needs to be verified on all 3-phase motors. To do so, place each motor in MAN mode from the OIT and bump by quickly clicking START then STOP. Rotation arrows are located most pieces of equipment. If rotation is backwards, swap two incoming power leads.

(**CAUTION** - Be sure to lock out and tag the main incoming power. Verify that the power is isolated using a multimeter/voltmeter.)

4.2 Bag Filters

1. Shut down the transfer pumps and remove any pressure that may be in the influent piping by opening the nearest sample port valve (refer to Drawings 2-14 through 2-18 for piping and valve nomenclature) to drain the piping. Then, close the sample port valve.
2. Select and install the correct size filter bag (50 micron to begin the project).
3. To install, open the lid and insert the filter bag into the metal filter basket. Make sure the filter bag is "seated" to the top of the basket and tightly close the lid.
4. Make sure all water connections are made and valves are open or closed as necessary.
5. Open the vent plug on lid to allow air to escape from housing.
6. When the housing body is full of water, close the vent.
7. Open the outlet connection and fully open the inlet connection. Housing is now operating properly.

4.3 Transfer Pumps – Currently Bypassed Unless RW-6 is Running

1. Ensure that the equalization tank has sufficient water and that all valves up stream on the pump are open. (Note: Valves up stream should never be used to throttle the pump. All valves located up stream of a pump are strictly isolation valves for servicing the pump.) Close all sample taps.
2. Turn on the air stripper.
3. Bump the pump to verify rotation as described in Section 4.1, Step #8. Rotation arrows are located on the pump to signify proper rotation. If rotation is backwards, have an electrician exchange two of the power leads as discussed in Section 4.1, Step #8.
4. Prime the pump by running with the discharge throttling valve (HV-INF-TP and HV2-INF-TP) mostly closed then adjust the valve for normal operation. (Note: Never exceed the design hydraulic capacity of the air strippers – 60 gpm at GWTF #1 and 30 gpm at GWTF #2.)
5. Test the prime. Run the pump for a few seconds to verify that water is flowing through the pump at a constant rate and pressure. If not, turn the pump off, loosen the pump housing plug, examine for air, and, if necessary, fill housing with water. Then, repeat Step #3.

6. Put the pump OIT control panel in the "MAN" position with sufficient water in the equalization tank and click START. Throttle the pump to the desired flow. Record the following operating conditions on the initial set-up form provided in Appendix R:
   - PUMP motor amp draw
   - PUMP pressure
   - PUMP flow rate
   - Deadhead pressure [pressure with pump isolation valve (HV-INF-TP and HV2-INF-TP) closed]

4.4 Air Strippers

1. Verify that all influent and effluent connections have been made, and open the air inlet valve (HV-VAP-AS) to ensure that there are no restrictions on the blower. Close all sample taps.
2. Verify that the panel is operational and installed is correctly (refer to Section 4.1).
3. For GWTF #1, turn on the heat exchanger after completing the initial setup procedure presented in Section 4.9 (**Heat Exchanger is no longer in use)**.
4. Bump the blower to verify rotation as described in Section 4.1, Step 8. Rotation arrows are located on the blower to signify proper rotation. If rotation is backwards, have an electrician exchange two of the power leads as discussed in Section 4.1, Step #8.
5. Once rotation has been confirmed to be correct, and the blower has completely stopped from Step #4, put the STAT blower OIT control panel in the "AUTO" position and click START to start the blower. Let the blower run with no load for a few minutes.
6. Introduce water into the system.
7. Adjust the air inlet valve (HV-VAP-AS) until the desired air flow rate is achieved.
8. Once the system has reached operating conditions, record the following applicable operating conditions on the initial set-up form provided in Appendix R:
   - STAT sump pressure
   - STAT motor amp draw
   - STAT back pressure, if there is off-gas treatment
   - Air flow rate
   - Water flow rate

4.5 Submersible Well Pumps

1. Verify that all pump effluent connections have been made, and open all valves downstream of the pump. Close all sample taps.
2. Review the Grundfos® CU300 Installation and Operation Instructions (refer to Appendix L) and set up each well pump for remote on-off control using the R100 hand-held remote

control unit. Set up RW-6 pump P-6 for dry run protection. Set up RW-7 pump P-7, RW-9 pump P-9, RW-1 pump P-1, and RW-1S pump P-1S for 4 – 20 mA external speed control.

3. From the OIT PID screen, set RW-7, RW-9, RW-1 and RW-1S level controllers to DISABLE AUTO cycling, and MAN control mode. Manually set the output from each level controller to 100%.
4. Ensure that there is sufficient excess capacity in the EQ tank for temporary storage of recovered groundwater during this initial setup procedure.
5. Close the EQ tank bypass valve (HV-INF-EQB).
6. From the OIT MOTORS screen, place each pump in MAN mode and bump the pump to verify proper operation by clicking START, allowing sufficient time for air to be driven from the empty discharge lines, then clicking STOP.
7. If no there is no flow, then the pump is either not submerged or not wired correctly. If necessary, re-examine the wiring connections versus manufacturer's installation instructions. Verify water level in each well. Do not run the pump for an extended length of time without water. The pump height should be reevaluated.
8. After verifying flow in MAN mode, put the pump control panel in the "AUTO" position. Throttle the P-6 to the desired flow. Set the level controller setpoint for the other pumps per the Routine Operating Parameters, Tables 5-1 and 5-2. Place each PID controller in ENABLE cycle control and AUTO level control mode. Record the following operating conditions on the initial set-up form provided in Appendix R:
   - PUMP motor amp draw
   - PUMP pressure
   - PUMP flow rate
   - Deadhead pressure [pressure with wellhead shutoff valve (HV-INF-RW6V, -RW7V, etc) closed]

4.6 SVE System (Facility #1)- Currently Offline

The SVE system was taken offline in April 2006.

4.7 Chemical Feed Systems

1. Verify that all influent and effluent connection have been made, and open all outlet, valves to ensure that there are no restrictions on the pump.
2. Prime the pump as discussed in the LMI Operations Manual (Appendix C) with the recycle tubing open to the storage tank. To prime the pump without enabling the entire system, place the chemical feed pump OIT control panel in MAN.

3. Once the pump has been primed, adjust the stroke speed and length to the recommended settings, and adjust the tubing valves from recycle to discharge. For the muriatic acid pumps, this should be done by first putting the pH controller in the PID screen in DISABLE AUTO cycle and MAN controller mode. Manually adjust the controller output to 100%, then adjust stroke speed and length.
4. With all other systems running, put the pump control panel in the AUTO position. Record the following operating conditions on the initial set-up form provided in Appendix R:
   - Speed setting
   - Stroke setting
   - Maximum rate flow (from tag on the pump body)

4.8 Off-Gas Treatment System (Facility #1) - Currently Offline

The off-gas treatment system was taken offline in April 2006.

4.9 Heat Exchanger (Facility #1) - Currently Offline

The heat exchanger is not currently operated.

4.10 Miscellaneous Equipment

1. Check the magnetic flow meters for the combined well influent and air stripper influent for proper operation after starting the well pumps and transfer pumps. Verify flow rates based on change in water level in the EQ tanks.
2. Calibrate the effluent pH transmitters per manufacturer's instructions.
3. Calibrate the water table elevation calculations for RW-7, RW-9, and RW-1S using the PID screens for each facility. With the recovery well pumps turned off and the water column readings fairly stable, obtain a depth to water reading from each well. Using the current water column reading obtained from the PID screens, perform the following calculation: TOC-DTW-WC = LTEL (where each of these acronyms are defined in the PID screen) and enter the resulting new value for LTEL for each well. The re-calibrated water table elevation calculations will begin instantly in the PLC, as displayed on the PID screens.
4. Verify proper operation and make adjustments as necessary for the air stripper influent bag filters by throttling the filter discharge valves (HV2-INF-BF1 and HV2-INF-BF2) and reading the upstream and downstream pressure gauges.

5.0 Systems Operating Procedures

This section presents the procedures for operating each GWTF once the equipment is installed and initial set-up (refer to Section 4.0) is completed. In the event the system is shutdown for a period of months or years, the procedures presented in Section 4.0 should be repeated. Both systems currently operate with bypass of the EQ tank and transfer pumps.

5.1 Preliminary Checks Prior to System Start-Up

A series of checks must be performed prior to starting up the system following a prolonged shutdown, a maintenance/repair event, a valve adjustment, or other change in system conditions. Preliminary, visual checks shall include the following items:

- Check to be sure that each extraction well shutoff valve (HV-INF-RW6V, -RW7V, etc) inside the wellhead vault is in the normal, open position.
- Check the groundwater line Y-strainers, and clean as necessary.
- Check to be sure that the groundwater influent line isolation valves (HV-INF-RW6, HV2-INF-RW6, HV-INF-RW7, HV2-INF-RW7, etc) are open.
- Check to be sure that the treated water discharge valve is open.
- Check the bag filters and replace as necessary.
- Check to be sure that the EQ tank bypass valve (HV-INF-EQB) is closed, unless bypass mode is desired (refer to Section 5.5)
- Check to be sure that the transfer pumps isolation valves (HV-INF-TP and HV2-INF-TP) are closed, unless no bypass mode is desired (refer to Section 5.5).
- Check the chemical levels in each drum. Batch and refill as necessary.
- Check the chemical feed pumps for prime. If necessary, prime the pump(s) in accordance with LMI instructions (Appendix C).

5.2 Full Automatic Start-Up and Operation

The start-up procedure described here begins only after all mechanical and electrical start-up procedures are completed in accordance with Section 4.0. Assuming that electrical power has been successfully applied to the building, control panel and all process motors, including checking for correct rotation on all 3-phase motors, the on-site operator should examine any alarm conditions indicated on any OIT screen by a flashing red or steady yellow condition of the ALARM button in the top right hand corner. If this button is not steady green, the operator

should click on the ALARM button to access a description of the alarm condition, acknowledge the alarm with the ACKNOWLEDGE button at the bottom of the ALARM screen, and investigate. As indicated in Tables 3-1 and 3-2, some alarm conditions will prevent the system from running and must therefore be corrected prior to start-up. Take all appropriate corrective measures to resolve any alarm condition before proceeding with start-up. Refer to the troubleshooting section (Section 8.0) for more information on resolving alarm conditions. Once the condition causing an alarm is resolved, the operator must click RESET to clear any latched conditions that may prevent start-up.

Prior to startup, the operator must examine the setpoints and outputs for all PID controllers and decide whether to make changes or leave them as is. Setpoints only change as a result of operator intervention to adjust a setpoint in the manner described earlier by clicking on the increment or decrement buttons on each controller. Unless a change in operational parameters is warranted, these values would remain set regardless of whether the system has recently been down or running. The PID outputs change automatically and therefore should be examined to make sure that system startup proceeds smoothly and as expected. The PID controllers are programmed to maintain their last output prior to the point at which the corresponding process equipment was turned off or shutdown automatically. But system conditions may have changed significantly since the last time a piece of equipment ran under PID control and therefore a significant change in controller output may be required prior to startup, or the PID controller may need to be operated in MAN(ual) mode for a short period of time during and after startup to assure a smooth transition to steady-state operation.

The system is configured for two modes of start-up, i.e., automatic and manual start-up. Automatic start-up is initiated by clicking the System START button on any OIT screen, or by pressing the START pushbutton on the front of the control panel. The control system automatically starts all motors and controllers in AUTO modes in sequential order, as described in Section 3.2. Manual startup involves sequentially starting each motor by selecting it from either the MAIN scr\een or MOTORS screen in the OIT. In a manual startup the Operator must be careful to select AUTO mode for each motor and PID controller.

Each motor in the system can be placed in service or out of service with a button provided in its control panel. When a motor is taken out of service it will not be started automatically with the

rest of the system by clicking the System START button. Any motor taken out of service is so indicated on its control panel, the MAIN screen, and the MOTORS screen.

Full automatic startup starts all motors and processes in the system, as follows:

1. Power up the control panel and OIT from the 60 amp circuit breaker in Panel P-1. The RSView32® HMI software will start automatically and display the MAIN screen.
2. Switch to the MOTORS screen and select *all motors* for service using the service button in each motor control panel.
3. Switch to the PID screen and examine the setpoints and outputs for all PID controllers. In particular, make sure the effluent pH controller output is not at 100%. A good place to start for the pH controller output and the dosage rates would be the last values of each controller prior to the previous system shutdown, as displayed on the historical Trend screens. To change any controller output, first, disable the AUTO cycling feature of the controller, then place the controller in MAN mode and manually adjust the controller output using the increment and decrement buttons. Place all controllers back into AUTO mode and enable AUTO cycling. Examine the dosage rate (ppmv) for sequestering agent. Adjust chemical feed rate manually at metering pump.
4. Check the Grundfos® CU300 controller for each recovery well submersible pump to make sure it is set for remote speed and on-off control. (Follow manufacturer's instructions provided in Appendix L.)
5. Click the System START button at the top of any screen. Startup will take a few seconds during which time the message box at the top of the screen will indicate that the system is starting. All motors and processes will be started.
6. Confirm that all motors and processes have started and observe operations for at least 30 minutes to see if any alarms occur. Any alarm condition will require acknowledgement and RESET through the OIT (or the RESET pushbutton on the control panel). If necessary, see the Troubleshooting Guidelines in Section 8.0 for further discussion on resolving alarm conditions.
7. When EQ tank is used such as when operating RW-6, adjust the transfer pump discharge valves (HV2-INF-TP1 and HV2-INF-TP2) to ensure that the well pumps do not cycle, yet maximize the time it takes to drain the EQ tanks. In other words, the transfer pumping rate should be set slightly higher than the combined well influent rate when all pumps are running.

5.3 Automatic Startup and Operation of Select Equipment

Some motors or processes may not be functioning or may not be part of the desired operational plan. In these instances, follow the procedure below.

1. Power up the control panel and OIT from the 60 amp circuit breaker in Panel P-1. The RSView32® HMI software will start automatically and display the MAIN screen.
2. Switch to the MOTORS screen and select *only the motors required* for service using the service button in each motor control panel.
3. Switch to the PID screen and examine the setpoints and outputs for all PID controllers. In particular, make sure the effluent pH controller output is not at 100%. A good place to start for the pH controller output and the dosage rates would be the last values of each controller prior to the previous system shutdown, as displayed on the historical Trend screens. To change any controller output, first, disable the AUTO cycling feature of the controller, then place the controller in MAN mode and manually adjust the controller output using the increment and decrement buttons. Place all controllers back into AUTO mode and enable AUTO cycling. Examine the dosage rate (ppmv) for sequestering agent. Enter the desired dosage rates at each numeric input using the OIT keyboard.
4. Check the Grundfos® CU300 controller for each recovery well submersible pump to make sure it is set for remote speed and on-off control. (Follow manufacturer's instructions provided in Appendix L.)
5. Click the System START button at the top of any screen. Startup will take a few seconds during which time the message box at the top of the screen will indicate that the system is starting. Only the selected motors and processes will be started. PID controllers associated with motors taken out of service will remain in MAN mode but the outputs will have no effect on any processes.
6. Confirm that selected motors and processes have started and observe operations for at least 30 minutes to see if any alarms occur. Any alarm condition will require acknowledgement and RESET through the OIT (or the RESET pushbutton on the control panel). If necessary, see the Troubleshooting Guidelines in Section 8.0 for further discussion on resolving alarm conditions.
7. When EQ tank is used such as when operating RW-6, adjust the transfer pump discharge throttling valves (HV2-INF-TP1 and HV2-INF-TP2) to ensure that the well pumps do not cycle, yet maximize the time it takes to drain the EQ tanks. In other words, the transfer

pumping rate should be set slightly higher than the combined well influent rate when all pumps are running.

5.4 Manual Speed Control for Submersible Well Pumps

The recovery well PID level controllers may be placed in MAN(ual) mode to control the submersible well pump motor speed and flow rate directly, as follows:

1. From the PID screen or PID controller pop-up window on the MAIN screen, disable AUTO cycling and place the controller in MAN(ual) mode.
2. Adjust the controller output using the increment and decrement buttons on either side of the CV numeric display. The speed of the pump motor may be adjusted from 0 to 100% of range which corresponds to the full range of the Grundfos® CU300 controller for each pump.
3. Check the flow rates manually by reading the totalizing flow meter for each recovery well installed in the influent piping header system. These are located at GWTF #1 on the wall of the equalization tank secondary containment structure and at GWTF #2 on an exterior wall of the building.
4. With the PID controllers in MAN(ual) mode, the recovery well water table elevation control is no longer tied to the setpoint for water table elevation. Instead, the water level in the wells will be controlled between discrete high and low elevations programmed from the level transmitter signal for each well. ***Note that in order for these high and low level elevations to control (cycle) the recovery well pumps, the motors must be in AUTO mode as set through each motor control panel or the MOTORS screen***. The high and low level elevation settings are indicated in the Routine Operating Parameters (Tables 5-1 and 5-2) for each facility.

5.5 Operation with Equalization Tank Bypass

Both facilities currently operate with bypass of the EQ tank. If desired, this may be implemented as follows:

1. From the MOTORS screen, turn off all recovery well pumps and allow the rest of the groundwater treatment system to run until the EQ tank is drained to the low level shut off for the transfer pumps.
2. Manually drain any water or sludge remaining in the bottom of the equalization tank and drum for off-site disposal.

3. Open the EQ tank manual bypass valves (HV-INF-EQB) and close the transfer pump isolation valves (HV-INF-TP and HV2-INF-TP).
4. From the MOTORS screen, take the transfer pumps out of service by toggling the SERVICE button in each motor control panel.
5. Disconnect power to each transfer pump at the disconnect switches provided inside the equipment room at each facility.
6. From the MOTORS screen, select BYPASS mode and turn on all recovery well pumps desired for operation. The control system will now function as before except the transfer pumps and EQ tank will not be utilized.

5.6 Routine Operations

The groundwater recovery and treatment systems are designed for unattended operation in AUTO mode. All automated process control interlocks (refer to Tables 3-1 and 3-2) will be applied in AUTO mode and safety interlocks will cause system shutdown in the event such alarm conditions occur. During routine operations, on-site and off-site operators can adjust recovery well water table elevations, sequestering agent dosage rates, and effluent pH setpoint without shutting the system down. The expected (normal) values and upper and lower limits for the routine operating parameters associated with each system are provided in Tables 5-1 and 5-2.

Various modes of operation are possible with the groundwater recovery and treatment system, but the initial control strategy is to maintain water table elevations in recovery wells RW-1S, RW-7 the desired setpoints in terms of feet above mean sea level (amsl). RW-9 is only operated as required to enhance drawdown at RW-7 during period of high groundwater levels. If well yields are sufficient, these pumps will run continuously in the absence of any other process upsets downstream. Water table elevation calculations should be checked periodically as a part of routine operations to ensure accurate water level sensing and the correct calculation of water table elevations. PID control and low well water shutdown interlocks depend on the accuracy of these process values. The procedure for checking and perhaps making adjustments to this calculation is herein referred to as a “calibration”. Calibration involves taking a manual depth-to-water reading in the recovery well, observing the water column value displayed in the PID screen, and calculating a new level transmitter elevation according to the formula provided on the screen. The new level transmitter elevation thus calculated is entered into the PLC data table through the numeric input provided in the PID screen. The recovery well pumps may need to be shut down temporarily in order to obtain steady depth-to-water or water column readings.

The sequestering agent dosage rates are selected by the operator based on experience with the treatment system and rate of accumulation of scale and bio-fouling in the air stripper pre-filters and air stripper trays. The initial settings anticipated prior to system installation were 125 ppmv for sequestering agent. Adjustments to the dosage rates are made manually at the metering pump.

5.7 Operator Shutdown

The systems can be shut down by the operator either automatically or manually. Automatic shutdown occurs when the operator clicks System STOP from any of the OIT screens or by pressing the STOP pushbutton on the front of the control panel. Alternatively, the Operator may choose to shut down any or all system components by selecting each from either the MAIN or MOTORS screens. Refer to the control logic section (Section 3.2) for further information on interlocks and the effect of shutting down individual motors. All motors and processes stop according to a pre-programmed sequence wherein everything stops immediately except the air stripper and heat exchanger continue to run for 5 minutes to treat any water remaining on the air stripper trays. In automatic shutdown the air stripper blower remains running for 5 minutes following the shutdown of all other liquid pumps in the system in order to treat any water remaining on the air stripper trays.

5.8 Automatic Shutdown on Alarm Condition

Automatic shutdown will occur in accordance with the interlocks listed in Table 3-1 and Table 3-2 for GWTF #1 and GWTF #2, respectively. Select recipients will be called according to the alarm callout list. Automatic shutdown conditions will cause an alarm interlock which must be investigated and reset prior to re-starting the system using the RESET button on any OIT screen or the RESET pushbutton on the front of the control panel.

Tables 3-1 and 3-2 list the alarm conditions that cause system shutdowns. The process is automatic and no intervention is required by the operator to initiate this type of shutdown. Alarm conditions must be acknowledged and RESET using the RESET button on any screen or the RESET pushbutton on the front of the control panel. Refer to the Troubleshooting Guidelines for specific details on resolving alarm conditions.

5.9 Emergency Shutdown

An emergency shutdown is initiated by pressing the E-STOP button on the front of the control panel. This de-energizes all I/O circuits and power supplies instantly and independently of the PLC and OIT. This would rarely be used except in emergency situations involving, e.g., fire, spills, motor bearing failures or any situation where the operator determines it is necessary to prevent a potential problem. The E-STOP is reset by twisting and pulling out on the E-STOP pushbutton.

6.0 Maintenance Procedures

Each GWTF is comprised of a number of commercially available equipment, instrumentation, and appurtenances. This section presents general procedures for preventative maintenance, repair, and replacement. The information in this section supplements the manufacturer O&M literature contained in Appendices A through M.

6.1 Preventative Maintenance and Lubrication Schedules

The components of the treatment plant require regular maintenance. Each major component has a preventative maintenance program established by the component manufacturer. Tables 6-1 and 6-2 are provided as a general guide for preventative maintenance. The recommended maintenance intervals are based upon past experience with the equipment and equipment manufacturer recommendations. Records of maintenance for each component should be maintained as discussed in Section 11.2. A maintenance log sheet is provided in Appendix R. For additional preventative maintenance and lubrication details, refer to the manufacturer specific O&M manuals in Appendices A through M.

6.2 Replacement of Consumable Items

Consumable items should be replaced at regular intervals and/or when field measurements suggest that replacement is necessary.

6.2.1 Bag Filters

When used, the Bag Filter should be changed whenever the pressure drop across the filter increases 12 psi higher than the pressure drop for new/clean filters. The following general procedure should be followed:

1. When the differential pressure across the housing reaches approximately 12 psi, the filter bag(s), need to be replaced. (Note: It may take days or weeks for the differential pressure to reach 12 psi, but the differential pressure will rise very quickly when it approaches 12 psi.)
2. Relieve pressure through the sample tap on lid and drain using the valve (HV-D-BF1 and HV-D-BF2) near the bottom of housing.
3. Loosen eye nuts on housing, and swing the lid to gain full access to the inside of the housing.
4. Pull the filter out of the basket and discard the filter in accordance with the EPP.
5. Remove filter baskets and clean thoroughly.

6. Debris and sludge should be removed from the housing, to prolong filter efficiency.
7. Install filter basket and new filter bag in housing and follow the start up procedure (refer to Section 4.2).

6.2.2 Chemical Additives

The scale inhibitor (sequesterant) and muriatic (hydrochloric) acid solutions are batched in respective 50-gallon HPDE tanks (drums). On a weekly basis, the tanks must be checked and refilled or replaced as necessary. Currently, sequesterant is being batched at 9 gallons of Caltrol 100 to 41 gallons of water (equivalent to a 20% solution). Muriatic acid is being batched at 16 gallons of muriatic acid (31.45% HCl) to 34 gallons of water. This ratio, based on experience, is optimal for achieving pH control at both sites. Refer to Appendix O for MSDSs for each product. Since muriatic acid is a solution of hydrochloric acid gas, beware of toxic or irritating gaseous emissions.

6.2.3 Off-Gas Treatment Media – Currently Offline

The off-gas system was taken offline in April 2006.

6.3 Extraction Well Maintenance

At least once per year, each extraction well pump should be pulled and inspected for bacterial accumulation ("slime"). Flow rates from each well should be monitored closely. If, for example, the flow rate from a well declines, even though the valve positioning has not changed, then the specific capacity of the well has changed, the pump is not functioning properly, or the in-line Y-strainer is plugged. The Y-strainer should be checked on a regular basis and cleaned as necessary.

The groundwater extraction wells may be subject to bacterial activity that causes biofouling. As a preventative measure, shock chlorination should be performed whenever the treatment plant is shutdown for maintenance or during other prolonged shutdown periods. It is recommended that approximately ½ gallon of chlorine bleach be poured into each well and allowed to set for around 12 hours. Shock chlorination may only be performed after all groundwater sampling activities are completed.

6.4 Shutdown for Maintenance, Repair, or Replacement

The following general procedures should be followed in the event a piece of equipment must be shutdown for prolonged maintenance, repair, or replacement. **CAUTION** – When disabling any motor or piece of equipment, be certain that all source of power and fluid have been locked out and tagged.

6.4.1 Bag Filters

1. Disable all source of water up stream of the bag filters.
2. Drain the filter housing.

6.4.2 Transfer Pumps

1. Disable pump.
2. Drain pump head and all inlet and effluent lines.

6.4.3 Air Strippers

1. Be sure that all sources of water are disabled.
2. Let system blower continue to run for 10 minutes.
3. Disable blower.
4. Remove all remaining water in the sump.

6.4.4 Submersible Well Pumps

1. Disable pump.
2. Drain all water from pump effluent line.

6.4.5 SVE System – Currently Offline

The SVE system is offline.

6.4.6 Chemical Feed Systems

1. Disable power to the pump.
2. Drain pump head and all inlet and effluent lines.

6.4.7 Off-Gas Treatment System – Currently Offline

The off-gas system is offline.

6.4.8 Heat Exchanger – Not Used

The heat exchanger is currently not operated.

6.5 Spare Parts List

Table 6-3 provides a list of spare parts and identification numbers for the primary pieces of equipment in each system.

7.0 Inspection and Monitoring Procedures

This section discusses the general inspection and monitoring procedures required to:

- Ensure safe operation of the treatment plant
- Identify signs that maintenance is necessary
- Promote conformance of operation with relevant regulations and permit requirements
- Reduce unplanned shutdowns of the plant
- Prevent accidental discharges of untreated groundwater and chemicals
- Prolong the service life of plant components
- Enhance treatment performance

In addition to routine preventative maintenance (refer to Section 6.0), all components of the treatment plant will require regular inspection and monitoring during long-term O&M. A general schedule for routine inspection, monitoring, and maintenance is presented in Table 7-1. (Table 7-1 supplements Table 6-1 with respect to preventative maintenance requirements.) The inspection, monitoring, and maintenance frequencies presented in Table 7-1 are based on operating experience and manufacturer recommendations.

7.1 Extraction Wells and Pumps

The groundwater extraction wells and submersible pumps must be regularly monitored to evaluate the performance of groundwater extraction system. The following parameters should be monitored and recorded:

- Position of the shutoff valve at each wellhead
- Wellhead/pump pressure readings
- Pump totalized flow and flow rate

A groundwater extraction well monitoring log is included in Appendix R. Operators should regularly inspect all equipment associated with the wells and perform maintenance as needed, as discussed in Section 6.4.

7.2 Conveyance Piping

A thorough inspection of visible portions of the conveyance system should be performed at least monthly. The primary issues of concern for the conveyance system are leakage, deterioration of

the pipelines, and clogging of the pipelines due to scaling, biofouling, or other physical obstructions. The following items should be addressed:

- Piping must not be allowed to release fluids. Any evidence of leakage outside a containment features must be reported to DPNR immediately. Leaking pipes must be shutdown, isolated, repaired, and pressure tested as soon as possible.
- Low-point sumps should be inspected on a regular basis and emptied as necessary.
- All valves and appurtenances should be inspected and maintained as recommended by the manufacturer.

7.3 Treatment Plants

The treatment plant operating and process parameters must be monitored on a daily basis (during visits to each GWTF). Routine inspection and monitoring activities shall include:

- Checking the OIT for alarm conditions
- Recording relevant operating parameters, including:
  - Extraction well water level
  - Extraction well pump flow rate, pressure, and totalized flow
  - Air stripper influent flow rate and totalized flow
  - Transfer pump(s) discharge pressure and flow rate, when used
  - Bag filter differential pressure
  - Air stripper blower flow rate
  - Air stripper blower vacuum, discharge pressure, and temperature
  - Chemical injection rates
  - Treated water effluent pH
  - Other routine operating parameters (refer to Tables 5-1 and 5-2)
- Checking the position of isolation and throttling valves (refer to Drawings 2-14 through 2-18 for piping and valve nomenclature)
- Adjusting operations, as necessary
- Performing scheduled routine maintenance (refer to Tables 6-1 and 7-1), as necessary

The expected (normal) values for the primary operating parameters are presented in Tables 5-1 and 5-2. Operating parameter values shall be recorded manually using the log sheets/forms provided in Appendix R or printed in a hardcopy report format using the datalogging function of the OIT (refer to Section 3.4.6). All other plant information and operating data should be kept in a field logbook.

8.0 Troubleshooting Guidelines

The general troubleshooting guidelines for each primary piece of equipment are presented in Tables 8-1 and 8-2. Further details are provided in the manufacturer-specific O&M literature contained in Appendices A through M.

In general, any time the system will not run, and there is not an alarm condition present, verify the following:

1. The control panel and OIT are powered. (The OIT is configured to come on automatically each time its power is restored.) Check voltages on L1, L2 & L3 entering the control panel for 480VAC between each.
2. All circuit breakers are reset. Open the inner door and reset any circuit breakers that may have been tripped. Inspect the system for abnormal conditions.
3. On the control panel terminal strip, verify that positions 121, 121A and 201 all have 120VAC.
4. Verify that all motor temperature switches are wired. Some motors have internal temperature switches that do not require external connection. If a motor has internal temperature switches, the provided space in the panel for external temperature switches must be wired to close the circuit.

9.0 Sampling and Monitoring Activities

This section provides a brief summary of the sampling and field measurements requirements for long-term O&M. For details, the reader is referred to the site-specific QAPP (CDM Smith, 2009). These documents cover, among other things, data quality objectives, field sampling procedures, analytical methods, field and laboratory QA/QC, and sample documentation protocols.

Environmental sampling, monitoring, and field measurement data will be collected as part of the following long-term O&M programs:

- Performance and compliance monitoring
- Sitewide groundwater monitoring

Tables 2-9 and 2-10 from this document present the schedule for each of these programs, including the types of environmental samples and field measurements that will be collected, collection frequencies, and the sample and measurement locations.

Performance and Compliance Monitoring

- Groundwater influent samples from each extraction well
- Treated water effluent samples
- Air emissions samples from the stack at GWTF #1
- Readings from each system's instrumentation, meters, and gauges

Sitewide Groundwater Monitoring

- Groundwater monitoring well samples and field measurements
- Groundwater level measurements (synoptic and continuous)

10.0 Health and Safety Guidelines

The O&M subcontractor is responsible for preparing and implementing a SSHP in accordance with all applicable reference standards. This section of the O&M Manual is not intended to duplicate information to be contained in the SSHP. Rather, this section highlights the most significant health and safety issues specific to O&M.

10.1 Physical and Chemical Hazards

During O&M, operators will be exposed to the following physical and chemicals hazards:

- **Heavy Equipment** – Operators must be aware of the potential physical hazards associated with use of heavy equipment (fork lifts, vacuum trucks, cranes, and other vehicles) and electrical equipment (electrical panels, electric motors, electrical controls, and energized wires) during the operation and maintenance of each treatment plant.
- **Slip/Trip/Fall** – Significant slip/trip/fall hazards exist within the treatment plant, including piping, vaults, equipment skids, and secondary containment berms.
- **Chemical Vapors** – Volatile organic vapors may be released from process equipment and piping due to leaks. These vapors could potentially accumulate within the process building at unsafe levels.
- **Chemical Additives** – The chemical additives used in the process include muriatic acid, and anti-scalant. These chemicals will be stored in drums located inside the process room. The material safety data sheets (MSDS) for each chemical are provided in Appendix O. Since muriatic acid is a solution of hydrochloric acid, operators must beware of toxic or irritating gaseous emissions.
- **Hazardous Energy** – The unexpected startup of equipment is a serious hazard during maintenance and repair events. Lockout/tagout procedures must be implemented (consistent with the specific piece of equipment) to ensure that power and other sources of energy are de-energized or isolated.
- **Noise** – It is likely that noise (decibel) levels inside the process room will exceed OSHA permissible exposure limits.

10.2 Control Measures and Precautions

Appropriate O&M control measures include, but are not limited to, the following:

- Wearing hard-hats, safety glasses, and steel-toed boots
- Wearing gloves when handling heavy equipment
- Using hearing protection when noise levels exceed OSHA limits, particularly when working near running blowers
- Properly grounding electrical equipment
- Using lock out/tag out practices when electrically powered equipment must be taken out of service for maintenance
- Wearing protective equipment when handling acid
- Providing adequate ventilation by opening doors, louvers, and operating the exhaust fan, as appropriate
- Having first aid kit(s), eye wash stations, and fire extinguishers available at each facility
- Marking slip/trip/fall hazards with signs, paint schemes, or physical barriers, as appropriate.

Additional, system-specific safety precautions are listed here for reference:

- Never enter an equipment vessel without adequate ventilation, proper atmospheric testing and safety equipment. An equipment vessel is considered a confined space and therefore OSHA confined space entry safety procedures must be followed (29 CFR 1910.146).
- Safety goggles, chemical-resistant gloves, and a chemical-resistant apron must be worn when filling or replacing chemical tanks.
- Concentrated muriatic acid and sodium hypochlorite must NEVER be mixed.
- Once locks have been applied to a piece of equipment being serviced, the operator must attempt to start the equipment (i.e. by engaging the disconnect switch). In addition, the operator must test the power feed to the equipment using a multimeter/voltmeter. These steps are intended to ensure that the power has been properly de-energized or isolated.

11.0 Recordkeeping and Reporting

This section discusses the general recordkeeping and reporting requirements for operations and maintenance. Applicable forms and logs are provided in Appendix R, including:

- System runtime and shutdown
- Groundwater influent monitoring
- GWTF systems monitoring
- Monthly water levels
- Groundwater extraction well monitoring
- Chemical usage
- Maintenance activities
- Equipment initial start-up and testing

11.1 Operations Records

Routine operating parameters should be recorded on a monthly basis and recorded on the treatment plant monitoring log provided in Appendix R. Operators shall record the date, time, and value for each parameter obtained from one of the following sources:

- Manual readings from instruments, meters, and gauges
- OIT MAIN screen
- OIT real-time trend screens

Off-site record keeping will include at least monthly data file transfers of all “pv”, “sv” and “alarm” logs stored on the hard drive at the locations described in Sections 3.4.6 & 3.4.7.

Each groundwater extraction well shall be monitored on a weekly basis to verify the position of the wellhead shutoff valve, wellhead pressure, and water flow rate.

Chemical usage information shall be recorded each time the feed tank/drum is filled or replaced.

11.2 Maintenance Records

A record of maintenance and lubrication for each component should also be maintained. A file should be maintained for each component requiring or receiving maintenance or repair. The maintenance log sheet contained in Appendix R should be used to record the date, component serviced, nature of service (lubrication, cleaning, filter replacement, condensate removal, etc.),

and all additional related comments. A log of system shutdowns (refer to Appendix R) should also be maintained, including the date of the shutdown, the type of shutdown (planned or unplanned), root cause, and corrective actions, as applicable.

11.3 Monthly Operations Summary Report

The O&M Subcontractor shall prepare a monthly report summarizing the O&M data and systems monitoring information collected during the calendar month, including, but not limited to, the following items:

- Percentage of system uptime and hours of operation
- Measured values for all standard operating parameters
- Description of adjustments performed
- Analytical results for groundwater, treated water, and vapor samples
- Results of all field measurements (i.e. water levels)
- Summary of maintenance performed
- Description of any shutdown events
- Operational problems and remedies
- Utility usage and costs
- Chemical consumption
- Labor requirements
- Health and safety issues
- Technical support
- General systems observations

Applicable forms and logs (Appendix R) shall be submitted as attachments to the monthly operations summary report.

12.0 References

Arrowhead Contracting, Inc. June 2004. *Final Operations and Maintenance Manual, Groundwater Treatment Facilities #1 and #2, Site-wide Groundwater and Curriculum Center SVE Remedial Actions, Tutu Wellfield Superfund Site, St. Thomas, U.S. Virgin Islands*

CDM Smith. April 2009. *Final Quality Assurance Project Plan, Tutu Wellfield Site, Long Term Response Action, St. Thomas, U.S. Virgin Islands, Work Assignment No. 003-RALR-021D*

Table 1-1
Project O&M Directory

COMPANY / ORGANIZATION	ROLE / TITLE	ADDRESS / PHONE	CONTACT
U.S. EPA, Region 2	Project Manager	290 Broadway – 20th Floor New York, NY 10007-1866 (212) 637-4275	Caroline Kwan
Department of Planning and Natural Resources (DPNR)	Water Discharge Permitting	Div. of Environmental Protection Cyril E. King Airport Terminal Building, 2nd Floor St. Thomas, VI 00802 (340) 774-3320	Rhonda Liburd
	Air Discharge Permitting	Div. of Environmental Protection Cyril E. King Airport Terminal Building, 2nd Floor St. Thomas, VI 00802 (340) 774-3320	Aurea Olive
	Groundwater, UST, Terminal Facility Program Manager	Div. of Environmental Protection 45 Estate Mars Hill Frederiksted, VI 00840 (340)-773-1082	Syed Syedali
	Director	Div. of Environmental Protection Cyril E. King Airport Terminal Building, 2nd Floor St. Thomas, VI 00802 (340) 774-3320	David Alvaro Simon
Department of Public Works	Chief Engineer	82-44 Subbase St. Thomas, VI 00802 (340) 776-4844	Nicole Turner
Property Owners/Representatives:			
Department of Education	DOE Commissioner	1834 Kongens Gade St. Thomas, VI 00802 (340) 774-2810	LaVerne Terry
Curriculum Center	Curriculum Center Management	Curriculum Center #386 Anna's Retreat St. Thomas, VI 00802 (340) 775-2250	Jeanette Smith-Barry
	Curriculum Center Territorial Director of Maintenance	1834 Kongens Gade #386 Anna's Retreat St. Thomas, VI 00802 (340) 774-0100	Luis Hughes
Department of Human Services	Deputy Commissioner	Knud Hasnen Complex Building A 1303 Hospital Ground Charlotte Amalie, VI 00802 (340) 774-0930	Afiah Clendinen
Department of Public Works	Deputy Commissioner of Operations	82-44 Subbase St. Thomas, VI 00802 (340) 776-4844	Othniel Vanterpool
Grace Gospel Church	Pastor	P.O. Box 9790 St. Thomas, VI 00801	TBD
TNT Laundry	Tenant/Operator	P.O. Box 1841 St. Thomas, VI 00801	TBD

Table 1-2
Vendor O&M Directory

COMPANY	FUNCTION / EQUIP.	ADDRESS/PHONE	CONTACT
Carbonair Environmental Systems, Inc.	Process Equipment Fabricator, Warranty Information	2731 Nevada Avenue North New Hope, Minnesota 55427 (800) 526-4999	Chris Riddle Mark Hansen Don Weirens
Rockwell Automation	Software (RSView32) and Hardware	(440) 646-5800	Tech Support
Rensenhouse Electric Supply	Rockwell Automation	1919 Cherry St. Kansas City, Missouri 64108 (816) 421-7350	Bill Motley
Pressure Systems, Inc.	Pressure Transducers	34 Research Drive Hampton, Virginia 23666 (800) 328-3665	Marsha Gray
Geotechnical Services	Submersible Well Pumps	2852 Walnut Ave Tustin, CA 92780 (714) 832-5610	Fred Schramm
Instrument Specialties, Inc.	Electromagnetic Water Flow Meters	3885 St. Johns Parkway Sanford, Florida 3277 (407) 324-7800 x105	Steven Manning
Chemline Plastics LTD	Check Valves	55 Guardsman Rd. Thornhill, Ontario LT3 6L2 (905) 889-7890 x104	Michael Nissenthall
R.S. Corcoran Co.	Transfer Pumps	500 N. Vine Street New Lenox, IL 60451 (800) 637-1067	Mick Kramer
Rotron Blowers	Air Stripper & SVE Blowers	75 North Street Saugerties, NY 12477 (914) 246-3401	Neil Lintch
Hersey Products, Inc.	Mechanical Water Flow Meters	150 Venture Blvd Spartanburg, SC 29305	Tech Support
LMI / Milton Roy	Chemical Feed Pumps	8 Post Office Square Acton, MA 01720 (508) 263-9800	Tech Support
Krystil Klear Filtration	Bag Filters	9449 South 550 West Winamac, IN 46996 (800) 869-0325	Jay Stonebraker
Xchanger, Inc	Heat Exchanger	1401 South 7th Street Hopkins, MN 55343 (952) 933-2559	David Wangensteen
Barksdale	Temperature and Pressure Switches	3211 Fruitland Ave Los Angles, CA 90058 (213) 589-6181	Tech Support
Hydrosil International LTD	Hydrosil HS-600 Media	1180 St Charles Street Elgin, IL 60120 (847) 741-1600	Bill Waldschmidt
Signet Scientific Co.	pH Meter/Transmitter	3401Aerojet Ave El Monte, CA 91731 (626) 571-2770	Tech Support

Table 2-1
TPDES Storm Sewer / Surface Water Discharge Criteria

PARAMETER	DISCHARGE CRITERIA	
	VALUE	UNITS
Storm Sewer / Surface Water (TPDES) Discharge:		
pH	7.0 to 8.3	
Total Organic Carbon	20	mg/L
Total Suspended Solids	40	mg/L
Vinyl Chloride	>99.9% reduction or ND	
Cis-1,2-DCE	>99.9% reduction or ND	
Trans-1,2-DCE	>99.9% reduction or ND	
TCE	>99.9% reduction or ND	
PCE	>99.9% reduction or ND	

Table 2-2
DPNR Air Discharge Criteria

PARAMETER	DISCHARGE CRITERIA	
	VALUE	UNITS
Air (DPNR) Discharge:		
Vinyl Chloride	0.01	lb/d
cis – 1,2-DCE	14.29	lb/d
TCE	0.16	lb/d
PCE	0.42	lb/d
Total VOCs	14.48	lb/d

Table 2-3
Equipment List
Groundwater Extraction and Treatment – GWTF #1

(1) Grunfos 5 Redi-Flo3-250 submersible pump, ½ hp, 230 VAC, 1 ph, w/communications electronics for CU300 control, PN 5SQE05B-250NE, w/CU300 controller equipped for Remote control, and 130 feet of #12 AWG motor leads w/ground (RW-1) (1) Grunfos 22Redi-Flo3-140 submersible pump, 3/4 hp, 230 VAC, 1 ph, w/communications electronics for CU300 control, PN 22SQE07B-140-NE, w/CU 300 controller equipped for Remote control, and 60 feet of #12 AWG motor leads w/ground (RW-9) (1) Grundfos 30 Redi-Flo3-160 submersible pump, 1-1/2 hp, 230VAC, 1 ph, w/communications electronics for CU300 control, PN 30SQE15C-160NE, w/CU300 controller equipped for Remote control, and 80 feet of #12 AWG motor leads w/ground (RW-7) (2) KPSI #710-140-0030 Submersible level transducers, Tefzel vented cable, and aneroid bellows #815 (RW-7 and RW-9)
Well Pump Piping, Fittings & Misc. Equipment: (3) Ashcroft Model 1005 Pressure gauge, 0 – 100 psi (3) Wye Line Strainers 1 ½" PVC (3) Colonial Check valves 1 ½" PVC (3) Apollo 70-300 Series Ball valves 1 ½" Bronze (3) Sample port (shipped loose) (1) Hersey MVR-30 water flow meter for RW-6 - 30 gpm capacity - Local readout with totalizer (1) Hersey MVR-50 water flow meter for RW-7 - 50 gpm capacity - Local readout with totalizer (1) Hersey MVR-30 water flow meter for RW-8 - 30 gpm capacity - Local readout with totalizer
(1) Equalization tank - 1,000 gallon capacity - HDPE, cone bottom construction (45 degree cone) - 64" diameter x 116.5" high - Steel stand (Tnemec-coated per Section 11246 2.03.A.3) & containment high level conductivity switch - High and low level alarm and pump operation switches (Flowline Switch-Tek #LU101045 ultrasonic gap style switches, bulkhead mounted); locate switches per Arrowhead instructions - Connections for tank influent, effluent, and vapor bleed-off (per Arrowhead detail); connections shall conform to Section 11246 2.04B - Valved outlet at tank bottom for clean out (per Arrowhead detail); cleanout line and valve shall extend horizontally to edge of tank to facilitate access
(1) Carbonair GPC 3 vapor phase carbon adsorber - HDPE construction (55-gallon poly drum or equivalent) - Influent and effluent sample ports - Condensate drain line - 200 lbs. of reactivated vapor phase carbon - Piped to tank vent

(2) R.S. Corcoran Series 2000, Model D.G. VE, 1.5" suction x 1" discharge, 4.25" impeller, 316 stainless steel (skid-mounted, see below)
- Maximum flow rate 30 gpm @ 56' TDH
- Motor, 1 hp, 3450 rpm, 460VAC, 3 phase, TEFC
- Discharge check valve, throttling valve, and pressure gauge

(1) Scale Inhibitor feed system
- LMI A941-155S chemical feed pump with 4-20mA input (115V, single phase motor), with Digi-Pulse run-feedback option
- Injection fittings, 4 way valve, pressure relief, and back pressure valve
- Dosage range of 0.006 – 0.66 gallons per hour (actual dosage rate to be determined)
- 50 gallon HDPE tank with Flowline Ultrasonic low level alarm switch
- 100 ml calibration column
- 60 ft. Teflon PTFE tubing (1/4")

(1) Hersey B.E.P. magnetic flow meter/transmitter with Model 1000 local readout/totalizer (NEMA 4X rated)
- 4-20 mA output
- By-pass piping
- Provided with local readout in GPM

(2) Krystil Klear model 88 bag filters (skid-mounted, see below)
- 30" stainless steel housing each (per Section 13720 2.01C)
- (25) 50 micron filter bags (4.4 sq. ft. surface area)
- 2" side inlet and outlet connections each
- 100 psi maximum design pressure each
- Inlet and outlet pressure gauges (0 – 30 psi)
- Interconnecting piping and valving for parallel operation (Sch 80 PVC)

(1) Barksdale #DPD1T-A80 Differential pressure switch
- 0.4 – 60 psig range

(1) Temperature gauge
- 50-300 ^{o}F

(2) Pressure gauges
- 0-30 psig each

(1) Carbonair STAT 80 low profile air stripper, 304 stainless steel, (skid-mounted along with blower, see below)
- Piped for induced-draft air flow
- SST gravity drain sump with high level alarm switch
- 6 trays with demister (polypropylene) and fasteners
- Rotron CP909FJ72WLR regenerative blower, 350 cfm @ - 75" wc, 15 HP, 480 V, 3 phase, TEFC with optional corrosion resistant surface treatments and seals (skid-mounted along with air stripper, see below)
- Dwyer Series 1950 Blower Low (#1950-5) & High (#1950P-2) pressure alarm switches
- Blower pressure gauge (0-100" wc)
- Blower inlet filter
- Bleed air valve with silencer
- Rotron FM40A450Q air flow meter, 90 – 450 scfm
- Air temperature gauge (50-300 ^{o}F)
- Inlet and outlet sample ports
- 4" Chemline Series WP Wafer check valve (polypropylene with viton seals); located downstream of blower, prior to combined air stripper/SVE header line

(1) pH adjustment feed system
- WALCHEM-ClassEWB11Y1-PC chemical feed pump with 4-20 mA input (115V, single phase motor) and with Digi-Pulse run feedback option
- Glass fiber reienforced polypropylene pump head and fittings. Polytetrafluorethylene diaphragm and Injection fittings, 4 way valve, pressure relief, and back pressure valve Gaskets. Aluminum ceramic valve balls. Fluoroelastomer valve seat and seals
- Dosage range of 0.006 – 0.66 gallons per hour (actual dosage rate to be determined)
- 50 gallon HDPE tank with Flowline Ultrasonic low level alarm switch
- 100 ml calibration column
- 30 ft. polyethylene tubing (3/8")

(1) Signet pH sensor and transmitter
- SIGNET 3-2760-11 PRE AMP for pH Sensor
- Model 3-2724 bulb electrode sensor
- Model 3-8750-1P monitor/transmitter
- 4-20 mA output

(1) Xchanger, Inc. AA-500 air-to-air heat exchanger **- currently not operated**
- 500 scfm process air
- 1,850 scfm ambient air (fan)
- 1 HP TEFC motor
- Heresite P-413 baked phenolic coating

(1) Barksdale Model ML1H-H204S high temperature switch, -50 – 200 F (mounted downstream of heat exchanger)

(1) Vacuum breaker (anti-siphon valve) for treated water effluent discharge line

(1) High level alarm switch for surface water discharge location (shipped loose), Flowline Switch-Tek Powered Level Switch #LU101405 with 10' cable, 4-inch long polypropylene sensor, 3/4" MPT.

(2) Skids (Tnemec-coated), as follows:
- Skid #1 – Dual-level @ 18" high for two transfer pumps and 6" high for bag filters
- Skid #2 – STAT 80 air stripper and Rotron blower @ 6" high

(1) Series 3000 programmable logic controller (PLC)-based Control System:
For operation on 460 volt, 3Ø, 3 wire incoming electrical service. To control the 10 HP extraction blower, three extraction well pumps, 10 HP STAT low-profile air stripper blower, two 1 HP transfer pumps, and three (fractional HP) chemical feed pumps. Furnished loose for mounting by others. To include:

QTY	DESCRIPTION
1	Enclosure, NEMA 4X, freestanding computer/PLC/motor control enclosure; Hoffman APX (or equal) sized as required
1	Disconnect, non-fusible, 80A with padlockable operating handle and shaft
1	Power distribution terminal block, 3 pole; L1, L2, L3
1	Three phase surge arrestor
1	Lightning arrestor; 600 volt, 4 wire with bracket
2	Motor starter: Contactor 23A FLA with 1 aux. contact/Overload relay 3.7-12A, 3Ø, manual reset; transfer pumps (**revise as necessary for two 1 HP motors)
2	Motor starter: Contactor 23A FLA with 1 aux. contact/Overload relay 12-32A, 3Ø, manual reset; blowers
3	Mount and wire CU300 well pump controllers (provided by Arrowhead) per Grundfos specifications
2	Circuit breaker 460V 3P15A 22k/460,65K/230; transfer pumps
2	Circuit breaker 460V 3P25A 22k/460,65K/230; STAT and SVE blowers
3	Circuit breaker 230V 2P15A 14k; extraction wells
3	Fuseholder/fuse; chemical feed pumps
1	Forced air ventilation (170 cfm) with stainless steel shroud
1	Transformer; 480/240-120, 7.5 kVA with primary and secondary overcurrent protection
1	Allen-Bradley MicroLogix 1500 PLC including #1764-24AWA base unit, #1764-LRP processor & #1764-MM2RTC memory module, with required I/O (programming

	by Arrowhead)
1	Mount and wire Allen-Bradley VersaView 1500P industrial computer/touch screen (provided by Arrowhead; including any required cables, interface cards and adapters to communicate with MicroLogix 1500) (all programming by Arrowhead)
3	Switch; three position; Hand-Off-Auto with integral Run (green/LED) indication; blowers, transfer pumps
1	Pushbutton, Emergency Stop (red, NO/NC)
3	Pushbuttons, illuminated: System Start; System Stop & System Reset
2	24VDC power supply, 30W, 1.3A, DIN rail mount (analog power & discrete power)
1	Panel heater w/integral thermostat, 100W, 115VAC
1	Powerware 9125 Uninterruptable power supply (UPS) for PLC, OIT, autodialer, and all I/O circuits
1	Sensaphone 2000 alarm dialer - I/O circuit breakers & fuses per Specs Section 13320 - Engraved laminated legends for all door mounted devices - Terminal blocks for external connections and fusing as required - Color-coded wiring with wire markers at all terminations - Serialized UL508 Industrial Control Panel label

Table 2-4
Equipment List
Soil Vapor Extraction System – GWTF #1 [1]

(2) Inlet vacuum gauges - 0-100” wc vacuum
(2) Rotron model FM30A250Q Venturi flow meter (one before the air bleed one on the blower discharge) - 50-250 cfm capacity - 3” connections - Aluminum construction - Low pressure drop (2-4” wc typical)
(1) Sample port
(1) Air dilution butterfly valve with inlet filter
(1) Carbonair CE 858 SVE system (skid-mounted, see below) - Rotron Model CP707FW72MXLR regenerative blower, 140 scfm @ - 70” wc, 5 HP, 3 phase, 480V, TEFC, with optional corrosion resistant surface treatments and seals - Maximum flow rate 400 cfm / Maximum vacuum 98" wc - 40 gallon capacity moisture separator tank (all steel surfaces Tnemec-coated)**(Removed)** - Sight glass with high-level alarm switch **(Removed)** - Vacuum relief valve **(Removed)** - In-line air filter with differential pressure gauge and small filter silencer **(Removed)** - Inlet temperature gauge (50-300 ^{o}F) **(Removed)** - Inlet vacuum gauge (0-100” wc vacuum) **(Removed)** - Inlet sample port - Discharge pressure relief valve - Mounted on a steel frame - 4” Chemline Series WP Wafer check valve (polypropylene with viton seals); located downstream of blower, prior to combined air stripper/SVE header line
(1) Inline inlet & discharge silencers (all steel surfaces Tnemec-coated)
(1) Pressure gauge (0-30” wc)
(1) Temperature gauge (50-300 ^{o}F)
(1) Low flow switch (mounted on discharge side of blower)
(1) Barksdale Model ML1H-H354S high temperature switch, 100 – 350 F (mounted on discharge side of blower) **(Removed)**
(1) Skid for all of the above items @ 6” high (Tnemec-coated)
Controls – Refer to Table 2-3.

Note:
1. Soil Vapor Extraction system has been offline since 2006 and Moisture Separator Tank has been removed due to severe rusting.

Table 2-5
Equipment List
Off-Gas Treatment System – GWTF #1 [1]

(1) Carbonair GPC 50R vapor phase carbon adsorber (Rental) - 8 ft. diameter x 7 ft. high steel vessels - 5,000 lbs. carbon capacity per vessel - 12 ¾" OD inlet/outlet connections - 24" top manway - 1/2" drain valves - Forkliftable channel iron base
(1) Carbonair GPC 28R vapor phase permanganate adsorber (Rental) - 6 ft. diameter x 7 ft. 3 in. high steel vessel - 7,000 lbs. of permanganate impregnated zeolite capacity (per vessel) - 8" OD inlet/outlet connections - 24" top manway - 1/2" drain valves - Forkliftable channel iron base
(1) Vapor phase adsorber piping kit - 125' uncut 4" diameter DURA-VENT flexible hose with connection fittings (4" x 12" reducers to the GPC 50R's and 4" x 8" reducers to GPC 20R's) - (4) Pressure gauges (0 – 60 in. wc) - (4) Sample ports

Note:
1. The Offgas System has been offline since 2006.

Table 2-6
Equipment List
Groundwater Extraction and Treatment – GWTF #2

(1) Grundfos 5 Redi-Flo3-170 submersible pump, ½ hp, 230VAC, 1 ph, w/communications electronics for CU300 control, PN 5SQE05A-170NE, w/ CU300 controller equipped for Remote control, and 120 feet of #12 AWG motor leads w/ground (RW-1) (1) Grundfos 30 Redi-Flo3-160 submersible pump, 1-1/2 hp, 230VAC, 1 ph, w/communications electronics for CU300 control, PN 30SQE15C-160NE, w/CU300 controller equipped for Remote control, and 120 feet of #12 AWG motor leads w/ ground (RW-15) (2) KPSI #710-140-0030 Submersible level transducers, Tefzel vented cable, and aneroid bellows #815 (RW-1 and RW-15)
Well Pump Piping, Fittings & Misc. Equipment (2) Ashcroft Model 1005 Pressure gauge, 0 – 100 psi (2) Wye Line Strainers 1 ½" PVC (2) Colonial Check valves 1 ½" PVC (2) Apollo 70-300 Series Ball valves 1 ½" Bronze (2) Sample port (shipped loose) (1) Hersey MVR-30 water flow meter for RW-1 - 30 gpm capacity - Local readout with totalizer (1) Hersey MVR-50 water flow meter for RW-1 - 50 gpm capacity - Local readout with totalizer
(1) Scale Inhibitor feed system - LMI A941-155S chemical feed pump with 4-20mA input (115V, single phase motor), with Digi-Pulse run-feedback option - Injection fittings, 4 way valve, pressure relief, and back pressure valve - Dosage range of 0.006 – 0.66 gallons per hour (actual dosage rate to be determined) - 50 gallon HDPE tank with Flowline Ultrasonic low level alarm switch - 100 ml calibration column - 25 ft. Teflon PTFE tubing (1/4")
(1) Equalization tank (skid-mounted, see below) - 500 gallon capacity - HDPE, cone bottom construction (45 degree cone) - 64" diameter x 90.5" high - Steel stand (Tnemec-coated per Section 11246 2.03.A.3) & containment high level conductivity switch - High and low level alarm and pump operation switches (Flowline Switch-Tek #LU101045 ultrasonic gap style switches, bulkhead mounted); locate switches per Arrowhead instructions - Connections for tank influent, effluent, and vapor bleed-off (per Arrowhead detail); connections shall conform to Section 11246 2.04B - Valved outlet at tank bottom for cleanout (per Arrowhead detail); cleanout line and valve shall extend horizontally to edge of tank to facilitate access

(1) Carbonair GPC 3 vapor phase carbon adsorber (**Presently disconnected for EQ Tank which is not in use)**

- HDPE construction (55-gallon poly drum or equivalent)
- Influent and effluent sample ports
- Condensate drain line
- 200 lbs. of reactivated vapor phase carbon
- Piped to tank vent

(1) R.S. Corcoran Series 2000, Model D.G. VE, 1.5" suction x 1" discharge, 4.25" impeller, 316 stainless steel (skid-mounted, see below)

- Maximum flow rate 30 gpm @ 56' TDH
- Motor, 1 hp, 3450 rpm, 460VAC, 3 phase, TEFC
- Discharge check valve, throttling valve, and pressure gauge

(1) Hersey B.E.P. magnetic flow meter/transmitter with Model 1000 local readout/totalizer (NEMA 4X rated)

- 4-20 mA output
- By-pass piping
- Provided with local readout in GPM

(2) Krystil Klear model 88 bag filters (skid-mounted, see below)

- 30" stainless steel housing each (per Section 13720 2.01C)
- (25) 50 micron filter bags (4.4 sq. ft. surface area)
- 2" side inlet and bottom outlet connections each
- 100 psi maximum design pressure each
- Inlet and outlet pressure gauges (0 – 30 psi)
- Interconnecting piping and valving for parallel operation (Sch 80 PVC)

(1) Barksdale #DPD1T-A80 Differential pressure switch

- 0.4 – 60 psig range

(1) Temperature gauge

- 50-300 ^{o}F

(2) Pressure gauges

- 0 – 30 psig each

(1) Carbonair STAT 30 low profile air stripper, 304 stainless steel (skid-mounted, see below)

- Piped for induced-draft air flow
- SST gravity drain sump with high level alarm switch
- 6 trays with demister (polypropylene) and fasteners
- Rotron CP707FF72MXLR regenerative blower, 150 cfm @ - 65" wc, 5 HP, 480 V, 3 phase, TEFC with optional corrosion resistant surface treatments and seals (skid-mounted along with air stripper, see below)
- Dwyer Series 1950 Blower low (#1950-5) & high (#1950P-2) pressure alarm switches
- Blower pressure gauge (0-100" wc)
- Blower inlet filter
- Bleed air valve with silencer
- Rotron FM30A250Q air flow meter, 50 - 250 scfm
    - Air temperature gauge (50-300 ^{o}F)
    - Inlet and outlet sample ports

(1) pH adjustment feed system
- LMI A941-155S chemical feed pump with 4-20 mA input (115V, single phase motor) and with Digi-Pulse run feedback option
- Injection fittings, 4 way valve, pressure relief, and back pressure valve
- Dosage range of 0.006 – 0.66 gallons per hour (actual dosage rate to be determined)
- 50 gallon HDPE tank with Flowline Ultrasonic low level alarm switch
- 100 ml calibration column
- 20 ft. Teflon PTFE tubing (1/4")

(1) Signet pH sensor and transmitter
- Model 3-2716 bulb electrode sensor
- Model 3-8750-1P monitor/transmitter
- 4-20 mA output

(1) Vacuum breaker (anti-siphon valve) for treated water effluent discharge line

(1) High level alarm switch for surface water discharge location (shipped loose) Switch-Tek Powered Level Switch #LU101405 with 10' cable, 4-inch long polypropylene sensor, 3/4" MPT.,

(2) Skids (Tnemec-coated), as follows:
- Skid #1 – EQ tank, transfer pump, and bag filters @ 6" high
- Skid #2 – STAT 80 air stripper AND Rotron blower @ 6" high

(1) Series 3000 programmable logic controller (PLC)-based Control System
For operation on 460 volt, 3Ø, 3 wire incoming electrical service. To control the two extraction well pumps, 7-½ HP STAT low-profile air stripper blower, 1 HP transfer pump and three (fractional HP) chemical feed pumps. Furnished loose for mounting by others. To include:

QTY	DESCRIPTION
1	Enclosure, NEMA 4X, freestanding computer/PLC/motor control enclosure; Hoffman APX (or equal) sized as required
1	Disconnect, non-fusible, 40A with padlockable operating handle and shaft
1	Power distribution terminal block, 3 pole; L1, L2, L3
1	Three phase surge arrestor
1	Lightning arrestor; 600 volt, 4 wire with bracket
1	Motor starter: Contactor 23A FLA with 1 aux. contact/Overload relay 3.7-12A, 3Ø, manual reset; transfer pump
1	Motor starter: Contactor 23A FLA with 1 aux. contact/Overload relay 12-32A, 3Ø, manual reset; blower
2	Mount and wire CU300 well pump controllers (provided by Arrowhead) per Grundfos specifications
1	Circuit breaker 460V 3P15A 22k/460,65K/230; transfer pump
1	Circuit breaker 460V 3P25A 22k/460,65K/230; STAT blower
2	Circuit breaker 230V 2P15A 14k; extraction wells
3	Fuseholder/fuse; chemical feed pumps
1	Forced air ventilation (170 cfm) with stainless steel shroud
1	Transformer; 480/240-120, 5 kVA with primary and secondary overcurrent protection
1	Allen-Bradley MicroLogix 1500 PLC including #1764-24AWA base unit, #1764-LRP processor & #1764-MM2RTC memory module, with required I/O (all programming by Arrowhead)
1	Mount and wire Allen-Bradley VersaView 1500P industrial computer/touch screen (provided by Arrowhead; including any required cables, interface cards and adapters to communicate with MicroLogix 1500) (all programming by Arrowhead)
2	Switch; three position; Hand-Off-Auto with integral Run (green/LED) indication; blowers, transfer pumps
1	Pushbutton, Emergency Stop (red, NO/NC)
3	Pushbuttons, illuminated: System Start; System Stop & System Reset
2	24VDC power supply, 30W, 1.3A, DIN rail mount (analog power & discrete power)
1	Panel heater w/integral thermostat, 100W, 115VAC

1	Powerware 9125 Uninterruptable power supply (UPS) for PLC, OIT, autodialer, and all I/O circuits
1	Sensaphone 2000 alarm dialer - I/O circuit breakers & fuses per Specs Section 13320 - Engraved laminated legends for all door mounted devices - Terminal blocks for external connections and fusing as required - Color-coded wiring with wire markers at all terminations - Serialized UL508 Industrial Control Panel label

Table 2-7
Piping and Valve Nomenclature – GWTF #1

Piping		
CGW-INF-RW6	CGW-INF-EQB	AIR-SVE
CGW-INF-RW7	CGW-INF-AS	VAP-INF-SVE
CGW-INF-RW-9	TW-EFF-SS	VAP-INF-CMB
CGW-INF-CMB	AIR-AS	VAP-EFF-ATM
CGW-INF-EQ	VAP-INF-AS	
Valves		
HV-INF-RW-6V	HV2-INF-EQ	HV-INF-FM
HV-INF-RW-7V	HV-D-EQ	HV2-INF-FM
HV-VAP-SVE-7V	HV-INF-EQB	HV-INF-FMB
HV-INF-RW-9V	HV2-INF-EQB	HV-TW-EFF
HV-INF-RW-6	HV-INF-TP1	HV-VAP-AS
CV-INF-RW-6	HV-INF-TP2	CV-VAP-AS
HV2-INF-RW-6	CV-INF-TP1	HV-VAP-SVE1V
HV-INF-RW-7	CV-INF-TP2	HV-AIR-SVE
CV-INF-RW-7	HV2-INF-TP1	HV-D-SVE
HV2-INF-RW-7	HV2-INF-TP2	CV-VAP-SVE
HV-INF-RW-9	HV-INF-BF1	HV-D-HX1
CV-INF-RW-9	HV-INF-BF2	HV-D-GAC1
HV2-INF-RW-9	HV2-INF-BF1	HV-D-GAC2
HV-INF-CMB	HV2-INF-BF2	HV-D-PP1
HV2-INF-CMB	HV-D-BF1	HV-D-PP2
HV-INF-EQ	HV-D-BF2	HV-D-STACK
Sample Taps		
SVE-1	RW-9	VAP-INF
SVE-7	GW1-INF1 (b/f EQ)	GAC1-EFF
SVE-INF (after air dilution)	GW1-INF2 (after TP1)	GAC2-EFF
RW-6	GW1-INF3 (after TP2)	PP1-EFF
RW-7	GW1-EFF	VAP-EFF

Refer to Drawings 2-14 through 2-16 for piping and valve diagrams with nomenclature.

Abbreviations:

AS – air stripper
HV – hand valve (i.e. ball valve)
CV – check valve
INF – influent line
EFF – effluent line
CGW – contaminated groundwater
TW – treated water
VAP – vapor/air
AIR – air (outside/atmospheric)
ATM – atmosphere
CMB – combined streams
TP – Transfer pump
EQ – Equalization tan k
EQB – Equalization tank bypass line
FM – Flow meter
FMB – Flow meter bypass line
BF – Bag filter
MS – Moisture separator
V (i.e. RW-6V) – Well vault
D – Drain

Table 2-8
Piping and Valve Nomenclature – GWTF #2

Piping		
CGW-INF-RW-1	CGW-INF-EQB	TW-EFF-SS
CGW-INF-RW-1S	CGW-INF-EQ	AIR-AS
CGW-INF-CMB	CGW-INF-AS	VAP-EFF-ATM
Valves		
HV-INF-RW-1V	HV-INF-EQB	HV2-INF-BF2
HV-INF-RW-1SV	HV-INF-EQ	HV-INF-FM
HV-INF-RW-1	HV2-INF-EQ	HV2-INF-FM
CV-INF-RW-1	HV3-INF-EQ	HV-INF-FMB
HV2-INF-RW-1	HV4-INF-EQ	HV-VAP-AS
HV-INF-RW-1S	HV-INF-TP	HV-D-EQ
CV-INF-RW-1S	CV-INF-TP	HV-D-BF1
HV2-INF-RW-1S	HV-INF-BF1	HV-D-BF2
HV-INF-CMB	HV-INF-BF2	HV-D-STACK
HV2-INF-CMB	HV2-INF-BF1	
Sample Taps		
RW-1	GW2-INF1 (b/f EQ)	GW2-INF3 (b/f AS)
RW-1S	GW2-INF2 (after TP)	GW2-EFF

Refer to Drawings 2-17 and 2-18 for piping and valve diagrams with nomenclature.

Abbreviations:

AS – air stripper
HV – hand valve (i.e. ball valve)
CV – check valve
INF – influent line
EFF – effluent line
CGW – contaminated groundwater
TW – treated water
VAP – vapor/air
AIR – air (outside/atmospheric)
ATM – atmosphere
CMB – combined streams
TP – Transfer pump
EQ – Equalization tan k
EQB – Equalization tank bypass line
FM – Flow meter
FMB – Flow meter bypass line
BF – Bag filter
MS – Moisture separator
V (i.e. RW-6V) – Well vault
D – Drain

Table 2-9
Sampling and Monitoring Schedule for Long-Term Operations and Maintenance

System or Wells	Sampling and/or Monitoring Activity	Location	Frequency						GW Samples							GW Monitoring Parameters							Air Samples		Field Measurements						Water Levels	Notes
			Daily	Weekly	Monthly	Quarterly	Semi-Annual	Annual	VOCs	TOC	TSS	Nitrate	Sulfate	Chloride	Ethane/ Ethene	Chlorine (Hach)	pH	DO	Cond.	Temp	Turb.	ORP	TO-14	AM 4.02	VOCs - PID	Pressure/ Vacuum	Temp.	Flow	pH	Level		
GWTF#1	Extraction well RW-6 sampling and monitoring	RW influent sample port			■				■																							
	Extraction well RW-7 sampling and monitoring	RW influent sample port			■				■																							
	Extraction well RW-9 sampling and monitoring	RW influent sample port			■				■																							
	GW influent (combined) sampling and monitoring	EQ tank effluent sample port			■				■																							
	GWT system monitoring and field measurements	Gauges, meters, instruments	■																							■	■	■	■	■		
	Treated water effluent - TPDES permit sampling and monitoring (monthly)	Air stripper effluent sample port			■				■																							1
	Treated water effluent - TPDES permit sampling and monitoring (weekly)	Air stripper effluent sample port		■						■	■						■											■				1
	Off-gas treatment system, air permit sampling	Stack sample ports			■																		■									2
GWTF#2	Extraction well RW-1 sampling and monitoring	RW influent sample port			■				■																							
	GWT system monitoring and field measurements	Gauges, meters, instruments	■																							■	■	■	■	■		
	Treated water effluent - TPDES permit sampling and monitoring (monthly)	Air stripper effluent sample port			■				■							■	■	■	■	■		■										1
	Treated water effluent - TPDES permit sampling and monitoring (weekly)	Air stripper effluent sample port		■						■	■						■											■				1
GW Monitoring Wells	Site-wide GW, Annual sampling	Refer to list of wells, Table 2-10.							■	■		■	■	■	■		■	■	■	■	■	■										3
	PRP Site-wide GW, semi-annual sampling by Texaco and annual sampling by Esso	Refer to list of wells, Table 2-10.					■		■																							
	Site-wide GW, continuous water levels	Refer to list of wells, Table 2-10.																													■	
	Site-wide GW, monthly water levels	Refer to list of wells, Table 2-10.																													■	

NOTES:

1 Per DPNR TPDES Permit Equivalency No. VID982272569, effective March 1, 2009 (refer to Appendix S).

2 Per DPNR Air Pollution Control Permit Conditions, dated July 22, 2003 (refer to Appendix S).

3 Sampling for TOC, nitrate, sulfate, chloride, and ethane/ethene applies to Southern Plume wells only (refer to Table 2-10).

Table 2-10
Sampling and Monitoring Schedule for Site-wide Groundwater

AREA	WELL LOCATION	SAMPLING [3,5]		WATER LEVEL MEASUREMENT		
		Annual	Notes	Continuous	Monthly	Notes
Curriculum	BP-1				X	
Center/	BP-2				X	
GWTF #1	BP-3				X	
	IW-1				X	
	IW-1S				X	
	IW-2				X	
	IW-2S				X	
	MW-17				X	
	MW-1D	X			X	
	MW-13				X	
	MW-13D	X			X	
	MW-14	X			X	
	MW-15	X			X	
	MW-16			X [7]	X	
	RW-8				X	
	RD-9	X			X	
	RD-10				X	
	RD-11			X [7]	X	
	RD-12				X	
	RD-13	X			X	
Texaco	MW-2	X				
	MW-3			X [7]	X	
	MW-4					
	MW-4D					
	MW-5					
	MW-6R					
	MW-6D	X				
	MW-7	X				
	RD-5	X				
	TT-1					
	TT-3D					
	TT-5					
	TT-6	X				
	Tillett	X				
Esso	CHT-1					
	CHT-3					
	CHT-4					
	CHT-7D					
	DW-1					
	MW-8	X				
	MW-9					
	MW-9S					
	MW-10					
	MW-10D	X				
	MW-25	X				
	P-1					
	SW-1R					
	SW-2R					
	SW-8R					
	SW-9					
	SW-10					

Table 2-10
Sampling and Monitoring Schedule for Site-wide Groundwater

AREA	WELL LOCATION	SAMPLING [3,5]		WATER LEVEL MEASUREMENT		
		Annual	Notes	Continuous	Monthly	Notes
GWTF #2	DW-2	X		X [7]	X	
	MW-11D	X			X	
	MW-12D	X			X	
	MW-19				X	
	RD-4				X	
	RD-7	X			X	
	SW-6				X	
	Eglin I				X	
	Eglin III	X	6			
Southern	Delegard	X	4,6			
Plume	Laplace	X	4,6			
	MW-21D	X		X [7]	X	
	PZ-4				X	
	RD-1	X			X	
	RD-2	X			X	
	RD-3	X	4		X	
	RD-6	X			X	
	RD-8	X			X	
	RD-14			X [7]	X	
	Smith	X	4,6			
	Steele	X	4,6			

Notes:

1. Not used
2. Not used
3. Sampling includes VOCs, unless otherwise noted.
4. Sampling includes VOCs, TOC, nitrate, sulfate, chloride, and ethane/ethene (intrinsic biodegradation parameters).
5. Field measurements shall be taken for water level, turbidity, DO, temperature, conductivity, pH, and ORP at all wells during sampling.
6. Active supply well.
7. Continuous water levels will be collected by transducers.

Acronyms:

DO - dissolved oxygen

GWTF - groundwater treatment facility

O&M - operations and maintenance

ORP - oxidation reduction potential

RA - remedial action

TOC - total organic carbon

VOC - volatile organic compound

Table 3-1
Control System Interlocks - GWTF #1

	Alarm Condition			Result #1		Result #2
Line no.	P&ID Tagname	HMI Tagname	Description	HMI Tagname	Description	Description
14	OS-1061		P6 CU300 fault status	P6_FAIL	P6 CU300 fault	autodialer ch 6
15	OS-1071		P7 CU300 fault status	P7_FAIL	P7 CU300 fault	autodialer ch 6
16	OS-1081		P9 CU300 fault status	P9_FAIL	P9 CU300 fault	autodialer ch 6
17	OS-1200		NaOCl metering pump flow switch	MP1_FAL	MP-1 low flow alarm	autodialer ch 8
18	OS-1210		anti-scalant metering pump flow sw	MP2_FAL	MP-2 low flow alarm	autodialer ch 8
19	OS-1400		acid metering pump flow switch	MP3_FAL	MP-3 low flow alarm	autodialer ch 8
20	OS-1500	B1_AUX	air stripper blower aux contacts	P1_OUT	P1 run output	
21	OS-1500	B1_AUX	air stripper blower aux contacts	P2_OUT	P2 run output	
22	OS-1500 & OS-1610	B1_AUX & B2_AUX	air stripper blower aux contacts & SVE blower MS auxillary contacts	HX_OUT	heat exchanger run output	
23	LSH-1200	NASC_LAH	NaOCl secondary containment	GWSYS_SD	GW system shutdown	autodialer ch 4
24	LSL-1200	NA_LAL	NaOCl storage			autodialer ch 7
25	LSH-1210	SASC_LAH	anti-scalant secondary containment	GWSYS_SD	GW system shutdown	autodialer ch 4
26	LSL-1210	SA_LAL	anti-scalant storage			autodialer ch 7
27	LSHH-1100	EQ_LAH	equalization tank	GWSYS_SD	GW system shutdown	autodialer ch 3
28	LSH-1100	EQ_LSH	equalization tank	P1_OUT	P1 transfer pump run output	
29	LSH-1100	EQ_LSH	equalization tank	P2_OUT	P2 transfer pump run output	
30	LSL-1100	EQ_LSL	equalization tank	P1_OUT	P1 transfer pump run output	
31	LSL-1100	EQ_LSL	equalization tank	P2_OUT	P2 transfer pump run output	autodialer ch 3
32	LSLL-1100	EQ_LAL	equalization tank	GWSYS_SD	GW system shutdown	
33	LSHH-1400	HCLSC_LAH	muriatic acid secondary containment	GWSYS_SD	GW system shutdown	autodialer ch 4
34	LSLL-1400	HCL_LAL	muriatic acid storage			autodialer ch 7
35	PSH-1300	FLTR_PAH	filter differential pressure	GWSYS_SD	GW system shutdown	autodialer ch 5
36	LSHH-1500	AS_LAH	air stripper sump	GWSYS_SD	GW system shutdown	autodialer ch 3
37	LSHH-1501	BLDG_LAH	building secondary containment	GWSYS_SD	GW system shutdown	autodialer ch 4
38	LSHH-1501	BLDG_LAH	building secondary containment	SVESYS_SD	SVE system shutdown	autodialer ch 4
39	PSL-1500	AS_PAL	air stripper blower low pressure	GWSYS_SD	GW system shutdown	autodialer ch 5
40	PSH-1500	AS_PAH	air stripper blower high pressure	GWSYS_SD	GW system shutdown	autodialer ch 5
41	FSL-1620	B2_FAL	SVE blower low flow switch	SVESYS_SD	SVE system shutdown	autodialer ch 5

	Alarm Condition			Result #1		Result #2
Line no.	P&ID Tagname	HMI Tagname	Description	HMI Tagname	Description	Description
42	TSH-1620	B2_TAH	SVE blower high temperature	SVESYS_SD	SVE system shutdown	autodialer ch 5
43	LSHH-1101	EQSC_LAH	EQ tank secondary containment	GWSYS_SD	GW system shutdown	autodialer ch 4
44	LSH-1590	EFF_LSHH	effluent discharge	GWSYS_SD	GW system shutdown	autodialer ch 3
45	LSHH-1610	KO_LSHH	knockout tank high level	SVESYS_SD	SVE system shutdown	autodialer ch 3
46	TSH-1625	HX_TAH	heat exchanger high temperature	GWSYS_SD	GW system shutdown	autodialer ch 5
47	TSH-1625	HX_TAH	heat exchanger high temperature	SVESYS_SD	SVE system shutdown	autodialer ch 5
48	LSH-1070	RW7_WTE	RW-7 water table elevation	P7_OUT	P7 run output	
49	LSL-1070	RW7_WTE	RW-7 water table elevation	P7_OUT	P7 run output	
50	LSLL-1070	RW7_WTE	RW-7 water table elevation	P7_OUT	P7 run output	autodialer ch 6
51	LSH-1080	RW9_WTE	RW-9 water table elevation	P9_OUT	P9 run output	
52	LSL-1080	RW9_WTE	RW-9 water table elevation	P9_OUT	P9 run output	
53	LSLL-1080	RW9_WTE	RW-9 water table elevation	P9_OUT	P9 run output	autodialer ch 6
54	FIT-1300	ASIN_FR	air stripper influent flow transmitter	GWSYS_SD	GW system shutdown	autodailer ch 5
55	AIT-1500	EFF_AAH	effluent pH transmitter	GWSYS_SD	GW system shutdown	autodailer ch 5
56	AIT-1500	EFF_AAL	effluent pH transmitter	GWSYS_SD	GW system shutdown	autodailer ch 5

NOTES:

Any GW system shutdown causes autodialer ch 1 output. Any SVE system shutdown causes autodialer ch 2 output.

P1 & P2 transfer pumps do not operate when in EQ Tank Bypass mode.

SVE/Offgas systems have been offline since 2006.

Table 3-2
Control System Interlocks - GWTF #2

	Alarm Condition			Result #1		Result #2
Line no.	P&ID Tagname	HMI Tagname	Description	HMI Tagname	Description	Description
14	OS-2011		P1 CU300 fault status	P1_FAIL	P1 CU300 fault	autodialer ch 6
15	OS-2021		P1S CU300 fault status	P1S_FAIL	P1S CU300 fault	autodialer ch 6
16	OS-2200		NaOCl metering pump flow switch	MP1_FAL	MP-1 low flow alarm	autodialer ch 8
17	OS-2210		anti-scalant metering pump flow sw	MP2_FAL	MP-2 low flow alarm	autodialer ch 8
18	OS-2400		acid metering pump flow switch	MP3_FAL	MP-3 low flow alarm	autodialer ch 8
19	OS-2500	B1_AUX	air stripper blower aux contacts	P2_OUT	P2 run output	
20	LSH-2200	NASC_LAH	NaOCl secondary containment	GWSYS_SD	GW system shutdown	autodialer ch 4
21	LSL-2200	NA_LAL	NaOCl storage			autodialer ch 7
22	LSH-2210	SASC_LAH	anti-scalant secondary containment	GWSYS_SD	GW system shutdown	autodialer ch 4
23	LSL-2210	SA_LAL	anti-scalant storage			autodialer ch 7
24	LSHH-2100	EQ_LAH	equalization tank	GWSYS_SD	GW system shutdown	autodialer ch 3
25	LSH-2100	EQ_LSH	equalization tank	P2_OUT	P2 transfer pump run output	
26	LSL-2100	EQ_LSL	equalization tank	P2_OUT	P2 transfer pump run output	autodialer ch 3
27	LSLL-2100	EQ_LAL	equalization tank	GWSYS_SD	GW system shutdown	
28	LSHH-2400	HCLSC_LAH	muriatic acid secondary containment	GWSYS_SD	GW system shutdown	autodialer ch 4
29	LSLL-2400	HCL_LAL	muriatic acid storage			autodialer ch 7
30	PSH-2300	FLTR_PAH	filter differential pressure	GWSYS_SD	GW system shutdown	autodialer ch 5
31	LSHH-2500	AS_LAH	air stripper sump	GWSYS_SD	GW system shutdown	autodialer ch 3
32	LSHH-2501	BLDG_LAH	building secondary containment	GWSYS_SD	GW system shutdown	autodialer ch 4
33	PSL-2500	AS_PAL	air stripper blower low pressure	GWSYS_SD	GW system shutdown	autodialer ch 5
34	PSH-2500	AS_PAH	air stripper blower high pressure	GWSYS_SD	GW system shutdown	autodialer ch 5
35	LSH-2590	EFF_LSHH	effluent discharge	GWSYS_SD	GW system shutdown	autodialer ch 3
36	LSH-2010	RW1_WTE	RW-1 water table elevation	P7_OUT	P7 run output	
37	LSL-2010	RW1_WTE	RW-1 water table elevation	P7_OUT	P7 run output	
38	LSLL-2010	RW1_WTE	RW-1 water table elevation	P7_OUT	P7 run output	autodialer ch 6
39	LSH-2020	RW1S_WTE	RW-1S water table elevation	P8_OUT	P8 run output	
40	LSL-2020	RW1S_WTE	RW-1S water table elevation	P8_OUT	P8 run output	
41	LSLL-2020	RW1S_WTE	RW-1S water table elevation	P8_OUT	P8 run output	autodialer ch 6

	Alarm Condition			Result #1		Result #2
Line no.	P&ID Tagname	HMI Tagname	Description	HMI Tagname	Description	Description
42	FIT-2300	ASIN_FR	air stripper influent flow transmitter	GWSYS_SD	GW system shutdown	autodailer ch 5
43	AIT-2500	EFF_AAH	effluent pH transmitter	GWSYS_SD	GW system shutdown	autodailer ch 5
44	AIT-2500	EFF_AAL	effluent pH transmitter	GWSYS_SD	GW system shutdown	autodailer ch 5

NOTES:
Any GW system shutdown causes autodialer ch 1 output. Autodialer ch 2 output is spare.
P2 transfer pump does not operate when in EQ Tank Bypass mode.

Table 3-3
Control Tag Database - GWTF #1

Tag Type	Tag Name	Tag Description	Alarmed	Data Logged	Units	Address
A	alarm_status	alarm status	N	N		
A	all_alarms	all alarms	N	N		
D	AS_LAH	air stripper sump LAH	Y	N		B3:40/0
D	AS_PAH	air stripper blower high pressure	Y	N		B3:40/2
D	AS_PAL	air stripper blower low pressure	Y	N		B3:40/1
A	ASIN_100MG	air stripper influent totalizer 100,000,000 gals	N	Y		F8:22
A	ASIN_10KG	air stripper influent 10K gals totalizer, 10K's gals	N	Y		F8:23
D	ASIN_FAL	air stripper influent low flow alarm	Y	Y		b3:42/8
A	ASIN_FR	air stripper influent flow rate, gpm	N	Y	gpm	F8:2
A	ASIN_G	air stripperi nfluent totalizer, gals	N	Y	gals	F8:24
D	B1_0R	B-1 stop request	N	Y		B3:30/0
A	B1_100HRS	air stripper blower runtime, 100 hrs	N	Y		N7:0
D	B1_1R	air stripper blower start req	N	Y		B3:20/0
D	B1_AM	air stripper blower auto / man	N	Y		B3:10/0
D	B1_AUX	air stripper blower aux contacts	N	Y		I:0/11
D	B1_OUT	B1 run output	N	Y		O:0/8
D	B1_SERV	B! in service	N	Y		B3:4/8
D	B2_0R	B-2 stop req	N	Y		B3:31/0
A	B2_100HRS	SVE blower 100 hours	N	Y		N7:2
D	B2_1R	B-2 start req	N	Y		B3:20/9
D	B2_AM	B-2 auto / man	N	Y		B3:10/9
D	B2_AUX	SVE blower MS auxillary contacts	N	Y		I:1/0
D	B2_FAL	SVE blower low flow alarm	Y	N		B3:41/0
D	B2_OUT	SVE blower run output	N	Y		O:0/9
D	B2_SERV	B2 in service	N	Y		B3:4/9
D	B2_TAH	SVE blower high temperature alarm	Y	N		B3:41/1
D	BLDG_LAH	building secondary containment alarm	Y	N		B3:40/10
D	EFF_AAH	effluent pH high alarm	Y	N		B3:40/14
D	EFF_AAL	effluent pH low alarm	Y	N		B3:40/15
D	EFF_AIC_AM	EFF-AIC auto / man	N	Y		PD10:2/AM
D	EFF_AIC_CE	EFF-AIC cycle enable	N	Y		B3:50/2
A	EFF_AIC_CV	EFF-AIC CV output, 0-16383	N	Y		PD10:2.CVP
A	EFF_AIC_OUT	EFF-AIC CV output, 0-16383	N	Y		N9:83
A	EFF_AIC_SP	EFF-AIC setpoint, 0-14 pH	N	Y		PD10:2.SPS
D	EFF_LAH	effluent high level alarm	Y	N		B3:40/8

Table 3-3
Control Tag Database - GWTF #1

Tag Type	Tag Name	Tag Description	Alarmed	Data Logged	Units	Address
A	EFF_PH	effluent pH	N	Y		F8:4
D	EQ_BYPASS	EQ tank bypass mode	N	Y		B3:4/13
D	EQ_ID	MMI initiate EQ drain	N	Y		B3:1/3
D	EQ_IF	MMI initiate EQ tankfill	N	Y		B3:1/8
D	EQ_LAH	EQ tank high-high level	Y	N		B3:40/5
D	EQ_LAL	EQ tank low-low level	Y	N		B3:40/6
D	EQ_LSH	equalization tank	N	Y		I:1/6
D	EQ_LSL	equalization tank	N	Y		I:1/7
D	EQINF_FAL	equalization tank influent low flow alarm	Y	N		B3:42/9
A	EQINF_FR	EQ tank influent flow rate, gpm	N	Y		F8:3
A	EQINF_LIM	equalization tank influent flow rate low limit	N	Y		f8:15
D	EQSC_LAH	EQ tank secondary containment	Y	N		B3:42/4
D	FLTR_PAH	filter differential pressure high alarm	Y	N		B3:40/9
A	GW_RTIME	GW system runtime today	N	Y	mins	c5:6.acc
D	GWSTOPPING	GW system stopping	N	Y		B3:0/6
D	GWSYS_SD	GW system shutdown	Y	N		B3:45/0
D	HCL_LAL	muriatic acid low level alarm	Y	N		b3:42/5
D	HCLSC_LAH	muriatic acid secondary containment alarm	Y	N		B3:40/7
D	HX_0R	HX stop req	N	Y		B3:31/1
A	HX_100HRS	HX runtime, 100 hours	N	Y		N7:20
D	HX_1R	HX start req	N	Y		B3:20/10
D	HX_AM	HX auto / man	N	Y		B3:10/10
D	HX_AUX	heat exchanger aux	N	Y		I:2/8
D	HX_OUT	heat exchanger run output	N	Y		O:3/6
D	HX_TAH	HX high temperature	Y	N		B3:40/11
D	KO_LAH	SVE knockout tank high level alarm	Y	N		B3:41/2
D	MMI_RESET	system reset	N	Y		B3:0/2
D	MMI_START	system start	N	Y		B3:0/0
D	MMI_STOP	system stop	N	Y		B3:0/1
D	MP1_0R	MP-1 stop req	N	Y		B3:30/6
A	MP1_100HRS	MP1 runtime, 100 hours	N	Y		N7:14
D	MP1_1R	MP-1 start req	N	Y		B3:20/6
D	MP1_AM	MP-1 auto / man	N	Y		B3:10/6
A	MP1_DRCONC	NaOCl dosage rate from MMI, ppmv	N	Y		F8:9
A	MP1_DRFLOW	NaOCl dosage rate calculated in PLC, gal/hr	N	Y	gph	F8:11

Table 3-3
Control Tag Database - GWTF #1

Tag Type	Tag Name	Tag Description	Alarmed	Data Logged	Units	Address
D	MP1_FAL	MP1 low flow alarm	Y	N		B3:40/12
D	MP1_OUT	MP1 run output	N	Y		O:0/3
D	MP1_SERV	MP1 in service	N	Y		B3:4/5
D	MP2_0R	MP-2 stop req	N	Y		B3:30/7
A	MP2_100HRS	MP2 runtime, 100 hours	N	Y		N7:16
D	MP2_1R	MP-2 start req	N	Y		B3:20/7
D	MP2_AM	MP-2 auto / man	N	Y		B3:10/7
A	MP2_DRCONC	sequestering agentdosage rate from MMI, ppmv	N	Y	ppmv	F8:12
A	MP2_DRFLOW	sequestering agent dosage rate calculated in PLC, gal/hr	N	Y	gph	F8:14
D	MP2_FAL	MP2 low flow alarm	Y	N		B3:40/13
D	MP2_OUT	MP2 run output	N	Y		O:0/4
D	MP2_SERV	MP2 in service	N	Y		B3:4/6
D	MP3_0R	MP-3 stop req	N	Y		B3:30/8
A	MP3_100HRS	MP3 runtime, 100 hours	N	Y		N7:18
D	MP3_1R	MP-3 start req	N	Y		B3:20/8
D	MP3_AM	MP-3 auto / man	N	Y		B3:10/8
D	MP3_OUT	MP3 run output	N	Y		O:0/7
D	MP3_SERV	MP3 in service	N	Y		B3:4/7
D	NA_LAL	NaOCl low level alarm	Y	N		b3:42/6
D	NASC_LAH	NaOCl secondary containment alarm	Y	N		B3:40/3
D	P1_0R	P-1 stop req	N	Y		B3:30/1
A	P1_100HRS	P1 runtime, 100 hours	N	Y		N7:4
D	P1_1R	P-1 start req	N	Y		B3:20/1
D	P1_AM	P-1 auto / man	N	Y		B3:10/1
D	P1_AUX	P1 MS auxillary contacts	N	Y		I:0/8
D	P1_OUT	P1 run output	N	Y		O:0/5
D	P1_SEL	P1 select to run	N	Y		b3:3/3
D	P1_SERV	P1 in service	N	Y		B3:4/0
D	P2_0R	P-2 stop req	N	Y		B3:30/2
A	P2_100HRS	P2 runtime, 100 hours	N	Y		N7:6
D	P2_1R	P-2 start req	N	Y		B3:20/2
D	P2_AM	P-2 auto / man	N	Y		B3:10/2
D	P2_AUX	P2 MS auxillary contacts	N	Y		I:0/9
D	P2_OUT	P2 run output	N	Y		O:0/6
D	P2_SEL	P1 select to run	N	Y		b3:3/4

Table 3-3
Control Tag Database - GWTF #1

Tag Type	Tag Name	Tag Description	Alarmed	Data Logged	Units	Address
D	P2_SERV	P2 in service	N	Y		B3:4/13
D	P6_0R	P-6 stop req	N	Y		B3:30/3
A	P6_100HRS	P6 runtime, 100 hours	N	Y		N7:8
D	P6_1R	P-6 start req	N	Y		B3:20/3
D	P6_AM	P-6 auto / man	N	Y		B3:10/3
D	P6_AUX	P6 CU300 run status	N	Y		I:0/0
D	P6_FAIL	P-6 auto shutdown	Y	N		B3:45/4
D	P6_OUT	P6 run output	N	Y		O:0/0
D	P6_SERV	P6 in service	N	Y		B3:4/2
D	P7_0R	P-7 stop req	N	Y		B3:30/4
A	P7_100HRS	P7 runtime, 100 hours	N	Y		N7:10
D	P7_1R	P-7 start req	N	Y		B3:20/4
D	P7_AM	P-7 auto / man	N	Y		B3:10/4
D	P7_AUX	P7 CU300 run status	N	Y		I:0/2
D	P7_FAIL	P-7 CU300 fault	Y	N		B3:42/1
D	P7_OUT	P7 run output	N	Y		O:0/1
D	P7_SERV	P7 in service	N	Y		B3:4/3
D	P9_0R	P-9 stop req	N	Y		B3:30/5
A	P9_100HRS	P9 runtime, 100 hours	N	Y		N7:12
D	P9_1R	P-9 start req	N	Y		B3:20/5
D	P9_AM	P-9 auto / man	N	Y		B3:10/5
D	P9_AUX	P9 CU300 run status	N	Y		I:0/4
D	P9_FAIL	P-9 CU300 fault	Y	N		B3:42/3
D	P9_OUT	P9 run output	N	Y		O:0/2
D	P9_SERV	P9 in service	N	Y		B3:4/4
D	RW7_EXT_SP	RW7-LIC external setpoint	N	Y		f8:16
D	RW7_ID	RW-7 pump down control	N	Y		B3:1/15
D	RW7_LAL	RW7 low level alarm	Y	N		b3:42/0
D	RW7_LIC_AM	RW7-LIC auto / man	N	Y		PD10:0/AM
D	RW7_LIC_CE	RW7-LIC cycle enable	N	Y		B3:50/0
A	RW7_LIC_CV	RW7-LIC CV, 0-100%	N	Y		PD10:0.CVP
A	RW7_LIC_LE	RW7-LIC extra logic enable	N	Y		b3:51/0
A	RW7_LIC_OUT	RW7-LIC CV output, 0-16383	N	Y		N9:23
A	RW7_LIC_SP	RW7-LIC setpoint, 150-200 ft amsl	N	Y	ft amsl	PD10:0.SPS
A	RW7_LTEL	RW-7 level transmitter elevation, ft amsl	N	Y		F8:5

Table 3-3
Control Tag Database - GWTF #1

Tag Type	Tag Name	Tag Description	Alarmed	Data Logged	Units	Address
A	RW7_WC	RW-7 water column, ft	N	Y		F8:0
A	RW7_WTE	RW-7 water table elevation, ft amsl	N	Y		F8:6
D	RW9_EXT_SP	RW9-LIC external setpoint	N	Y		f8:28
D	RW9_ID	RW-9 pump down control	N	Y		B3:2/5
D	RW9_LAL	RW9 low level alarm	Y	N		b3:42/2
D	RW9_LIC_AM	RW9-LIC auto / man	N	Y		PD10:1/AM
D	RW9_LIC_CE	RW9-LIC cycle enable	N	Y		B3:50/1
A	RW9_LIC_CV	RW9-LIC CV, 0-100%	N	Y		PD10:1.CVP
A	RW9_LIC_LE	RW9-LIC extra logic enable	N	Y		b3:51/1
A	RW9_LIC_OUT	RW9-LIC CV output, 0-16383	N	Y		N9:53
A	RW9_LIC_SP	RW9-LIC setpoint, 150-200 ft amsl	N	Y	ft amsl	PD10:1.SPS
A	RW9_LTEL	RW-9 level transmitter elevation, ft amsl	N	Y		F8:7
A	RW9_WC	RW-9 water column, ft	N	Y		F8:1
A	RW9_WTE	RW-9 water tableelevation, ft amsl	N	Y		F8:8
D	SA_LAL	sequestering agent low level alarm	Y	N		b3:42/7
D	SASC_LAH	sequestering agent secondary containment alarm	Y	N		B3:40/4
D	STARTING	system starting	N	Y		B3:0/3
D	STOPPED	system stopped	N	Y		B3:0/7
D	SVE_RTIME	SVE system runtime today	N	Y	mins	c5:7.acc
D	SVESYS_SD	SVE system shutdown	Y	N		B3:46/0
A	unacked_alarms	unacknowledged alarms	N	N		

Tag Type: A= analog (process variable, pv)
D= discrete (status variable, sv)

SVE/Offgas systems have been offline since 2006.

Table 3-4
Control Tag Database - GWTF #2

Tag Type	Tag Name	Tag Description	Alarmed	Data Logged	Units	Address
A	alarm_status	alarm status	N	N		
A	all_alarms	all alarms	N	N		
D	AS_LAH	air stripper sump LAH	Y	N		B3:40/0
D	AS_PAH	air stripper blower high pressure	Y	N		B3:40/2
D	AS_PAL	air stripper blower low pressure	Y	N		B3:40/1
A	ASIN_100MG	air stripper influent totalizer 100,000,000 gals	N	Y		F8:22
A	ASIN_10KG	air stripper influent 10K gals totalizer, 10K's gals	N	Y		F8:23
D	ASIN_FAL	air stripper influent low flow alarm	Y	Y		b3:42/8
A	ASIN_FR	air stripper influent flow rate, gpm	N	Y	gpm	F8:2
A	ASIN_G	air stripper influent totalizer, gals	N	Y	gals	F8:24
D	B1_0R	B-1 stop request	N	Y		B3:30/0
A	B1_100HRS	air stripper blower runtime, 100 hrs	N	Y		N7:0
D	B1_1R	air stripper blower start req	N	Y		B3:20/0
D	B1_AM	air stripper blower auto / man	N	Y		B3:10/0
D	B1_AUX	air stripper blower aux contacts	N	Y		I:0/11
A	B1_HRS	air stripper blower runtime, hours	N	Y		N7:1
D	B1_OUT	B1 run output	N	Y		O:0/8
D	BLDG_LAH	building secondary containment alarm	Y	N		B3:40/10
D	EFF_AAH	effluent pH high alarm	Y	N		B3:40/14
D	EFF_AAL	effluent pH low alarm	Y	N		B3:40/15
D	EFF_AIC_AM	EFF-AIC auto / man	N	Y		PD10:2/AM
D	EFF_AIC_CE	EFF-AIC cycle enable	N	Y		B3:50/2
A	EFF_AIC_CV	EFF-AIC CV output, 0-16383	N	Y		PD10:2.CVP
A	EFF_AIC_OUT	EFF-AIC CV output,0-16383	N	Y		N9:83
A	EFF_AIC_SP	EFF-AIC setpoint, 0-14 pH	N	Y		PD10:2.SPS
D	EFF_LAH	effluent high level alarm	Y	N		B3:40/8
A	EFF_PH	effluent pH	N	Y		F8:4
D	EQ_BYPASS	EQ tank bypass mode	N	Y		B3:1/10
D	EQ_ID	MMI initiate EQ drain	N	Y		B3:1/3
D	EQ_IF	MMI initiate EQ tankfill	N	Y		B3:1/8
D	EQ_LAH	EQ tank high-high level	Y	N		B3:40/5
D	EQ_LAL	EQ tank low-low level	Y	N		B3:40/6
D	EQ_LSH	equalization tank	N	Y		I:1/6
D	EQ_LSL	equalization tank	N	Y		I:1/7
D	EQINF_FAL	EQ tank influent low flow alarm	Y	N		B3:42/10

Table 3-4
Control Tag Database - GWTF #2

Tag Type	Tag Name	Tag Description	Alarmed	Data Logged	Units	Address
A	EQINF_FR	EQ tank influent flow rate, gpm	N	Y		F8:3
A	EQINF_LIM	EQ tank influent low flow limit, gpm	N	Y		F8:15
D	FLTR_PAH	filter differential pressure high alarm	Y	N		B3:40/9
D	GWSTOPPING	GW system stopping	N	Y		B3:0/6
D	GWSYS_SD	GW system shutdown	Y	N		B3:45/0
D	HCL_LAL	muriatic acid low level alarm	Y	N		b3:42/5
D	HCLSC_LAH	muriatic acid secondary containment alarm	Y	N		B3:40/7
D	MMI_RESET	system reset	N	Y		B3:0/2
D	MMI_START	system start	N	Y		B3:0/0
D	MMI_STOP	system stop	N	Y		B3:0/1
D	MP1_0R	MP-1 stop req	N	Y		B3:30/6
A	MP1_100HRS	MP-1 runtime, 100 hours	N	Y		n7:8
D	MP1_AM	MP-1 auto / man	N	Y		B3:10/6
A	MP1_DRCONC	NaOCl dosage rate from MMI, ppmv	N	Y		F8:9
A	MP1_DRFLOW	NaOCl dosage rate calculated in PLC, gal/hr	N	Y	gph	F8:11
D	MP1_FAL	MP1 low flow alarm	Y	N		B3:40/12
D	MP1_OUT	MP1 run output	N	Y		O:0/3
D	MP1_SERV	MP-1 in service	N	Y		b3:3/3
D	MP2_0R	MP-2 stop req	N	Y		B3:30/7
A	MP2_100HRS	MP-2 runtime, 100 hours	N	Y		n7:10
D	MP2_1R	MP-2 start req	N	Y		B3:20/7
D	MP2_AM	MP-2 auto / man	N	Y		B3:10/7
A	MP2_DRCONC	sequestering agent dosage rate from MMI, ppmv	N	Y	ppmv	F8:12
A	MP2_DRFLOW	sequestering agent dosage rate calculated in PLC, gal/hr	N	Y	gph	F8:14
D	MP2_FAL	MP2 low flow alarm	Y	N		B3:40/13
D	MP2_OUT	MP2 run output	N	Y		O:0/4
D	MP2_SERV	MP2 in service	N	Y		b3:3/4
D	MP3_0R	MP-3 stop req	N	Y		B3:30/8
A	MP3_100HRS	MP3 runtime, 100 hours	N	Y		n7:12
D	MP3_1R	MP-3 start req	N	Y		B3:20/8
D	MP3_AM	MP-3 auto / man	N	Y		B3:10/8
D	MP3_OUT	MP3 run output	N	Y		O:0/7
D	MP3_SERV	MP3 in service	N	Y		b3:3/5
D	NA_LAL	NaOCl low level alarm	Y	N		b3:42/6
D	NASC_LAH	NaOCl secondary containment alarm	Y	N		B3:40/3

Table 3-4
Control Tag Database - GWTF #2

Tag Type	Tag Name	Tag Description	Alarmed	Data Logged	Units	Address
D	P1_0R	P-1 stop req	N	Y		B3:30/4
A	P1_100HRS	P1 runtime, 100 hours	N	Y		N7:2
D	P1_1R	P-1 start req	N	Y		B3:20/4
D	P1_AM	P-1 auto / man	N	Y		B3:10/4
D	P1_AUX	P1 CU300 run status	N	Y		I:0/2
D	P1_FAIL	P-1 CU300 fault	Y	N		B3:42/1
D	P1_OUT	P1 run output	N	Y		O:0/1
D	P1_SERV	P1 in service	N	Y		B3:3/1
D	P1S_0R	P-1S stop req	N	Y		B3:30/5
A	P1S_100HRS	P1S runtime, 100 hours	N	Y		N7:4
D	P1S_1R	P-1S start req	N	Y		B3:20/5
D	P1S_AM	P-1S auto / man	N	Y		B3:10/5
D	P1S_AUX	P1S CU300 run status	N	Y		I:0/4
D	P1S_FAIL	P-1S CU300 fault	Y	N		B3:42/3
D	P1S_OUT	P1S run output	N	Y		O:0/2
D	P1S_SERV	P1S in service	N	Y		B3:3/2
D	P2_0R	P-2 stop req	N	Y		B3:30/1
A	P2_100HRS	P2 runtime, 100 hours	N	Y		N7:6
D	P2_1R	P-2 start req	N	Y		B3:20/1
D	P2_AM	P-2 auto / man	N	Y		B3:10/1
D	P2_AUX	P2 MS auxillary contacts	N	Y		I:0/6
D	P2_FAL	P2 low flow alarm	Y	N		B3:42/8
D	P2_OUT	P2 run output	N	Y		O:0/4
D	P2_SEL	P2 select to run	N	Y		b3:3/4
D	P2_SERV	P2 in service	N	Y		B3:3/0
D	RW1_ID	RW-1 pump down control	N	Y		B3:1/15
D	RW1_LAL	RW1 low level alarm	Y	N		b3:42/0
D	RW1_LIC_AM	RW1-LIC auto / man	N	Y		PD10:0/AM
D	RW1_LIC_CE	RW1-LIC cycle enable	N	Y		B3:50/0
A	RW1_LIC_CV	RW1-LIC CV, 0-100%	N	Y		PD10:0.CVP
A	RW1_LIC_OUT	RW1-LIC CV output, 0-16383	N	Y		N9:23
A	RW1_LIC_SP	RW1-LIC setpoint, 150-200 ft amsl	N	Y	ft amsl	PD10:0.SPS
A	RW1_LTEL	RW-1 level transmitter elevation, ft amsl	N	Y		F8:5
A	RW1_WC	RW-1 water column, ft	N	Y		F8:0
A	RW1_WTE	RW-1 water table elevation, ft amsl	N	Y		F8:6

Table 3-4
Control Tag Database - GWTF #2

Tag Type	Tag Name	Tag Description	Alarmed	Data Logged	Units	Address
D	RW1S_ID	RW-8 pump down control	N	Y		B3:2/5
D	RW1S_LAL	RW1S low level alarm	Y	N		b3:42/2
D	RW1S_LIC_AM	RW1S-LIC auto / man	N	Y		PD10:1/AM
D	RW1S_LIC_CE	RW1S-LIC cycle enable	N	Y		B3:50/1
A	RW1S_LIC_CV	RW1S-LIC CV, 0-100%	N	Y		PD10:1.CVP
A	RW1S_LIC_OUT	RW1S-LIC CV output,0-16383	N	Y		N9:53
A	RW1S_LIC_SP	RW1S-LIC setpoint, 150-200 ft amsl	N	Y	ft amsl	PD10:1.SPS
A	RW1S_LTEL	RW-1S level transmitter elevation, ft amsl	N	Y		F8:7
A	RW1S_WC	RW-1S water column, ft	N	Y		F8:1
A	RW1S_WTE	RW-1S water table elevation, ft amsl	N	Y		F8:8
D	SA_LAL	sequestering agent low level alarm	Y	N		b3:42/7
D	SASC_LAH	sequestering agent secondary containment alarm	Y	N		B3:40/4
D	STARTING	system starting	N	Y		B3:0/3
D	STOPPED	system stopped	N	Y		B3:0/7
D	SYS_RTIME	system runtime today	N	Y	mins	c5:6.acc
A	unacked_alarms	unacknowledged alarms	N	N		

Tag Type: A= analog (process variable, pv)
D= discrete (status variable, sv)

Table 5-1
Routine Operating Parameters - GWTF #1

Parameter Description	Normal Value	Upper Limit	Lower Limit	Units
RW-6 water table elevation	150	180	130	ft amsl
Recovery well pump P-6 pressure	30	160	0	psig
Recovery well pump P-6 flow rate	4	7	0	gpm
RW-7 water table elevation	153	180	135	ft amsl
Recovery well pump P-7 pressure	15	97	0	psig
Recovery well pump P-7 flow rate	20	36	0	gpm
RW-9 water table elevation	170	180	135	ft amsl
Recovery well pump P-9 pressure	20	82	0	psig
Recovery well pump P-9 flow rate	10	27	0	gpm
Transfer pump P-1 pumping rate (am)	30 - 35	60	4	gpm
Transfer pump P-1 motor current	1.4 - 1.6	FLA = 1.8	---	amps
Transfer pump P-2 pumping rate (pm)	30 - 35	60	4	gpm
Transfer pump P-1 and P-2 discharge pressure	27	40	20	psig
Transfer pump P-2 motor current	1.4 - 1.6	FLA = 1.8	---	amps
NaOCl concentration in influent	20	na	na	ppmv
NaOCl dosage rate	0.042	0.66	0	gal/hr
MP-1 stroke length	100	100	0	%
Sequesterant (20%) conc in influent	17	na	na	ppmv
Sequestering agent dosage rate	0.036	0.66	0	gal/hr
MP-2 pump stroke length	100	100	20	%
Bag filter differential pressure	<12	20	0	psig
Air stripper blower B-1 flow rate	300 - 350	400	300	scfm
Air stripper blower B-1 motor current	16 - 18	FLA = 22.0	---	amps
Air stripper blower suction pressure	45	70	40	inches W.C. vacuum
Air stripper blower discharge pressure	48	60	40	inches W.C. pressure
Air stripper blower discharge temperature	190	160	220	°F
Effluent pH	7.5	8.3	7	pH units
SVE-1 wellhead vacuum	30	40	20	inches W.C. vacuum
SVE influent flow rate	140	160	120	scfm
SVE blower motor current	5.5 - 7.0	FLA = 8.0	---	amps
SVE blower suction pressure	30	40	20	inches W.C. vacuum
SVE blower discharge pressure	45	60	40	inches W.C. pressure
SVE blower discharge temperature	170	180	158	°F
Heat exchanger motor current	1 - 1.4	FLA = 1.9	---	amps
Heat exchanger discharge temp	110	120	100	°F
GAC #1 discharge pressure	30	---	---	inches W.C. pressure
GAC #2 discharge pressure	15	---	---	inches W.C. pressure
KMnO4 #1 discharge pressure	5	---	---	inches W.C. pressure

Note:
SVE/Offgas systems have been offline since 2006.

Table 5-2
Routine Operating Parameters - GWTF #2

Parameter Description	Normal Value	Upper Limit	Lower Limit	Units
RW-1 water table elevation	111	150	85	ft amsl
Recovery well pump P-1 pressure	30	104	0	psig
Recovery well pump P-1 flow rate	4	7	0	gpm
RW-1S water table elevation	122	150	85	ft amsl
Recovery well pump P-1S pressure	20	97	0	psig
Recovery well pump P-1S flow rate	15	36	0	gpm
Transfer pump pumping rate	25	60	4	gpm
Transfer pump motor current	1.4 - 1.6	FLA = 1.8	0	amps
Transfer pump discharge pressure	25	40	20	psig
NaOCl concentration in influent	20	na	na	ppmv
NaOCl dosage rate	0.03	0.66	0	gal/hr
MP-1 stroke length	100	100	20	%
Sequesterant (20%) conc in influent	12	na	na	ppmv
Sequestering agent dosage rate	0.018	0.66	0	gal/hr
MP-2 stroke length	100	100	20	%
Bag filter differential pressure	<12	20	0	psig
Air stripper blower B-1 flow rate	150	200	0	scfm
Air stripper blower B-1 motor current	6.5 - 7	FLA = 8.0	0	amps
Air stripper blower suction pressure	43	70	30	inches W.C. vacuum
Air stripper blower discharge pressure	<10	---	---	inches W.C. pressure
Air stripper blower discharge temperature	200	250	160	°F
Effluent pH	7.5	8.3	7	pH units

Table 6-1
Routine and Preventative Maintenance Schedule – GWTF #1

System	Task	Recommend frequency
STAT 80 Air Stripper and Blower	Clean trays, and demister	As needed, depending on the amount of hardness in the water. An initial inspection of the trays is suggested after the two to three weeks. If the differential pressure across the unit exceeds 7" of water pressure per tray, the system should be cleaned.
	Clean site glass and level assembly	As needed, depending on the amount of hardness in the water. If the site glass every becomes rust colored, the site glass should be cleaned.
	Replace tray gaskets.	As needed.
	Blower filter cleaning or replacement	As needed, depending on air quality conditions
	Grease blower motor bearings with NLGI #2. Grease, if applicable.	Yearly
	Replace bearings	After 15,000 – 20,000 hours, on average.
Bag Filters	Clean/replace bag filters	As needed, depending on the amount of sediment. If the differential pressure across the bag exceeds 12 psi, then the bag should be serviced.
Transfer Pumps	Disassemble, inspect, and clean impeller housing	Yearly, but may require service more often if the water hardness level is high.
	Grease motor with NLGI #2, if applicable.	Yearly
Chemical Feed Pumps	Monitor chemical usage	Monitor the chemical usage rate at your convenience.
	Check pump for proper zero position (stroke knob).	Periodically.
	Replace Liquifram (Diaphragm), cartridge valves or seal rings/valve balls, valve cap assemblies, and injection check valve spring.	Yearly.

System	Task	Recommend frequency
Exhaust Fans	Lubricate motors using SAE 20 non-detergent oil.	Every six months.
	Clean propeller blades and motor of excessive dirt.	Periodically.
Air Conditioners	Lubricate fan motor using 2 – 3 drops of light machine oil.	Every three months.
	Clean intake filter.	Periodically.
Roll-Up Doors	Lubricate roller chains, spur gears, guides, end brackets, bearings, and lock mechanisms.	Periodically.

Table 6-2
Routine and Preventative Maintenance Schedule – GWTF #2

System	Task	Recommend frequency
STAT 30 Air Stripper and Blower	Clean trays, and demister	As needed, depending on the amount of hardness in the water. An initial inspection of the trays is suggested after the two to three weeks. If the differential pressure across the unit exceeds 7" of water pressure per tray, the system should be cleaned.
	Clean site glass and level assembly	As needed, depending on the amount of hardness in the water. If the site glass every becomes rust colored, the site glass should be cleaned.
	Replace tray gaskets	As needed.
	Blower filter cleaning or replacement	As needed, depending on air quality conditions
	Grease blower motor bearings with NLGI #2. Grease, if applicable.	Yearly
	Replace bearings	After 15,000 – 20,000 hours, on average.
Bag Filters	Clean/replace bag filters	As needed, depending on the amount of sediment. If the differential pressure across the bag exceeds 12 psi, then the bag should be serviced.
Transfer Pumps	Disassemble, inspect, and clean impeller housing	Yearly, but may require service more often if the water hardness level is high.
	Grease motor with NLGI #2, if applicable.	Yearly
Chemical Feed Pumps	Monitor chemical usage	Monitor the chemical usage rate at your convenience.
	Check pump for proper zero position (stroke knob).	Periodically.
	Replace Liquifram (Diaphragm), cartridge valves or seal rings/valve balls, valve cap assemblies, and injection check valve spring.	Yearly.
Exhaust Fans	Lubricate motors using SAE 20 non-detergent oil.	Every six months.

System	Task	Recommend frequency
	Clean propeller blades and motor of excessive dirt.	Periodically.
Air Conditioners	Lubricate fan motor using 2 – 3 drops of light machine oil.	Every three months.
	Clean intake filter.	Periodically.
Roll-Up Doors	Lubricate roller chains, spur gears, guides, end brackets, bearings, and lock mechanisms.	Periodically.

Table 6-3
Spare Parts List

System	Spare Part(s) Description	On-Hand	Upon Request
STAT 80 Air Stripper	Carbonair #211451 STAT 80 tray gasket		X
	Carbonair #127581 STAT 30/80 polypropylene mist eliminator pad	X	
	Carbonair #117842 VL GD flapper		X
	Carbonair #117923 Float ball 5 SS		X
	Carbonair #211451 STAT 80 tray gasket	X	
	Carbonair #128272 Pressure gauge (0-100" wc)	X	
	Carbonair #108357 Sample port	X	
	Carbonair #124827 Dwyer model 1950-5 differential pressure switch		X
STAT 30 Air Stripper	Carbonair #117842 VL GD flapper		X
	Carbonair #117923 Float ball 5 SS		X
	Carbonair #211452 STAT30 tray gasket	X	
	Carbonair #128272 Pressure gauge (0-100" wc)	X	
	Carbonair #127581 STAT 30/80 polypropylene mist eliminator pad	X	
	Carbonair #108357 Sample port	X	
	Carbonair #124827 Dwyer model 1950-5 differential pressure switch		X
Bag Filters	Carbonair #108357 Sample port	X	
	Carbonair #211320 25 Micron bag filter	X	
	Carbonair #210027 50 Micron bag filter		X
	Carbonair #166980 Bag filter, oil removing	X	
	Carbonair #165924 Pressure gauge (0-60 psi)	X	
	Carbonair #108365 Pressure gauge (0-100 psi)	X	
	Carbonair #214737 O-ring for bag filter housing lid	X	
	Carbonair #214738 O-ring for bag filter basket	X	
	Carbonair #163286 Barksdale model DPD1T-GH80SS differential pressure switch (4-80 PSI)		X
	Filter basket		X
Chemical Feed Pumps	No on-hand spare parts recommended. Spare Parts Kit or RPM ProPacs available from LMI. Refer to the information contained in Appendix C.		X
Well Pumps	No on-hand spare parts recommended. Service kits and service tools available from Grundfos. Refer to the information contained in Appendix L.		X
Pressure Transducers	No on-hand spare parts recommended. Service provided by Pressure Systems. Refer to the information contained in Appendix L.		X
Transfer pumps	No on-hand spare parts recommended. Replacement parts available from Corcoran. Refer to spare parts list in Appendix B.		X
Exhaust Fans	No on-hand spare parts recommended. Replacement parts available from Dayton. Refer to spare parts list in Appendix M.		X
Air conditioners	No on-hand spare parts recommended. Replacement parts available from Nordic Air. Refer to spare parts list in Appendix M.		X

System	Spare Part(s) Description	On-Hand	Upon Request
Roll-up doors	No on-hand spare parts recommended. Replacement parts available from Cornell KH International. Refer to spare parts list in Appendix M.		X

Table 7-1
Routine Inspection, Monitoring, and Maintenance Schedule

Daily/Weekly Checklist Items
• Check/record readings from all instruments, meters, and gauges • Check overall plant operations • Check OIT/PLC for alarm conditions • Check all valve positions • Change bag filters when DP reaches 12 psig • Pull weeds and clean grounds • Check all sumps in the SVE lines and drain if necessary
Monthly Checklist Items
• Check off-gas treatment vessels and stacks for moisture collection • Check well vaults and pull boxes for leaks • Restart computers
Quarterly Checklist Items
• Turn all valves
Bi-Annual Checklist Items
• Change eyewash liquid • Lubricate exhaust fan motors • Lubricate roll-up doors
Annual Checklist Items
• Grease fittings on blowers • Grease/lubricate all motors • Grease transfer pump and clean impeller housing as needed • Pull and check well pump for biofouling • Shock-chlorinate recovery wells as needed • Clean transformers (certified electrician) • Clean exhaust fan blades
Periodic / As-Needed Checklist Items
• Drain moisture separator • Clean or replace blower inlet air filters (all blowers) • Clean AC intake filter • Empty condensate collection drums at TU#2 and TU#4 and treat at TU#3

NOTE: Refer to Tables 6-1 and 6-2 for additional details regarding routine maintenance.

Table 8-1
General Troubleshooting Guidelines – GWTF #1

System	Problem	Possible Cause	Solution
GWTF #1 - Overview	**One or more components will not run in AUTO**	**System-wide shutdown conditions exist**	**Examine the ALARM screen, acknowledge any existing alarms, click the RESET button at the top of any screen, and investigate any remaining alarm conditions. All alarm conditions capable of preventing AUTO operation are listed in Table 3-1.**
SVE Blower[1]	Blower will run in "MAN" but not in "AUTO"	Alarm conditions – General	Clear any alarm condition and reset the control panel, see "Section 3" for alarm interlocks. Conditions with obvious solutions include high KO tank water level, secondary containment leak detection. See HX troubleshooting for high HX discharge temperature.
		Low flow alarm	Remove and inspect flow switch and flapper. Check continuity across switch terminals with flapper in up and down positions. If switching action is not detected, replace switch. If switching action is detected, examine flapper for scale or corrosion buildup. Clean and replace.
		SVE blower high discharge temperature	Check for low flow situation (may not be low enough for a low flow alarm), high differential pressure across the inlet filter, or high discharge pressure indicating blockage in the off-gas treatment system. Clean or replace filter. Check vacuum at wellhead versus KO tank and determine if pressure losses are excessive. Check for blockage in piping. Check pressure drops across GAC and KMnO4 vessels.
	Blower will not run in the "MAN" position	Tripped circuit protector	Open the inner door and reset the circuit protector. Inspect the system thoroughly and check the operating conditions. If it will run at least momentarily, check amps at startup and compare to initial operating conditions.
		Motor temperature switch is inoperative	Check to see that the motor temperature switch has been wired, or that there is a jumper, if a switch is not present.
		Faulty Blower	Refer to Appendix or contact CARBONAIR for help in diagnosing faulty blower.

System	Problem	Possible Cause	Solution
	Blower runs at a reduced performance	Incorrect blower rotation	Verify and change rotation
		Inlet filter fouled	Clean or replace inlet filter
		Excessive effluent pressure	Verify operating condition. Ensure that there is not excessive backpressure on the unit, (eg, fouled Carbon bed)
		Moisture separator relief valve set to low	Adjust pressure relief valve, be careful not to overload blower motor
	Abnormal sound	Impeller rubbing against housing	Adjust impeller
		Inlet filter fouled	Clean or replace inlet filter
		Bearings defective	Change bearings
	Motor overheats	Impeller rubbing against housing	Adjust impeller
		Inlet filter fouled	Clean or replace inlet filter
		Bearings defective	Change bearings
		One phase of stator winding short circuited	Rewind or purchase new motor
		Operating beyond performance range	Reduce system pressure/vacuum
Well Pumps	Pump will run in "MAN" but not in "AUTO"	Alarm conditions – General	Clear any alarm condition and reset the control panel. See "Section 3" for alarm interlocks.
		CU300 fault	Check the CU300 controller for a fault condition. Follow instructions in Grundfos® manual for troubleshooting
		Well water level is below the cycle off level.	Check the LSL switch setting in the interlocks Table and allow the aquifer sufficient time to re-charge the well. When the water table elevation exceeds the low level switch, click the START button on the pump control panel.
	Pump will not run in the "MAN" position	CU300 controller not properly setup for remote control.	Check CU300 controller for proper setup for remote control of on-off and motor speed.
		PID controller output set to 0%	Adjust the PID controller output.
		Tripped circuit protector	Open the inner door and reset the circuit protector. Inspect the system thoroughly and check the operating conditions.
		Motor temperature switch is inoperative	Check to see that the motor temperature switch has been wired, or that there is a jumper, if a switch is not present.

System	Problem	Possible Cause	Solution
		Faulty pump	Refer to Appendix or contact CARBONAIR for help in diagnosing faulty pump.
	Pump operating, but at reduced performance	Incorrect pump rotation	Verify and change rotation
		Pumping sediment	The pump may be too close to the bottom of the well. Move the pump up.
		Pump restricted	Inspect and clean all effluent lines. Check to ensure that discharge valves are open.
STAT Air Stripper	Water in air discharge line	Water flow rate too high	Verify water flow rate conditions and adjust flow rate accordingly
		Air flow rate too high	Verify airflow rate conditions and adjust flow rate accordingly.
		Foaming	Contact CARBONAIR for a foaming test kit.
	High Pressure Drop Pressure in the unit exceeds the recommended maximum (9" H_2O per tray).	Water flow rate too high	Verify water flow rate conditions and adjust flow rate accordingly
		Air flow rate too high	Verify airflow rate conditions and adjust flow rate accordingly.
		Excessive effluent pressure	Verify operating condition. Ensure that there is not excessive backpressure on the unit, (i.e. reduced pipe sizes, fouled Carbon bed, or fouled CATOX.)
		Trays fouled	Inspect and clean trays
	Reduction in treatment performance	Inadequate air/water ratio	Verify that the system flows are within design specifications
		Aeration trays are fouled	Clean STAT trays
	Leaky Gaskets	Pressure drop too high	See "STAT-High Pressure Drop" section
		Damaged gaskets	Replace leaky gasket
STAT Blower[1]	Blower will run in "MAN" but not in "AUTO"	Alarm conditions – General	Clear any alarm condition and reset the control panel. See "Section 3" for alarm interlocks.
		High pressure alarm	Check for high discharge pressure indicating blockage in the off-gas treatment system. Check pressure drops across GAC and KMnO4 vessels. Check for proper operation of the discharge check valve. Check for adequate accumulation of water on air stripper trays. Check pressure switch adjustment.

System	Problem	Possible Cause	Solution
		Low pressure alarm	Check the inlet filter and clean or replace as necessary. Check air stripper trays for fouling and clean if necessary. Check pressure switch adjustment.
	Blower will not run in the "MAN" position	Tripped circuit protector	Open the inner door and reset the circuit protector. Inspect the system thoroughly and check the operating conditions. . If it will run at least momentarily, check amps at startup and compare to initial operating conditions.
		Motor temperature switch is inoperative	Check to see that the motor temperature switch has been wired, or that there is a jumper, if a switch is not present.
		Faulty Blower	Refer to Appendix or contact CARBONAIR for help in diagnosing faulty blower.
	Blower runs at a reduced performance	Incorrect blower rotation	Verify and change rotation
		Inlet filter fouled	Clean or replace inlet filter
		Excessive effluent pressure	See "STAT-High Pressure Drop" section
	Abnormal sound	Impeller rubbing against housing	Adjust impeller
		Inlet filter fouled	Clean or replace inlet filter
		Bearings defective	Change bearings
	Motor overheats	Impeller rubbing against housing	Adjust impeller
		Inlet filter fouled	Clean or replace inlet filter
		Bearings defective	Change bearings
		One phase of stator winding short circuited	Rewind or purchase new motor
		Operating beyond performance range	Reduce system pressure/vacuum
Transfer Pumps	Pump will run in "MAN" but not in "AUTO"	Alarm conditions – General	Clear any alarm condition and reset the control panel. See "Section 3" for alarm interlocks.
		Equalization tank water level too low	Fill the tank to any level above the LSL (cycle off level) and click the START button on the pump control panel.
	Pump will not run in the "MAN" position	Tripped circuit protector	Open the inner door and reset the circuit protector. Inspect the system thoroughly and check the operating conditions. . If it will run at least momentarily, check amps at startup and compare to initial operating conditions.

System	Problem	Possible Cause	Solution
		Motor temperature switch is inoperative	Check to see that the motor temperature switch has been wired, or that there is a jumper, if a switch is not present.
		Faulty pump	Refer to Appendix or contact CARBONAIR for help in diagnosing faulty pump.
	Pump operating, but at reduced performance	Incorrect pump rotation	Verify and change rotation
		Pump restricted	Inspect and clean all influent lines, pump head and effluent lines.
	Pump leaking at seal	Shaft seal worn	Replace shaft seal
		Leak in system	Inspect system for leaks
Chemical Feed Pumps	Pump will run in "MAN" but not in "AUTO"	Low flow alarm	Check Digi-Pulse unit for proper operation, adjustment and pulse output.
	Pump will not run in the "MAN" position	PID controller output or dosage rate too low.	Check PID controller output on PID screen and adjust as necessary. Check dosage rate on PID screen and enter new value as necessary.
	Pump loses prime	Out of Chemical	Add more chemical
		Check valve not working or installed incorrectly	See Appendix for installation, make sure check valve functioning.
	Pump will not prime	Output not set properly	Set speed and stroke to 100%
		Suction lift too high	Lower pump
	Pump fails to pump	Worn seal ring, or diaphragm.	Inspect and replace damaged item
		Stroke setting too low	Adjust setting to a higher value
		Pump in not getting power	Confirm that the pump is getting power and be sure that the pump is enabled.
		Pump has failed	Refer to Appendix or contact CARBONAIR for help in diagnosing faulty pump.
GPC Vessels[1]	Early breakthrough or increased carbon usage	Actual concentrations higher than designed	Sample and Analyze influent water to determine if design contaminants or concentrations are different than anticipated. Contact Carbonair for revised modeling
		Additional contaminants present	
		High inlet temperature	Add heat exchanger
		High inlet relative Humidity	Add in-line duct heater for humidity control
	Higher than normal pressure drop	High inlet temperature	Check heat exchanger discharge temperature switch for proper operation.
		High inlet relative Humidity	Check GPC inlet piping for mist or water droplets and, if found, troubleshoot the air stripper as described earlier.

System	Problem	Possible Cause	Solution
		Accumulation of particles	Sample the carbon to determine if solids are clogging the bed. Back track to determine the source and correct
		Wet carbon	Dry out the carbon bed by draining any condensate and blow clean-dry air through the vessel.
Exhaust Fan	Excessive noise	Noisy motor bearings	Lubricate or replace bearings
		Loose fan blade	Tighten set screws
		Crooked or damaged propeller	Straighten or replace fan blade
	Insufficient air flow	Damper (shutter) closed/shut	Repair shutter
		Low voltage	Determine cause and correct

Note:
1. SVE/Offgas systems have been offline since 2006.

Table 8-2
General Troubleshooting Guidelines – GWTF #2

System	Problem	Possible Cause	Solution
GWTF #2 - Overview	**One or more components will not run in AUTO**	**System-wide shutdown conditions exist**	**Examine the ALARM screen, acknowledge any existing alarms, click the RESET button at the top of any screen, and investigate any remaining alarm conditions. All alarm conditions capable of preventing AUTO operation are listed in Table 3-2.**
Well Pumps	Pump will run in "MAN" but not in "AUTO"	Alarm conditions – General	Clear any alarm condition and reset the control panel. See "Section 3" for alarm interlocks.
		CU300 fault	Check the CU300 controller for a fault condition. Follow instructions in Grundfos® manual for troubleshooting
		Well water level is below the cycle off level.	Check the LSL switch setting in the interlocks Table and allow the aquifer sufficient time to re-charge the well. When the water table elevation exceeds the low level switch, click the START button on the pump control panel.
	Pump will not run in the "MAN" position	CU300 controller not properly setup for remote control.	Check CU300 controller for proper setup for remote control of on-off and motor speed.
		PID controller output set to 0%	Adjust the PID controller output.
		Tripped circuit protector	Open the inner door and reset the circuit protector. Inspect the system thoroughly and check the operating conditions.
		Motor temperature switch is inoperative	Check to see that the motor temperature switch has been wired, or that there is a jumper, if a switch is not present.
		Faulty pump	Refer to Appendix or contact CARBONAIR for help in diagnosing faulty pump.
	Pump operating, but at reduced performance	Incorrect pump rotation	Verify and change rotation
		Pumping sediment	The pump may be too close to the bottom of the well. Move the pump up.
		Pump restricted	Inspect and clean all effluent lines. Check to ensure that discharge valves are open.

System	Problem	Possible Cause	Solution
STAT Air Stripper	Water in air discharge line	Water flow rate too high	Verify water flow rate conditions and adjust flow rate accordingly
		Air flow rate too high	Verify airflow rate conditions and adjust flow rate accordingly.
		Foaming	Contact CARBONAIR for a foaming test kit.
	High Pressure Drop Pressure in the unit exceeds the recommended maximum (9" H_2O per tray).	Water flow rate too high	Verify water flow rate conditions and adjust flow rate accordingly
		Air flow rate too high	Verify airflow rate conditions and adjust flow rate accordingly.
		Excessive effluent pressure	Verify operating condition. Ensure that there is not excessive backpressure on the unit.
		Trays fouled	Inspect and clean trays
	Reduction in treatment performance	Inadequate air/water ratio	Verify that the system flows are within design specifications
		Aeration trays are fouled	Clean STAT trays
	Leaky Gaskets	Pressure drop too high	See "STAT-High Pressure Drop" section
		Damaged gaskets	Replace leaky gasket
STAT Blower	Blower will run in "MAN" but not in "AUTO"	Alarm conditions – General	Clear any alarm condition and reset the control panel. See "Section 3" for alarm interlocks.
		High pressure alarm	Check for high discharge pressure indicating blockage in the off-gas discharge piping. Check for adequate accumulation of water on air stripper trays. Check pressure switch adjustment.
		Low pressure alarm	Check the inlet filter and clean or replace as necessary. Check air stripper trays for fouling and clean if necessary. Check pressure switch adjustment.
	Blower will not run in the "MAN" position	Tripped circuit protector	Open the inner door and reset the circuit protector. Inspect the system thoroughly and check the operating conditions. . If it will run at least momentarily, check amps at startup and compare to initial operating conditions.
		Motor temperature switch is inoperative	Check to see that the motor temperature switch has been wired, or that there is a jumper, if a switch is not present.
		Faulty Blower	Refer to Appendix or contact CARBONAIR for help in diagnosing faulty blower.
	Blower runs at a reduced performance	Incorrect blower rotation	Verify and change rotation
		Inlet filter fouled	Clean or replace inlet filter

System	Problem	Possible Cause	Solution
		Excessive effluent pressure	See "STAT-High Pressure Drop" section
	Abnormal sound	Impeller rubbing against housing	Adjust impeller
		Inlet filter fouled	Clean or replace inlet filter
		Bearings defective	Change bearings
	Motor overheats	Impeller rubbing against housing	Adjust impeller
		Inlet filter fouled	Clean or replace inlet filter
		Bearings defective	Change bearings
		One phase of stator winding short circuited	Rewind or purchase new motor
		Operating beyond performance range	Reduce system pressure/vacuum
Transfer Pump	Pump will run in "MAN" but not in "AUTO"	Alarm conditions – General	Clear any alarm condition and reset the control panel. See "Section 3" for alarm interlocks.
		Equalization tank water level too low	Fill the tank to any level above the LSL (cycle off level) and click the START button on the pump control panel.
	Pump will not run in the "MAN" position	Tripped circuit protector	Open the inner door and reset the circuit protector. Inspect the system thoroughly and check the operating conditions. . If it will run at least momentarily, check amps at startup and compare to initial operating conditions.
		Motor temperature switch is inoperative	Check to see that the motor temperature switch has been wired, or that there is a jumper, if a switch is not present.
		Faulty pump	Refer to Appendix or contact CARBONAIR for help in diagnosing faulty pump.
	Pump operating, but at reduced performance	Incorrect pump rotation	Verify and change rotation
		Pump restricted	Inspect and clean all influent lines, pump head and effluent lines.
	Pump leaking at seal	Shaft seal worn	Replace shaft seal
		Leak in system	Inspect system for leaks
Chemical Feed Pumps	Pump will run in "MAN" but not in "AUTO"	Low flow alarm	Check Digi-Pulse unit for proper operation, adjustment and pulse output.
	Pump will not run in the "MAN" position	PID controller output or dosage rate too low.	Check PID controller output on PID screen and adjust as necessary. Check dosage rate on PID screen and enter new value as necessary.

System	Problem	Possible Cause	Solution
	Pump loses prime	Out of Chemical	Add more chemical
		Check valve not working or installed incorrectly	See Appendix for installation, make sure check valve functioning.
	Pump will not prime	Output not set properly	Set speed and stroke to 100%
		Suction lift too high	Lower pump
	Pump fails to pump	Worn seal ring, or diaphragm.	Inspect and replace damaged item
		Stroke setting too low	Adjust setting to a higher value
		Pump in not getting power	Confirm that the pump is getting power and be sure that the pump is enabled.
		Pump has failed	Refer to Appendix or contact CARBONAIR for help in diagnosing faulty pump.
Exhaust Fan	Excessive noise	Noisy motor bearings	Lubricate or replace bearings
		Loose fan blade	Tighten set screws
		Crooked or damaged propeller	Straighten or replace fan blade
	Insufficient air flow	Damper (shutter) closed/shut	Repair shutter
		Low voltage	Determine cause and correct

NOTES:

1. AREA WITHIN THE FENCE AND IN FRONT OF GATES COVERED WITH CRUSHER RUN SELECT FILL UNDERLAIN BY GEOTEXTILE FILTER FABRIC. ALL OTHER DISTURBED AREAS RESTORED TO PRE-EXISTING CONDITIONS.
2. RE-ESTABLISH VEGETATION IN AREAS IMPACTED BY CONSTRUCTION, EXCLUDING AREAS DESIGNATED FOR CRUSHED STONE.
3. REPAIR EXISTING FENCE SURROUNDING FACILITY #1 COMPOUND.
4. DUAL PHASE AND SVE PIPE TRENCH DETAIL SIMILAR
5. 250MCM INSULATED COPPER WIRE BURIED 36" BELOW GROUND SURFACE IN 3" DIAMETER PVC CONDUIT.
6. 4" DIAMETER SCH. 80 PVC PIPE BURIED MINIMUM OF 18" BELOW GRADE. 6" OF SELECT FILL MATERIAL INSTALLED ON ALL SIDES WITH WARNING TAPE PLACED 6" ABOVE PIPE. PIPE SLOPED TO DRAIN TOWARDS SUMP.

AIR EXHAUST PIPE TRENCH SEE NOTE 6
NEW U/G ELECTRICAL SERVICE SEE NOTE 5
EXISTING FENCE SEE NOTE 3
CRUSHER RUN SELECT FILL UNDERLAIN BY GEOTEXTILE FILTER FABRIC
EQUIPMENT PAD
AREA GRADED AND SURFACED WITH GRAVEL BY PROPERTY OWNER (FORD DEALER)
INJECTION WELL (TYP.)
MONITORING WELL (TYP.)
RIP-RAP
NEW 208V-3 PHASE POWER SERVICE POLE
CHECK DAM
INFLUENT PIPE TRENCH
EFFLUENT PIPE AND ELECTRICAL CONDUIT TRENCH
RIP-RAP
CLEAR AND REVEGETATE ALONG NEW EFFLUENT TRENCH LINE
CHAIN LINK FENCE
DOUBLE LEAF VEHICULAR SWING GATE (TYP.)
AIR EXHAUST PIPE TRENCH SEE NOTE 6
SVE PIPE TRENCH SEE NOTE 5
INFLUENT PIPE AND ELECTRICAL CONDUIT TRENCH.
PULLBOX
SVE PIPE TRENCH SEE NOTE 4
DUAL PHASE PIPE TRENCH SEE NOTE 4
SVE WELL VAULT
EXISTING EXTRACTION WELL RW-7. TOC EL. 202.56 FT AMSL
EXTRACTION WELL RW-9 TOC EL. 202.27 FT AMSL
GROUNDWATER EXTRACTION WELL VAULTS
EFFLUENT OUTFALL DISCHARGED TO EXISTING STORM SEWER INLET
POTABLE WATER SERVICE LINE
NEW WATER SERVICE CONNECTION PER WAPA
EXISTING WATER METER BOX
APPROXIMATE LOCATION 10" PVC SEWER ACCORDING TO PROPERY OWNERS - NOT LOCATED THIS SURVEY
APPROXIMATE LOCATION ACCORDING TO WAPA PLANS NOT LOCATED THIS SURVEY
N 187630.00
E 1035900.00
N 187630.00
E 1036400.00
SCHOOL (2-story conc. bldg.)
Satellite Dish Site (no access)
6'-9' Ht. Concrete Retaining Wall
TREATMENT FACILITY #1
PM
GAC
Curb/Wall
Top of 4" Pipe Elev. 178.79
Box Culvert Invert Elev. 177.86'
Top of Pipe Elev. 200.32'
Concrete Pad Elev. 202.2
RW-6 TOC EL. 201.04 FT. AMSL
Entrance, 2nd Flr Elev. 213.49
Open Shed
Open Shed
1 Story Conc. Bldg. Car Parts Office
Water Tank
Wall and Shed
Gravel Drive
CARIBBEAN AUTO (Office) 1 Story Concrete Bldg
Conc. Swale
Car Repair
Open Shed
Concrete Pavement
Grass
Conc. Box Culvert (5'x3'Inside)
1-story Masonry Bldg
1-story Masonry Bldg
Loading dock el = 203
Covered Loading Dock el = 205.3
Broken Ashpalt/ Dirt Parking Area
Dirt Drive
Generator Bldg.
1000 gal Tank
CURRICULUM CENTER BUILDING
Flag Pole
Concrete Slab
AC units in fenced area
AC on
Water Meters
SCALE IN FEET
10 0 20

REV. NO.	DATE	DRWN	CHK'D	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

DESIGNED BY: BSL
DRAWN BY: ANH
SHEET CHK'D BY: GWW
CROSS CHK'D BY: SFS
APPROVED BY: GWW
DATE: 6/8/04

Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

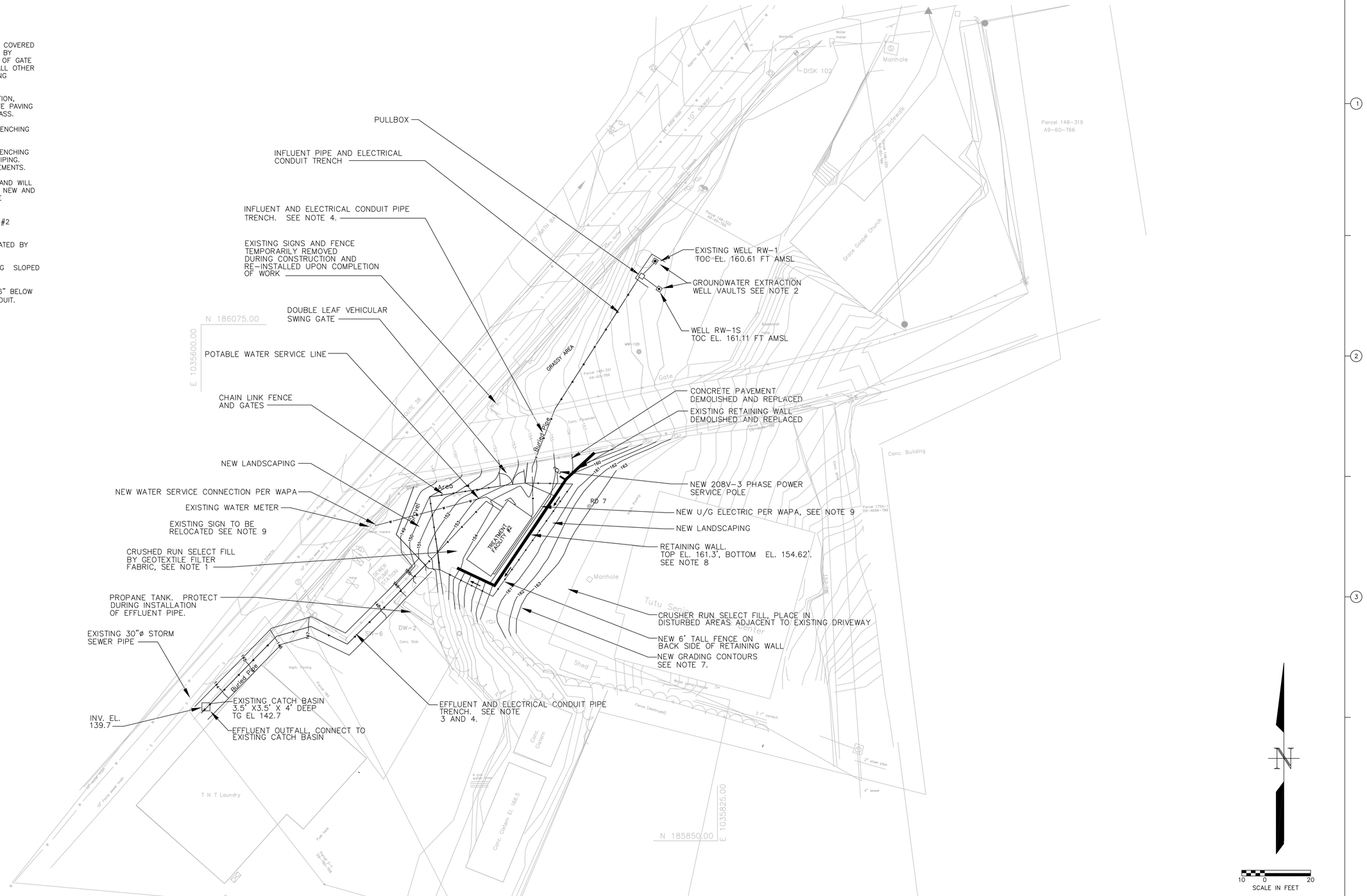
SITE LAYOUT AND YARD PIPING
GWTF #1

PROJECT NO. 03-209
FILE NAME: Sheet 2-1.dwg

SHEET NO.
2-1

NOTES:

1. AREA WITHIN AND ADJACENT TO THE FENCE COVERED WITH CRUSHER RUN SELECT FILL UNDERLAIN BY GEOTEXTILE FILTER FABRIC. AREA IN FRONT OF GATE COVERED WITH NEW CONCRETE DRIVEWAY. ALL OTHER DISTURBED AREAS RESTORED TO PRE-EXISTING CONDITIONS.
2. ALL GRASSY AREAS IMPACTED BY CONSTRUCTION, EXCLUDING AREAS DESIGNATED FOR CONCRETE PAVING AND CRUSHED STONE, REVEGITATED WITH GRASS.
3. RESURFACE ASPHALT AREAS IMPACTED BY TRENCHING FOR EFFLUENT PIPE PER DPW REQUIRMENTS.
4. REPLACE CONCRETE PAVING IMPACTED BY TRENCHING ASSOCIATED WITH INFLUENT AND EFFLUENT PIPING. REPLACE ROAD CONCRETE PER DPW REQUIREMENTS.
5. NEW GRADING CONTOURS ARE APPROXIMATE AND WILL BE ADJUSTED IN THE FIELD TO ACCOMODATE NEW AND EXISTING STRUCTURES AND TO PROMOTE SITE DRAINAGE.
6. EQUILIZATION TANK LOCATED INSIDE FACILITY #2 BUILDING.
7. REINSTALL SIGNS AT NEW LOCATIONS DESIGNATED BY CDM.
8. AREA BETWEEN RETAINING WALL AND BUILDING SLOPED TO PREVENT ACCUMULATION OF WATER.
9. 250MCM INSULATED COPPER WIRE BURIED 36" BELOW GROUND SURFACE IN 3" DIAMETER PVC CONDUIT.



REV. NO.	DATE	DRWN	CHKD	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

DESIGNED BY: BSL
DRAWN BY: ANH
SHEET CHK'D BY: GWW
CROSS CHK'D BY: SFS
APPROVED BY: GWW
DATE: 6/8/04

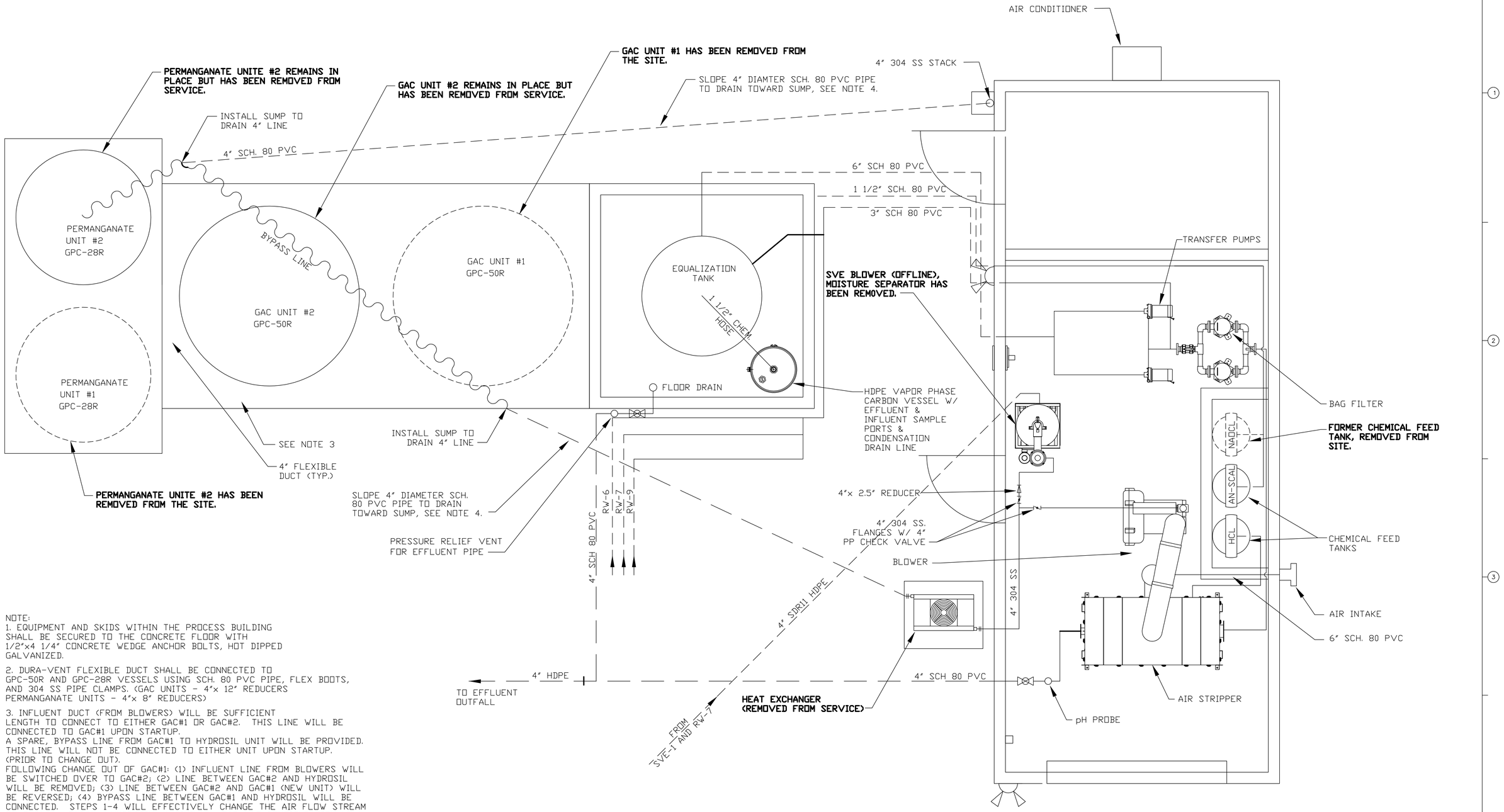
Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

SITE LAYOUT AND YARD PIPING
GWTF #2

PROJECT NO. 03-209
FILE NAME: Sheet 2-2.dwg

SHEET NO.
2-2



NOTE:

1. EQUIPMENT AND SKIDS WITHIN THE PROCESS BUILDING SHALL BE SECURED TO THE CONCRETE FLOOR WITH 1/2"x4 1/4" CONCRETE WEDGE ANCHOR BOLTS, HOT DIPPED GALVANIZED.

2. DURA-VENT FLEXIBLE DUCT SHALL BE CONNECTED TO GPC-50R AND GPC-28R VESSELS USING SCH. 80 PVC PIPE, FLEX BOOTS, AND 304 SS PIPE CLAMPS. (GAC UNITS - 4"x 12" REDUCERS PERMANGANATE UNITS - 4"x 8" REDUCERS)

3. INFLUENT DUCT (FROM BLOWERS) WILL BE SUFFICIENT LENGTH TO CONNECT TO EITHER GAC#1 OR GAC#2. THIS LINE WILL BE CONNECTED TO GAC#1 UPON STARTUP.
A SPARE, BYPASS LINE FROM GAC#1 TO HYDROSIL UNIT WILL BE PROVIDED. THIS LINE WILL NOT BE CONNECTED TO EITHER UNIT UPON STARTUP. (PRIOR TO CHANGE OUT).
FOLLOWING CHANGE OUT OF GAC#1: (1) INFLUENT LINE FROM BLOWERS WILL BE SWITCHED OVER TO GAC#2; (2) LINE BETWEEN GAC#2 AND HYDROSIL WILL BE REMOVED; (3) LINE BETWEEN GAC#2 AND GAC#1 (NEW UNIT) WILL BE REVERSED; (4) BYPASS LINE BETWEEN GAC#1 AND HYDROSIL WILL BE CONNECTED. STEPS 1-4 WILL EFFECTIVELY CHANGE THE AIR FLOW STREAM TO GAC#2 — GAC#1— HYDROSIL.. A SIMILAR LEAD-LAG CONFIGURATION WILL APPLY TO THE PERMANGANATE UNITS.

4. AIR EXHAUST LINE BURIED APPROXIMATELY 12" BELOW GROUND SURFACE.

2 0 4

SCALE IN FEET

REV. NO.	DATE	DRWN	CHK'D	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

DESIGNED BY: BSL
DRAWN BY: ANH
SHEET CHK'D BY: GWW
CROSS CHK'D BY: SFS
APPROVED BY: GWW
DATE: 6/8/04

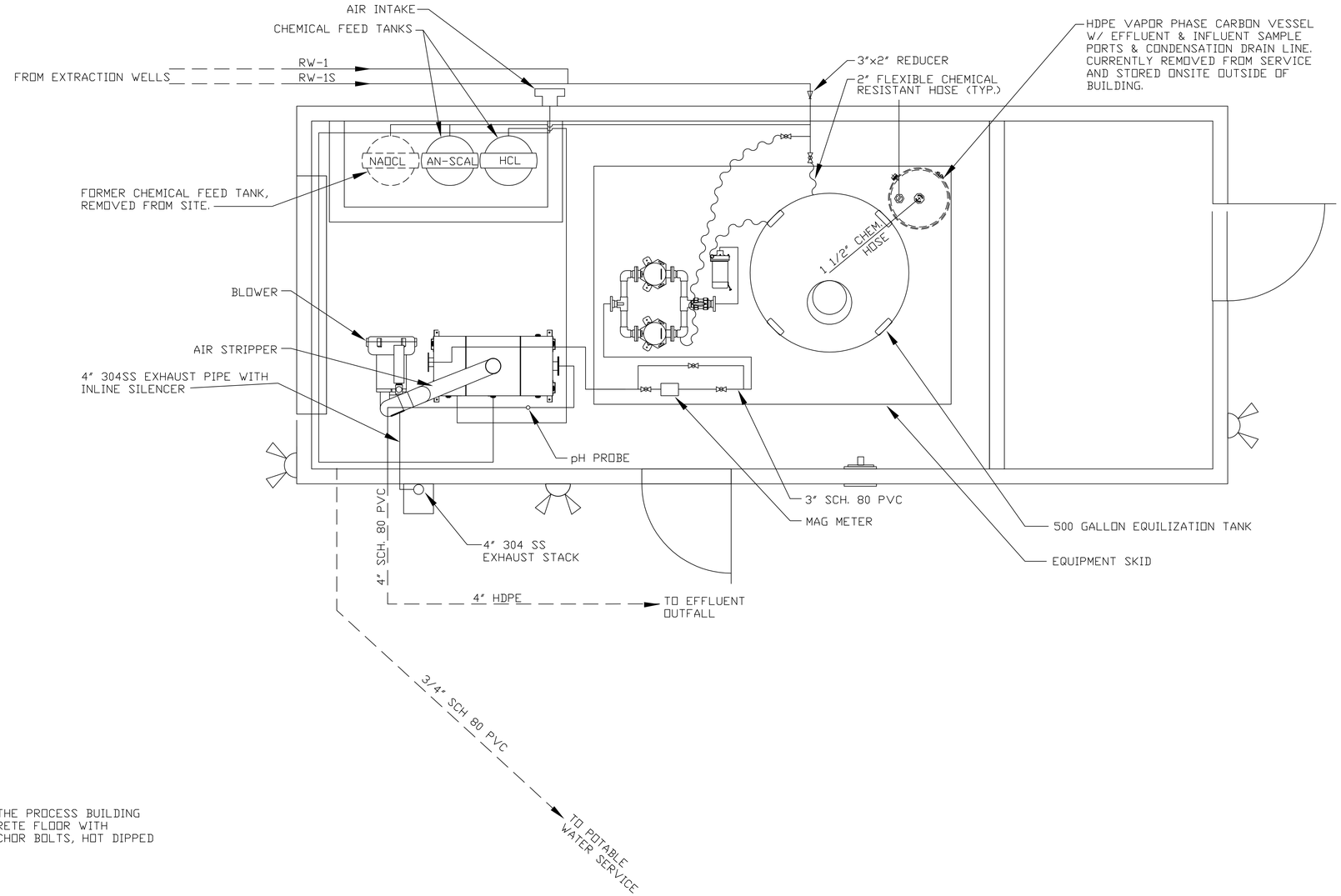
Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

EQUIPMENT ARRANGEMENT AND YARD PIPING GWTF #1

PROJECT NO. 03-209
FILE NAME: Sheet 2-3.dwg

SHEET NO.
2-3



NOTE:
1. EQUIPMENT AND SKIDS WITHIN THE PROCESS BUILDING SHALL BE SECURED TO THE CONCRETE FLOOR WITH 1/2"x4 1/4" CONCRETE WEDGE ANCHOR BOLTS, HOT DIPPED GALVANIZED.

2 0 4
SCALE IN FEET

REV. NO.	DATE	DRWN	CHKD	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

DESIGNED BY: BSL
DRAWN BY: ANH
SHEET CHK'D BY: GWW
CROSS CHK'D BY: SFS
APPROVED BY: GWW
DATE: 6/8/04

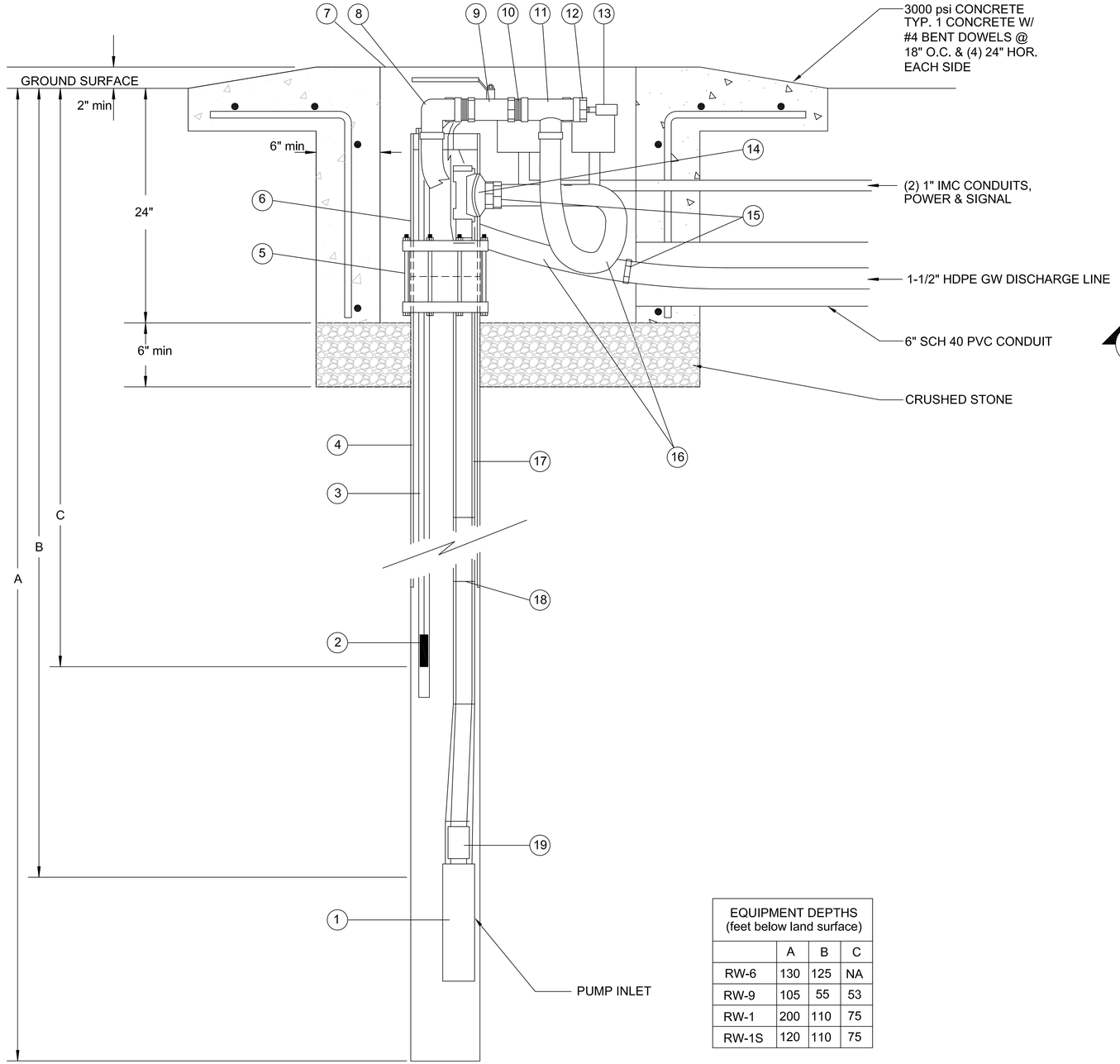
Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

EQUIPMENT ARRANGEMENT AND YARD PIPING
GWTF #2

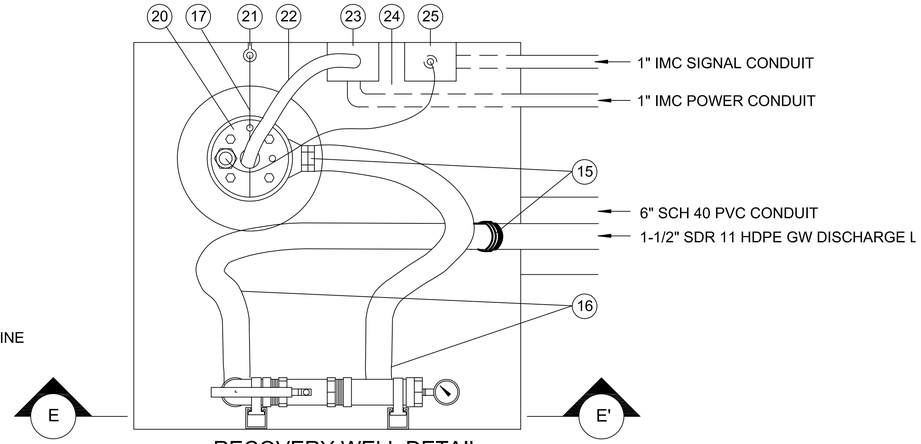
PROJECT NO. 03-209
FILE NAME: Sheet 2-4.dwg

SHEET NO.
2-4



CROSS-SECTION
NTS

EQUIPMENT DEPTHS (feet below land surface)			
	A	B	C
RW-6	130	125	NA
RW-9	105	55	53
RW-1	200	110	75
RW-1S	120	110	75



RECOVERY WELL DETAIL

1/2 0 1

SCALE IN FEET

BILL OF MATERIALS - RECOVERY WELLS			
ITEM	QTY	UNITS	DESCRIPTION
1			Recovery Well Pumps:
	2	ea	RW-1 & RW-6: Grundfos 10 REDI-FLO 3 - 140, 1/2 HP, 230VAC, 1 PH, 1-1/4 NPT
	1	ea	RW-9: Grundfos 22 REDI-FLO 3 - 140, 1/2 HP, 230VAC, 1 PH, 1-1/2" NPT
	2	ea	RW-1S & RW-7: Grundfos 30 REDI-FLO 3 - 160, 1-1/2 HP, 230VAC, 1 PH, 1-1/2" NPT
2	4	ea	Level Transmitters: KPSI PN 710-140-0030-009, Submersible Transducer, 0-30 psig, 4-20mA output, with Option 009 surge protection, and Aneroid bellows PN 815-000-000. NOTE: RW-6 shall not be equipped with a level transmitter.
	75	ft	Tefzel transmitter cable for RW-1
	75	ft	Tefzel transmitter cable for RW-1S
	67	ft	Tefzel transmitter cable for RW-7
	53	ft	Tefzel transmitter cable for RW-9
3	5	ea	1" SCH 40 PVC, flush threaded sounding tube, 1.315 OD. Top section shall be male flush joint x MPT fitted with a threaded reducer bushing allowing the tube to be inserted from above to rest on the well seal. Total length: RW-1 - 60ft, RW-1s - 60 ft, RW-7 - 68 ft, RW-9 - 54 ft. All measurements from top of casing.
4			6" Well Casings:
	1	ea	RW-1: SCH 40 PVC
	1	ea	RW-1S:
	1	ea	RW-6: Carbon Steel
	1	ea	RW-7: Stainless Steel
	1	ea	RW-9: Carbon Steel
5	5	ea	Dresser Coupling for steel pipe, 6-7/8" long x 11-1/4" high
6	5	ea	6" Sch 40 PVC wellhead casing
7	4	ea	Well Vault Cover, water-tight, locking, 30"x30", rated for H-20 loads, Bilco J-2ALH2O
8	5	ea	1-1/2" SCH 40 304SS 90 deg ell
9	5	ea	1-1/2" bronze ball valve, 150 psig
10	10	ea	1-1/2" SCH 40 close nipple 304SS
11	5	ea	1-1/2" SCH 40 tee 304SS
12	5	ea	1-1/2" x 1/4" bushing, 304SS
13	5	ea	100 psig pressure gauges, 1/4" NPT bottom connection, 2-1/2" dial, ABS case, polycarbonate window, Ashcroft Mod# 25W-1005PH
14	5	ea	Pitless adapter, brass, 2" FPT drop x 2" FPT discharge, teflon coated silicone O-ring, Maass Midwest Mfg Mod# S-20. Add 1-1/2"x2" 304SS bushings to discharge for all wells.
15	10	ea	1-1/2" threaded unions 304SS
16			UHMWPE chemical hose, 200 psig, max temp 200°F, NovaFlex 4700 chemical suction hose. All well vault discharge hose and downhole hose for RW-1S, RW-7 & RW-8 is 1-1/2" ID with 1-1/2" 304SS MPT end connections. Downhole hose for RW-1 & RW-6 is 1-1/4" ID wi
			Downhole hose lengths:
	110	ft	RW-1
	110	ft	RW-1S
	125	ft	RW-6
	75	ft	RW-7
	55	ft	RW-9
17			Safety cable
	110	ft	RW-1
	110	ft	RW-1S
	125	ft	RW-6
	75	ft	RW-7
	55	ft	RW-9
18	-	ea	Cable ties every 10 feet
19	5	ea	Torque arrestor, Cambell Mfg # TS48, flexible PVC.
20	5	ea	Cast Iron Split Well Seal, 6"x1", 1-1/2" tube hole, 1/2" safety cable hole, 1/2" vent hole. Simmons Mfg custom order using PN 136.

REV. NO.	DATE	DRWN	CHKD	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

DESIGNED BY: BSL
DRAWN BY: ANH
SHEET CHK'D BY: GWW
CROSS CHK'D BY: SFS
APPROVED BY: GWW
DATE: 6/8/04

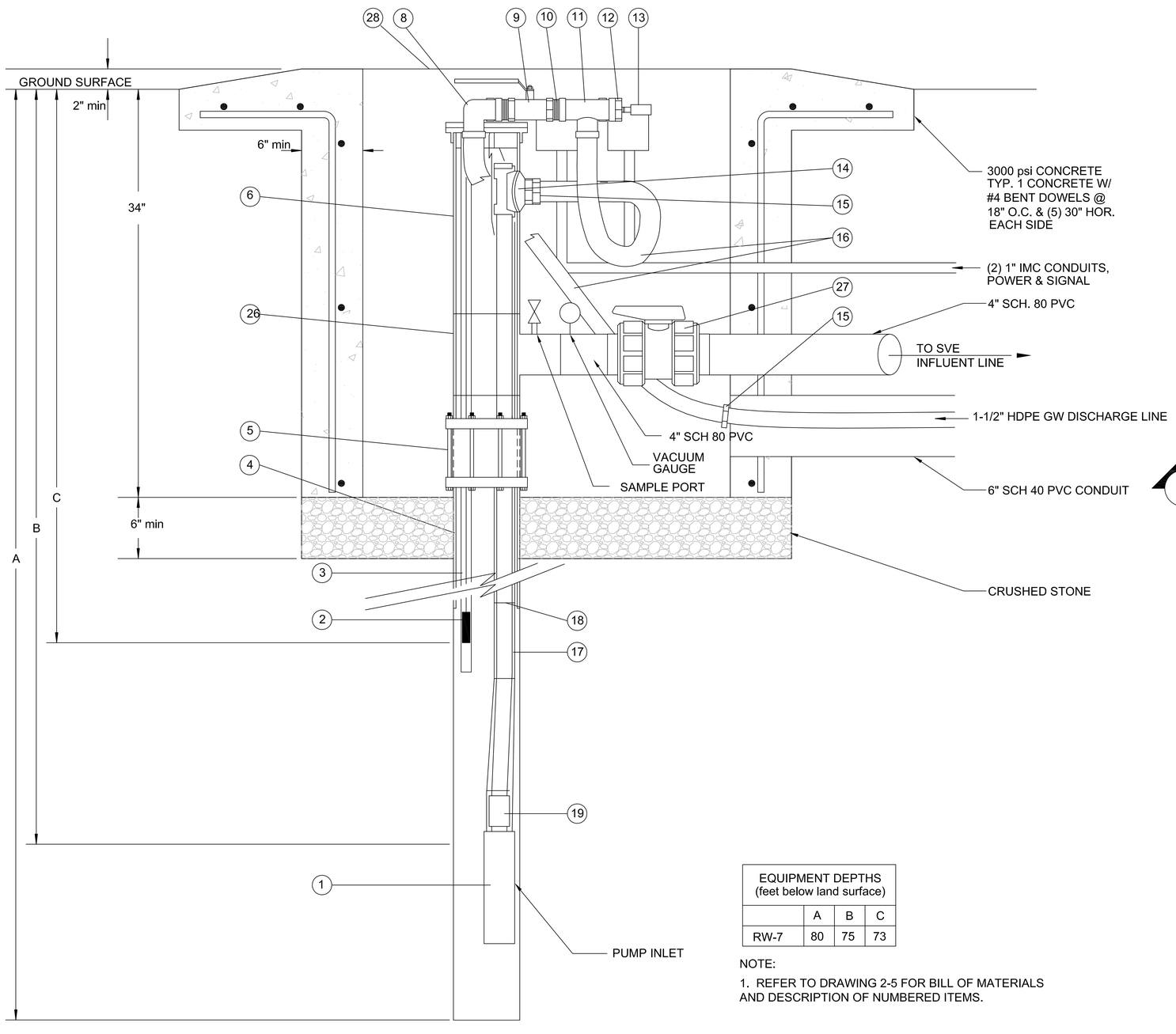
Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

RECOVERY WELL AND VAULT DETAILS RW-6, RW-9, RW-1, AND RW-1S

PROJECT NO. 03-209
FILE NAME: Sheet 2-5.dwg

SHEET NO.
2-5

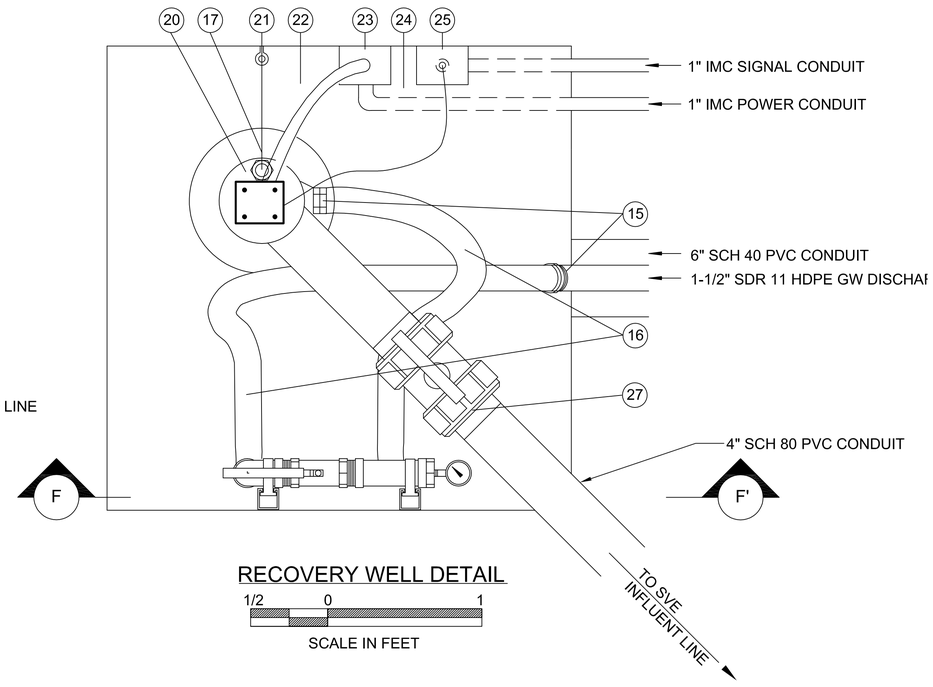


CROSS-SECTION
NTS

EQUIPMENT DEPTHS (feet below land surface)			
	A	B	C
RW-7	80	75	73

NOTE:

1. REFER TO DRAWING 2-5 FOR BILL OF MATERIALS AND DESCRIPTION OF NUMBERED ITEMS.



RECOVERY WELL DETAIL

1/2 0 1

SCALE IN FEET

REV. NO.	DATE	DRWN	CHKD	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

DESIGNED BY: BSL
DRAWN BY: ANH
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CROSS CHK'D BY: SFS
APPROVED BY: GWW
DATE: 6/8/04

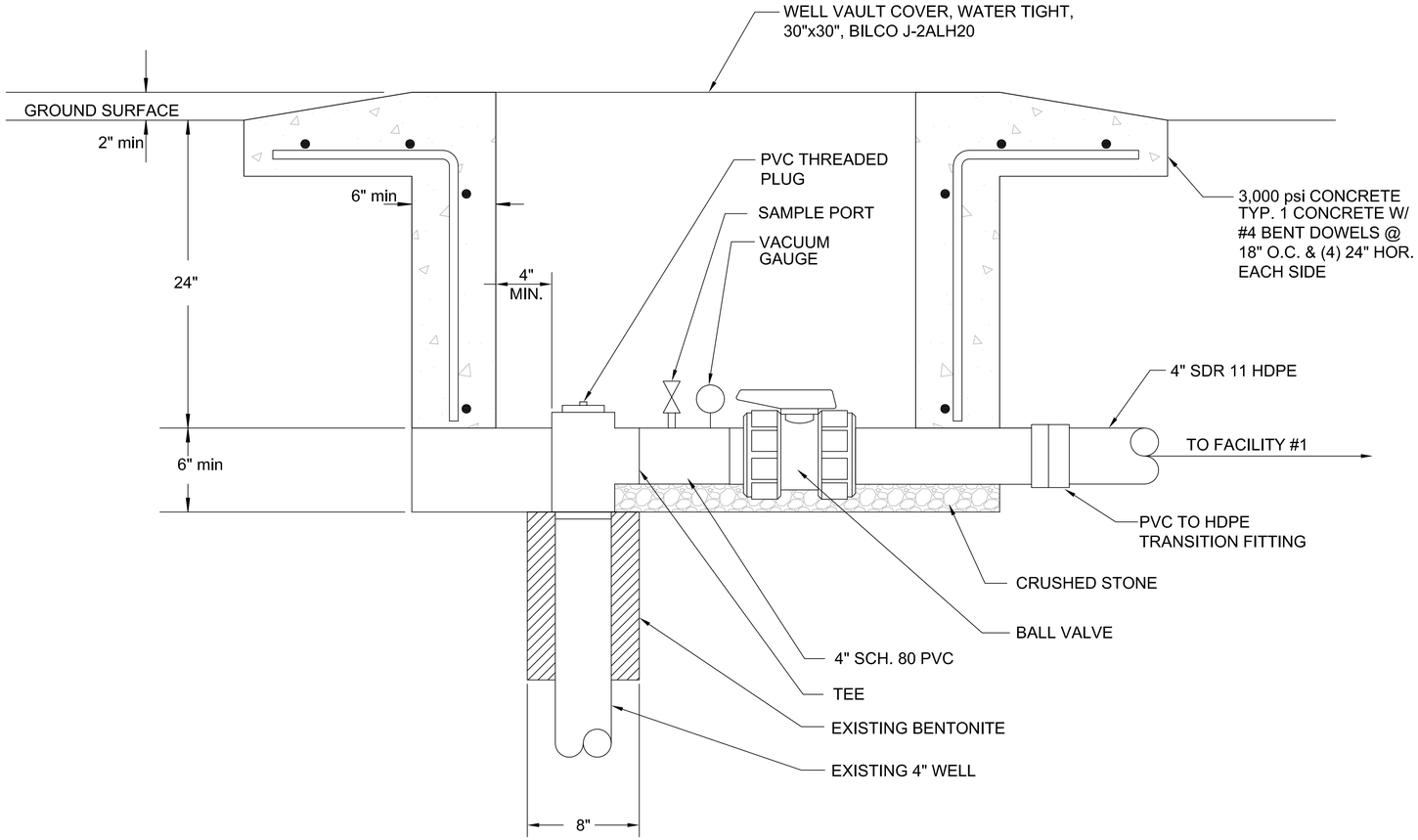
Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

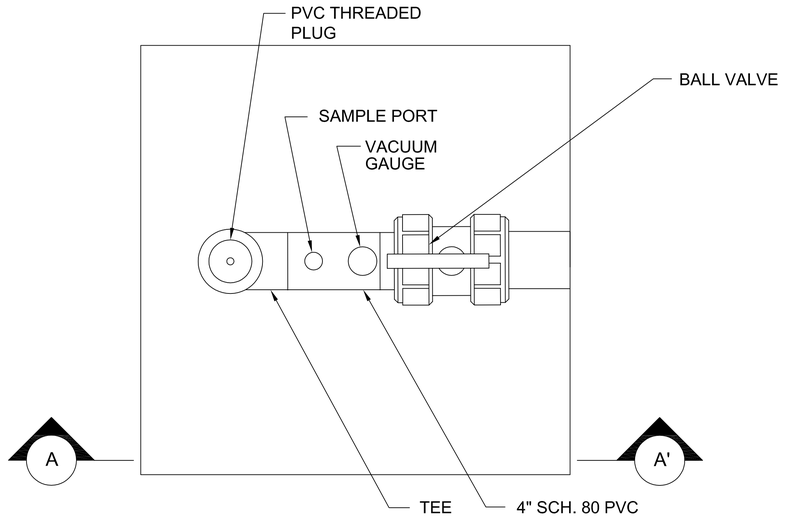
RECOVERY WELL AND WELL VAULT DETAILS – RW-7

PROJECT NO. 03-209
FILE NAME: Sheet 2-6.dwg

SHEET NO.
2-6



CROSS-SECTION A-A' (2-7)
NTS



SVE WELL VAULT DETAIL

1/2 0 1
SCALE IN FEET

REV. NO.	DATE	DRWN	CHKD	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

DESIGNED BY: BSL
DRAWN BY: ANH
SHEET CHK'D BY: GWW
CROSS CHK'D BY: SFS
APPROVED BY: GWW
DATE: 6/8/04

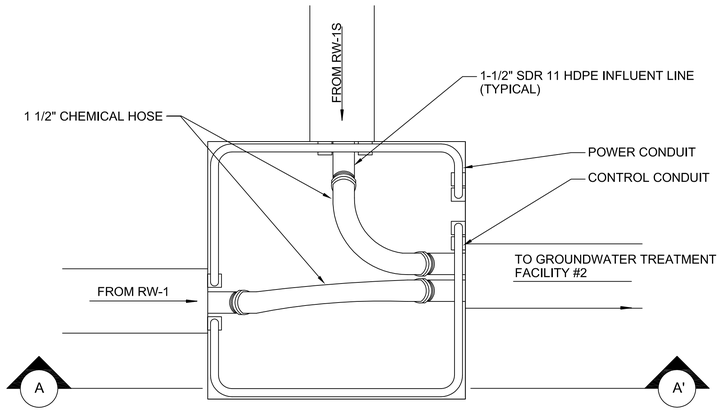
Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

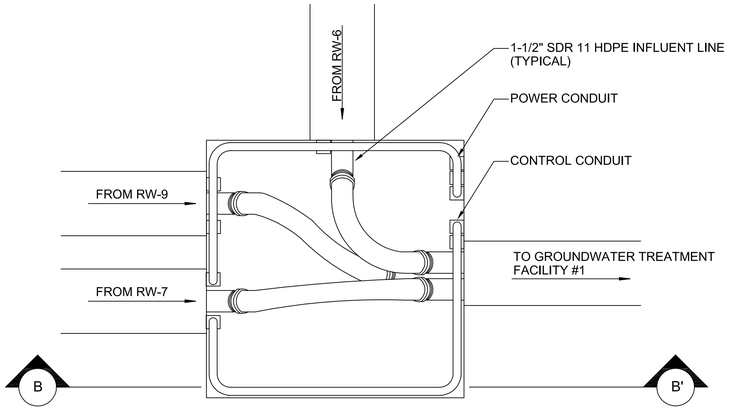
SVE WELL AND VAULT DETAIL
SVE-1

PROJECT NO. 03-209
FILE NAME: Sheet 2-7.dwg

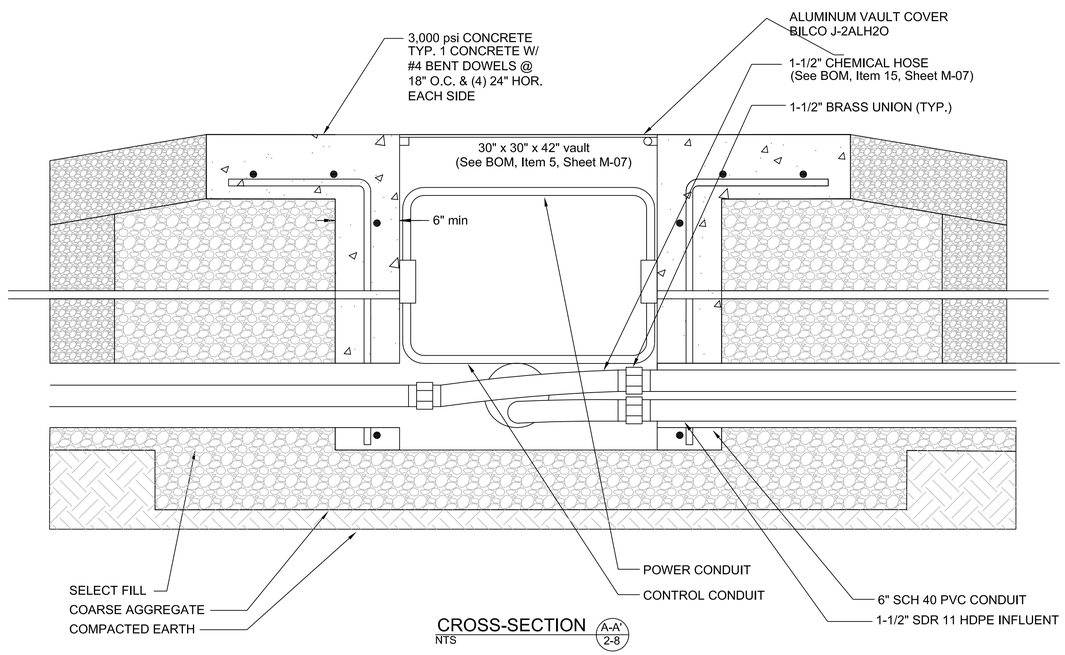
SHEET NO.
2-7



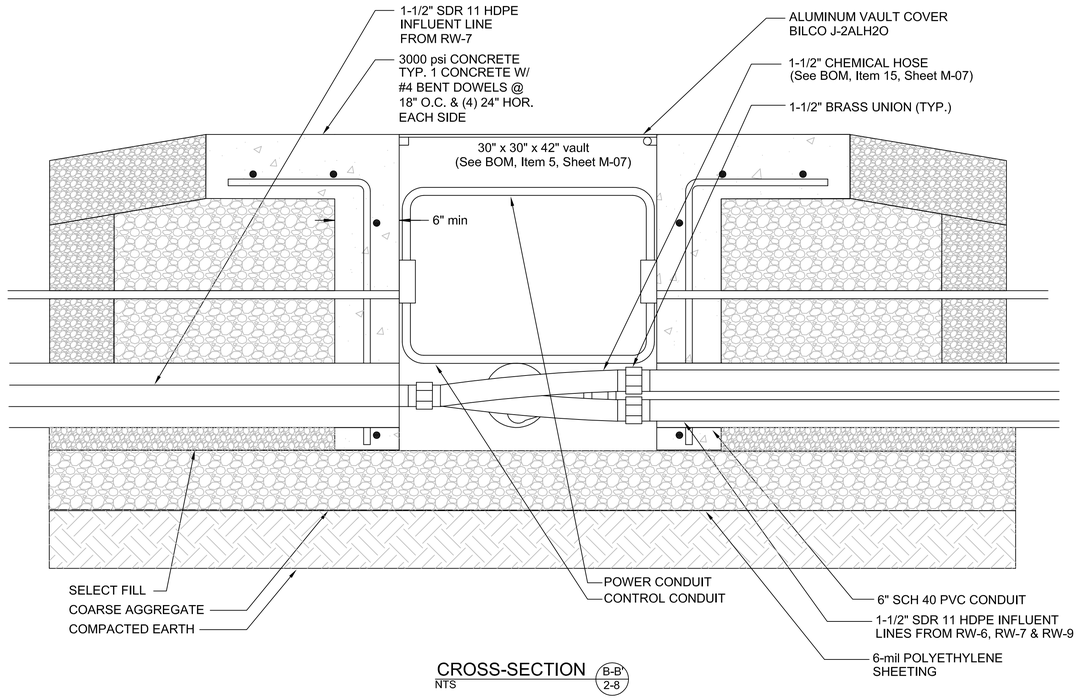
GWTF #1 PULL BOX
NTS



GWTF #2 PULL BOX
NTS



CROSS-SECTION (A-A' / 2-8)
NTS



CROSS-SECTION (B-B' / 2-8)
NTS

REV. NO.	DATE	DRWN	CHKD	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

DESIGNED BY: BSL
DRAWN BY: ANH
SHEET CHK'D BY: GWW
CROSS CHK'D BY: SFS
APPROVED BY: GWW
DATE: 6/8/04

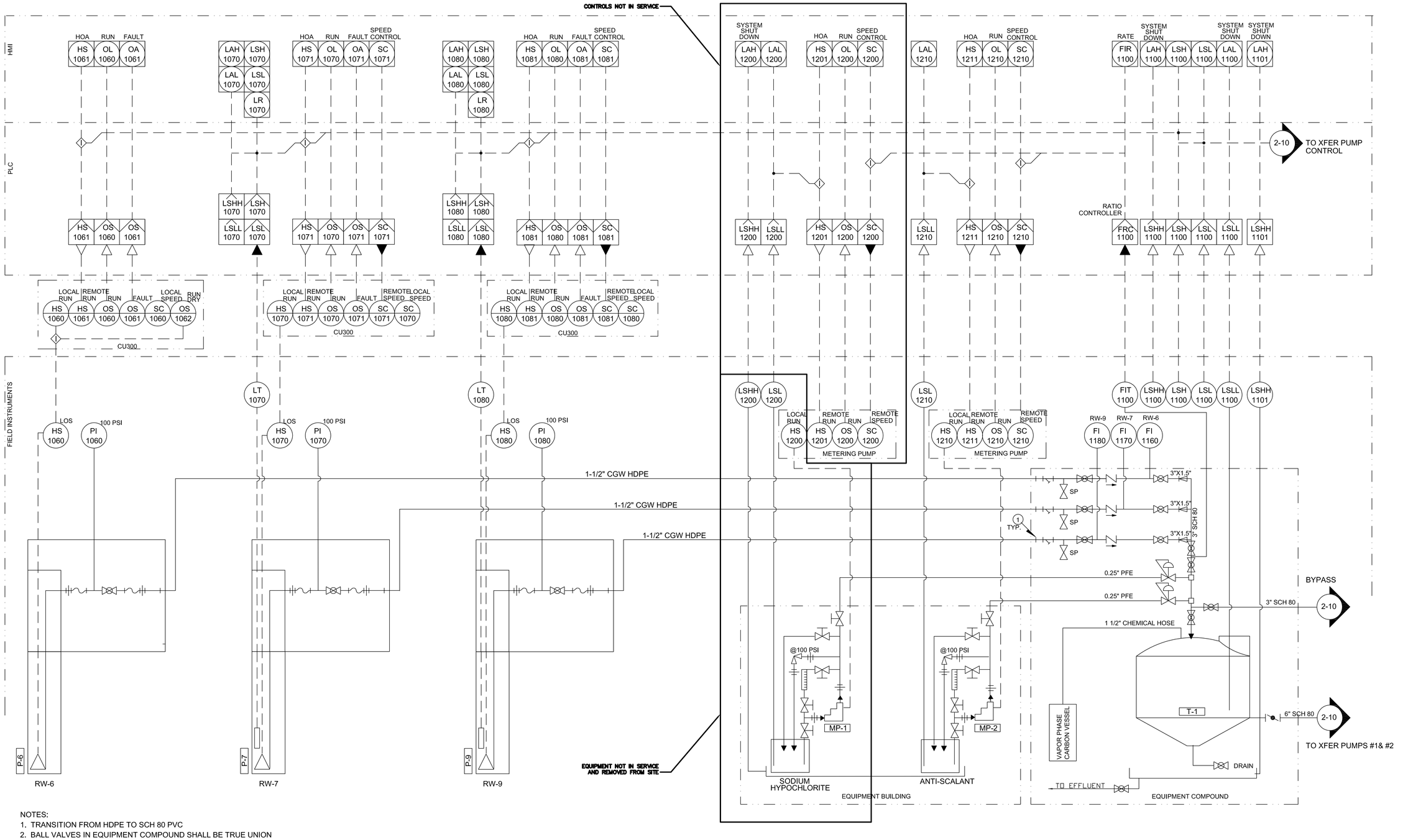
Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

PULL BOX DETAILS
GWTF #1 AND GWTF #2

PROJECT NO. 03-209
FILE NAME: Sheet 2-8.dwg

SHEET NO.
2-8



NOTES:
1. TRANSITION FROM HDPE TO SCH 80 PVC
2. BALL VALVES IN EQUIPMENT COMPOUND SHALL BE TRUE UNION

REV. NO.	DATE	DRWN	CHKD	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

DESIGNED BY: BSL
DRAWN BY: ANH
SHEET CHK'D BY: GWW
CROSS CHK'D BY: SFS
APPROVED BY: GWW
DATE: 6/8/04

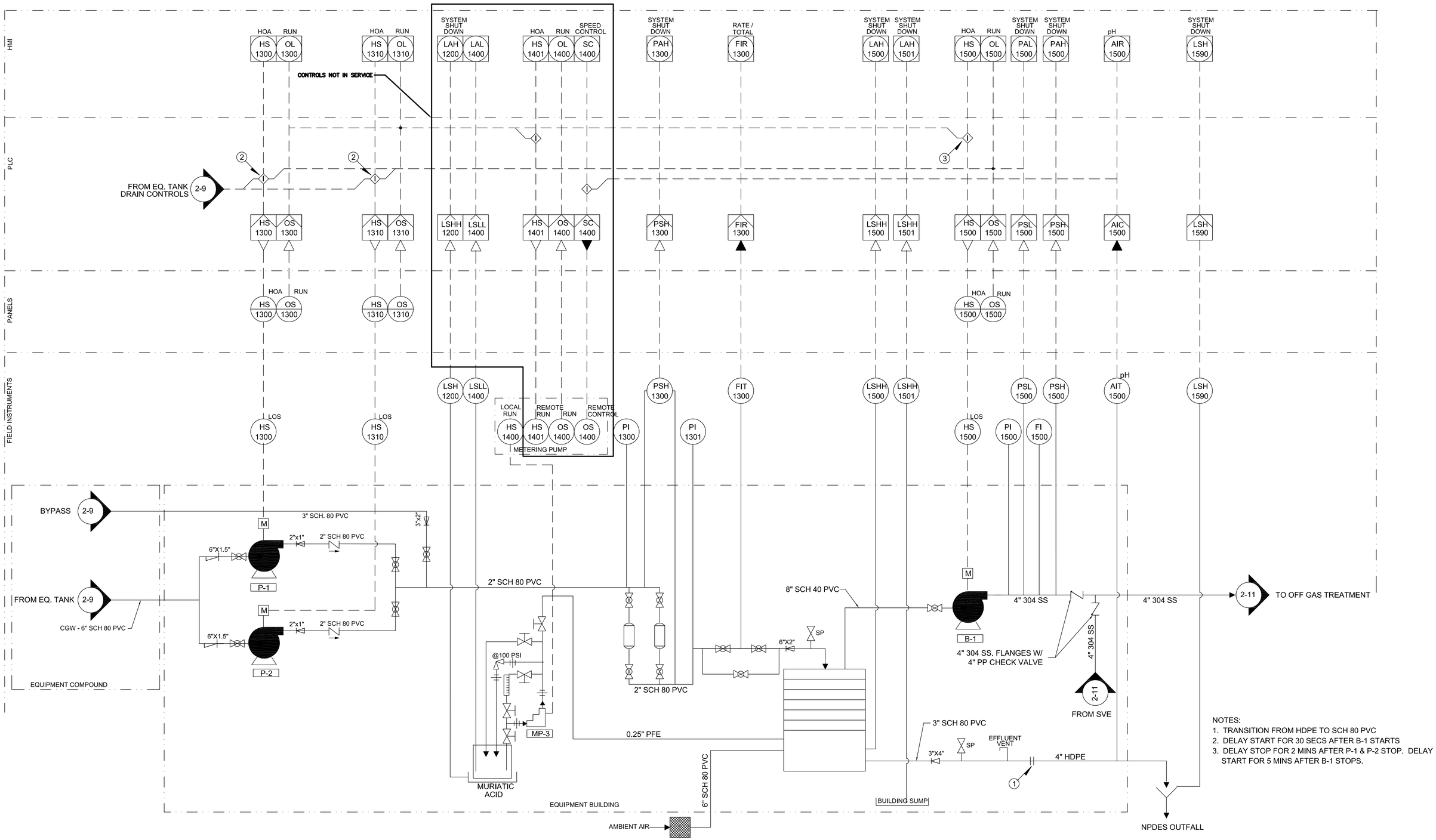
Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

PIPING, INSTRUMENTATION, AND CONTROL LOGIC DIAGRAM GWTF #1

PROJECT NO. 03-209
FILE NAME: Sheet 2-9.dwg

SHEET NO.
2-9



REV. NO.	DATE	DRWN	CHK'D	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

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DATE: 6/8/04

Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

PIPING, INSTRUMENTATION, AND CONTROL LOGIC DIAGRAM GWTF #1

PROJECT NO. 03-209
FILE NAME: Sheet 2-10.dwg

SHEET NO.
2-10

HMI

PLC

PANELS

INSTRUMENTS

FIELD INSTRUMENTS

SYSTEM SHUTDOWN
LAH 1610

HOA RUN
HS 1610 OL 1610

SYSTEM SHUTDOWN
TAH 1620

SYSTEM SHUTDOWN
FSL 1620

HOA RUN
HS 1625 OL 1625

SYSTEM SHUTDOWN
TAH 1625

CONTROLS NO LONGER IN SERVICE

LSHH 1610

HS 1610 OS 1610

TSH 1620

FSL 1620

HS 1625 OS 1625

TSH 1625

HOA RUN
HS 1610 OS 1610

HOA RUN
HS 1625 OS 1625

NO LONGER IN SERVICE, REMOVED FROM SITE.

NO LONGER IN SERVICE, REMAINS AT SITE.

NO LONGER IN SERVICE, REMOVED FROM SITE.

NO LONGER IN SERVICE, REMAINS AT SITE.

PI 1602

SP

1

4" VAP HDPE

RW - 7

PI 1601

SP

1

4" VAP HDPE

SVE - 1

FI 1600

PI 1600

DILUTION AIR

1

4" SCH 80 PVC

2.5" SCH 80 PVC

KO-1

NO LONGER IN SERVICE, REMOVED FROM SITE.

LSHH 1610

TI 1610

FI 1610

PI 1610

SP

INLET FILTER

LOS
HS 1610

M

B-2

SILENCER

SILENCER

4"x2.5"

4" 304 SS

2.5" 304 SS.

TSH 1620

TI 1620

PI 1620

FSL 1620

4" 304 SS. FLANGES W/
4" PP CHECK VALVE

FROM AIR STRIPPER 2-10 4" 304 SS

EQUIPMENT BUILDING

LOS
HS 1625

M

HX-1

TSH 1625

TI 1625

SP

4" SCH 80 PVC

NO LONGER IN SERVICE, REMAINS AT SITE.

PI 1630

PI 1631

PI 1632

PI 1633

4" 304 SS STACK

4" FLEXIBLE DUCT

SP

4" SCH. 80 PVC

GAC-1
GRANULAR ACTIVATED CARBON

GAC-2
GRANULAR ACTIVATED CARBON

KMnO4-1
POTASSIUM PERMANGANATE

KMnO4-2
POTASSIUM PERMANGANATE

4" FLEXIBLE DUCT

4" FLEXIBLE DUCT

4" FLEXIBLE DUCT

4" FLEXIBLE DUCT

SP

SP

SP

SP

CONDENSATE DRAIN

4" FLEXIBLE DUCT

4" FLEXIBLE DUCT
BY-PASS LINE

NOTES:
1. TRANSITION FROM SCH 80 PVC TO HDPE
2. TRANSITION FROM SCH 80 PVC TO FLEX HOSE

NO LONGER IN SERVICE, REMAINS AT SITE.

REV. NO.	DATE	DRWN	CHK'D	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

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Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

PIPING, INSTRUMENTATION, AND CONTROL LOGIC DIAGRAM GWTF #1

PROJECT NO. 03-209
FILE NAME: Sheet 2-11.dwg

SHEET NO.
2-11

HMI

PLC

PANELS

FIELD INSTRUMENTS

LAH 2010 | LSH 2010 | LAL 2010 | LSL 2010 | LR 2010

HOA RUN FAULT SPEED CONTROL
HS 2011 | OL 2010 | OA 2011 | SC 2011

LAH 2020 | LSH 2020 | LAL 2020 | LSL 2020 | LR 2020

HOA RUN FAULT SPEED CONTROL
HS 2021 | OL 2020 | OA 2021 | SC 2021

SYSTEM SHUT DOWN
LAH 2200 | LAL 2200

HOA RUN SPEED CONTROL
HS 2201 | OL 2200 | SC 2200

LAL 2210

HOA RUN SPEED CONTROL
HS 2211 | OL 2210 | SC 2210

RATE
FIR 2100

SYSTEM SHUT DOWN
LAH 2100 | LSH 2100 | LSL 2100 | LAL 2100

SYSTEM SHUT DOWN
LAH 2101

2-13
TO XFER PUMP CONTROL

LSHH 2010 | LSH 2010 | LSLL 2010 | LSL 2010

HS 2011 | OS 2010 | OS 2011 | SC 2011

LSHH 2020 | LSH 2020 | LSLL 2020 | LSL 2020

HS 2021 | OS 2020 | OS 2021 | SC 2021

LSHH 2200 | LSLL 2200

HS 2201 | OS 2200 | SC 2200

LSLL 2210

HS 2211 | OS 2210 | SC 2210

RATIO CONTROLLER
FRC 2100

LSHH 2100 | LSH 2100 | LSL 2100 | LSLL 2100

LSHH 2101

LOCAL RUN | REMOTE RUN | REMOTE RUN | FAULT | REMOTE SPEED | LOCAL SPEED
HS 2010 | HS 2011 | OS 2010 | OS 2011 | SC 2011 | SC 2010
CU300

LOCAL RUN | REMOTE RUN | REMOTE RUN | FAULT | REMOTE SPEED | LOCAL SPEED
HS 2020 | HS 2021 | OS 2020 | OS 2021 | SC 2021 | SC 2020
CU300

LT 2010

LOS
HS 2010

100 PSI
PI 2010

LT 2020

LOS
HS 2020

100 PSI
PI 2020

LSH 2200 | LSL 2200

LOCAL RUN | REMOTE RUN | RUN | REMOTE SPEED
HS 2200 | HS 2201 | OS 2200 | SC 2200
METERING PUMP

LSL 2210

LOCAL RUN | REMOTE RUN | RUN | REMOTE SPEED
HS 2210 | HS 2211 | OS 2210 | SC 2210
METERING PUMP

FIT 2100 | LSHH 2100 | LSH 2100 | LSL 2100 | LSLL 2100 | LSHH 2101

RW-1S | RW-1
FI 2120 | FI 2110

1-1/2" CGW HDPE

1-1/2" CGW HDPE

1 TYP.

SP

SP

3"X1.5"

3"X1.5"

0.25" PFE

0.25" PFE

3" SCH. 80

3" CHEM. HOSE

2-13
BYPASS

3" CHEM. HOSE

3" SCH. 80

1 1/2" CHEM. HOSE

@100 PSI

MP-1

@100 PSI

MP-2

T-1

3" SCH. 80
3" CHEM. HOSE

2-13
TO XFER PUMP

BUILDING SUMP

DRAIN

P-1

RW-1

P-1S

RW-1S

REMOVED FROM SERVICE, NO LONGER AT SITE

SODIUM HYPOCHLORITE

ANTI-SCALANT

VAPOR PHASE CARBON VESSEL

EQUIPMENT BUILDING

NOTES:
1. TRANSITION FROM HDPE TO SCH 80 PVC
2. BALL VALVES IN EQUIP COMPOUND SHALL BE TRUE UNION

REV. NO.	DATE	DRWN	CHKD	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

DESIGNED BY: BSL
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DATE: 6/8/04

Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

PIPING, INSTRUMENTATION, AND CONTROL LOGIC DIAGRAM GWTF #2

PROJECT NO. 03-209
FILE NAME: Sheet 2-12.dwg

SHEET NO.
2-12

HMI

PLC

PANELS

FIELD INSTRUMENTS

HOA RUN HS 2301 OL 2300

SYSTEM SHUT DOWN LAH 2200 LAL 2400

HOA RUN SPEED CONTROL HS 2401 OL 2400 SC 2400

SYSTEM SHUT DOWN PAH 2300

RATE / TOTAL FIR 2300

SYSTEM SHUT DOWN LAH 2500

HOA RUN HS 2501 OL 2500

SYSTEM SHUT DOWN PAL 2500

SYSTEM SHUT DOWN pH PAH 2500 AIR 2500

SYSTEM SHUT DOWN LSH 2590

FROM EQ. TANK DRAIN CONTROLS 2-12

HS 2301 OS 2300

LSHH 2200 LSLL 2400

HS 2401 OS 2400 SC 2400

PSH 2300

FIR 2300

LSHH 2500

HS 2501 OS 2500

PSL 2500

PSH 2500 AIC 2500

LSH 2590

HOA RUN HS 2301 OS 2300

CONTROLS NO LONGER IN SERVICE

HOA RUN HS 2501 OS 2500

LSHH 2200 LSLL 2400

REMOTE

LOCAL RUN REMOTE RUN RUN REMOTE CONTROL

HS 2400 HS 2401 OS 2400 SC 2400

METERING PUMP

PI 2300

PSH 2300

PI 2301

FIT 2300

LSHH 2500

PSL 2500

PSH 2500

pH AIT 2500

LSH 2590

LOS HS 2300

LOS HS 2500

PI 2500

FI 2500

BYPASS 2-12 3" SCH 80 PVC 3"x2"

FROM EQ. TANK 2-12 3" SCH 80 PVC 3"x1.5"

M P-2

1"x2" 2" SCH 80 PVC

2" SCH 80 PVC

0.25" PFE

@100 PSI

MP-3

MURIATIC ACID

DILUTION AIR

6" SCH 40 PVC

SP 6"x2"

GALVANIZED STEEL

6"x3" 3"x2.5"

M B-1

4"x2.5"

4" 304 SS

SILENCER

STACK

3" SCH 80 PVC

4" SCH 80 PVC

SP 3"X4"

1 4" HDPE

4" SCH 80 PVC

EQUIPMENT BUILDING

AMBIENT AIR

NPDES OUTFALL

NOTES:
1. TRANSITION FROM HDPE TO SCH 80 PVC
2. DELAY START FOR 30 SECS AFTER B-1 STARTS
3. DELAY STOP FOR 2 MINS AFTER P-1 & P-2 STOP. DELAY START FOR 5 MINS AFTER B-1 STOPS.

REV. NO.	DATE	DRWN	CHK'D	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

DESIGNED BY: BSL
DRAWN BY: ANH
SHEET CHK'D BY: GWW
CROSS CHK'D BY: SFS
APPROVED BY: GWW
DATE: 6/8/04

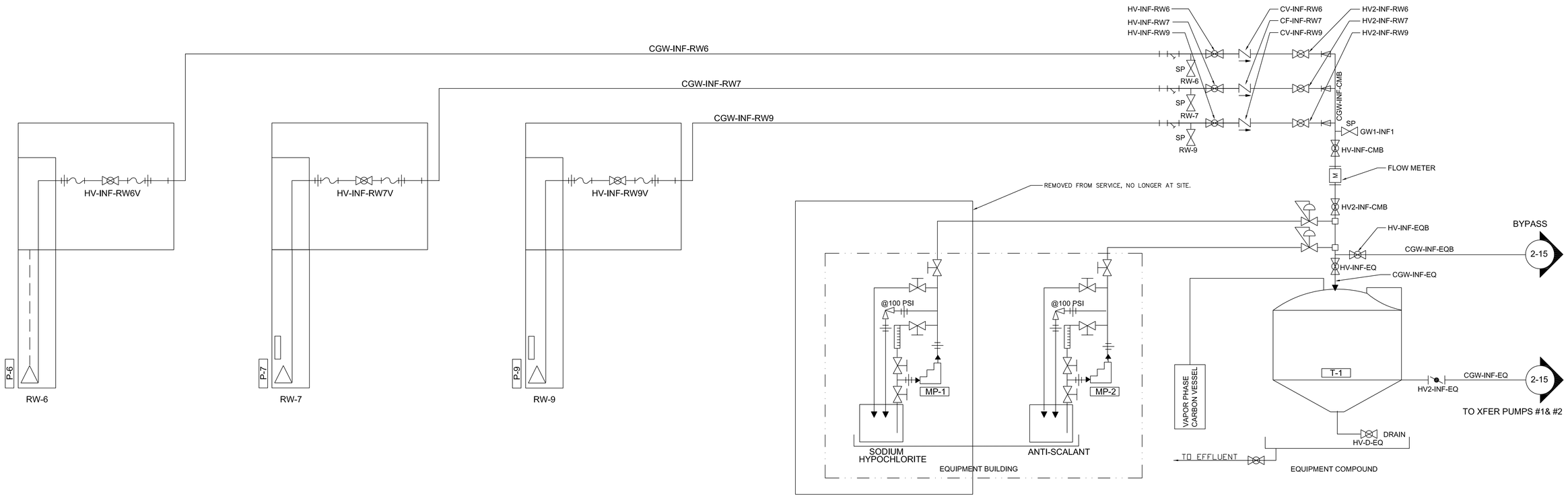
Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

PIPING, INSTRUMENTATION, AND CONTROL LOGIC DIAGRAM GWTF #2

PROJECT NO. 03-209
FILE NAME: Sheet 2-13.dwg

SHEET NO.
2-13



REV. NO.	DATE	DRWN	CHKD	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

DESIGNED BY: BSL
DRAWN BY: ANH
SHEET CHK'D BY: GWW
CROSS CHK'D BY: SFS
APPROVED BY: GWW
DATE: 6/8/04

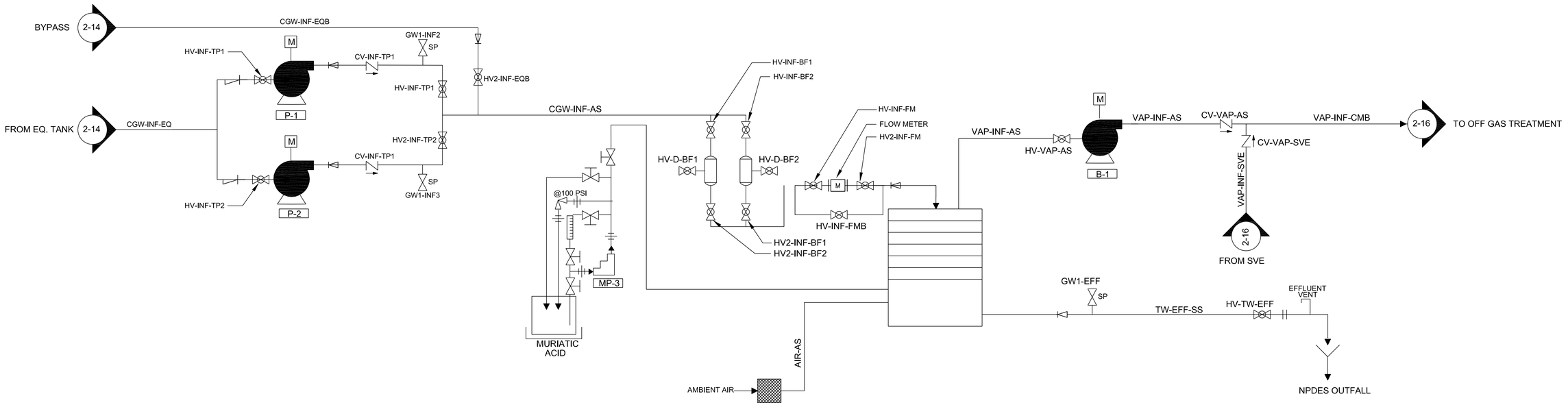
Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

PIPING AND VALVE NOMENCLATURE GWTF #1

PROJECT NO. 03-209
FILE NAME: Sheet 2-14.dwg

SHEET NO.
2-14



REV. NO.	DATE	DRWN	CHK'D	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

DESIGNED BY: BSL
DRAWN BY: ANH
SHEET CHK'D BY: GWW
CROSS CHK'D BY: SFS
APPROVED BY: GWW
DATE: 6/8/04

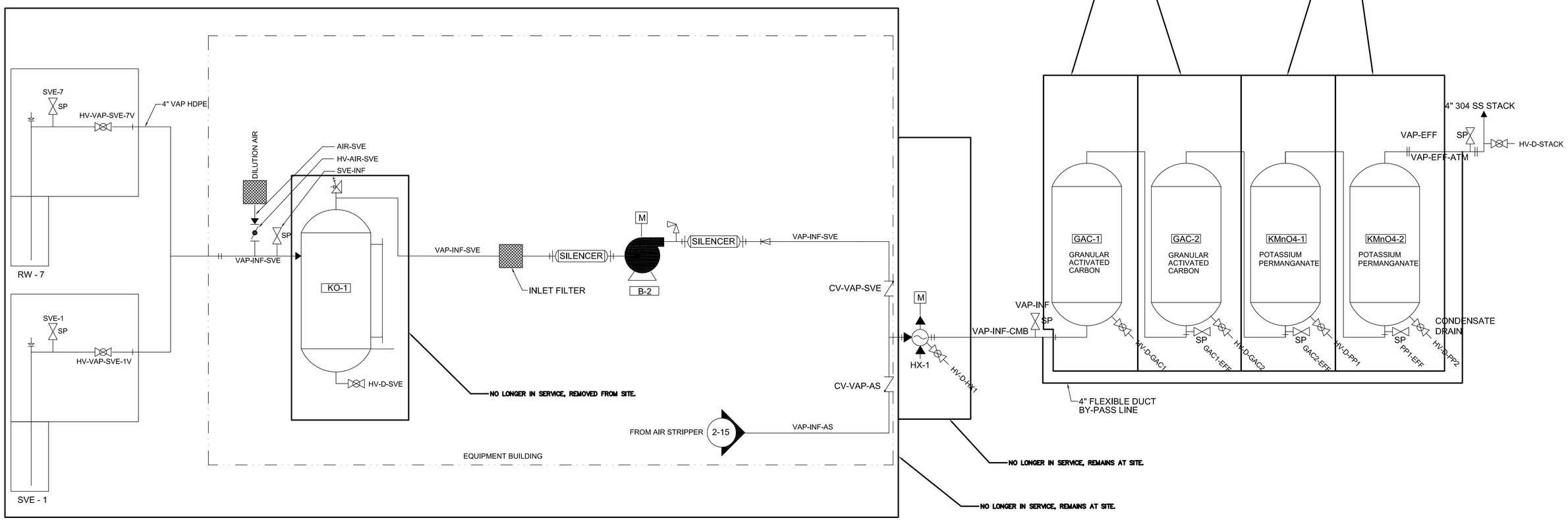
Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

PIPING AND VALVE NOMENCLATURE GWTF #1

PROJECT NO. 03-209
FILE NAME: Sheet 2-15.dwg

SHEET NO.
2-15



REV. NO.	DATE	DRWN	CHK'D	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

DESIGNED BY: BSL
DRAWN BY: ANH
SHEET CHK'D BY: GWW
CROSS CHK'D BY: SFS
APPROVED BY: GWW
DATE: 10/21/03

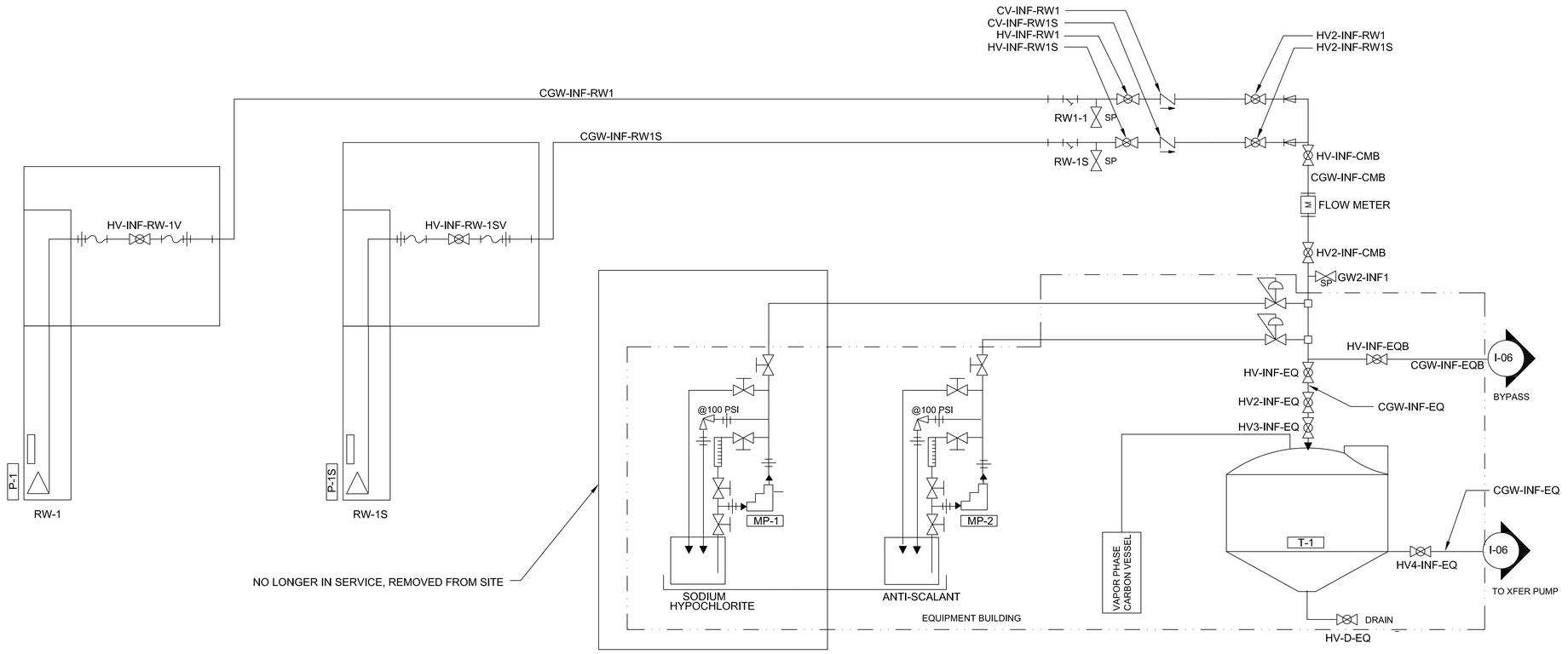
Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

PIPING AND VALVE NOMENCLATURE
GWTF #1

PROJECT NO. 03-209
FILE NAME: Sheet 2-16.dwg

SHEET NO.
2-16



REV. NO.	DATE	DRWN	CHKD	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

DESIGNED BY: BSL
DRAWN BY: ANH
SHEET CHK'D BY: GWW
CROSS CHK'D BY: SFS
APPROVED BY: GWW
DATE: 6/8/04

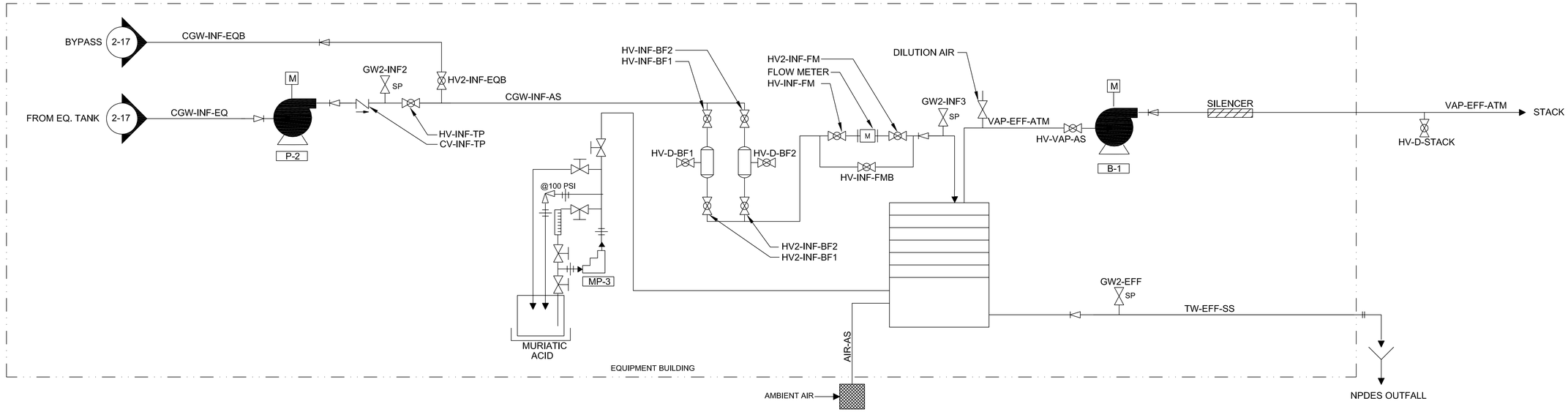
Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

PIPING AND VALVE NOMENCLATURE GWTF #2

PROJECT NO. 03-209
FILE NAME: Sheet 2-17.dwg

SHEET NO.
2-17



REV. NO.	DATE	DRWN	CHK'D	REMARKS
A	2/4/13	DLR	GWW	UPDATED TO MATCH CONDITIONS AS OF FEBRUARY 1, 2013

DESIGNED BY: BSL
DRAWN BY: ANH
SHEET CHK'D BY: GWW
CROSS CHK'D BY: SFS
APPROVED BY: GWW
DATE: 6/8/04

Arrowhead Contracting, Inc.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II
TUTU WELLFIELD SITE
ST. THOMAS, U.S. VIRGIN ISLANDS

PIPING AND VALVE NOMENCLATURE GWTF #2

PROJECT NO. 03-209
FILE NAME: Sheet 2-18.dwg

SHEET NO.
2-18