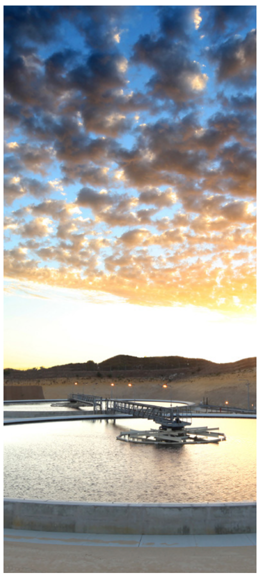
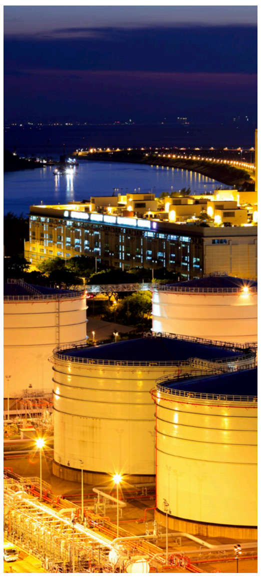
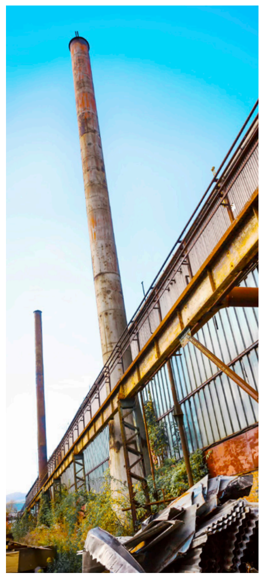

Operational Procedures Manual
F-Area Groundwater Remediation System

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Niagara Falls, New York

Glenn Springs Holdings, Inc.

GHD Services Inc.
2055 Niagara Falls Boulevard Niagara Falls New York 14304
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1. Introduction

This operating manual was prepared for the Bedrock and Overburden Groundwater Remediation Systems located at Occidental Chemical Corporation's (OCC) Niagara Plant (Plant) in Niagara Falls, New York. F-Area is located north of Buffalo Avenue and east of Iroquois Street. The system's Treatment Facility is located in the F-Area.

The Treatment Facility receives bedrock groundwater collected from the B, C, and D bedrock zones along the Plant's western and northwestern property boundaries and overburden groundwater collected from the Plant's northeastern and southern boundaries and within the F-Area and D-Area. The Treatment Facility is designed to remove suspended solids, sediments, and dissolved chemicals. Treated groundwater is monitored and discharged to Outfall 007, which discharges to the Niagara River (see Figure 1.1).

1.1 Purpose and Scope

The purpose and scope of this operating manual is to aid in training operating personnel by providing them with a description of the process, an understanding of the unit operations and control parameters involved, and an explanation of the system's start-up, normal operation, alarms, and shutdown procedures. A thorough review and understanding of this manual and the Niagara Plant Site Safety and Health Plan will lead to safe, environmentally sound, and efficient operation of the Facility.

Procedures for monitoring the performance of the Groundwater Remedial Systems are presented in the report entitled "Performance Monitoring Plan, Final Corrective Measures, Revised June 2016".

1.2 General Process Description

The following processes form the components of the Groundwater Remediation Systems:

- A series of 19 bedrock extraction wells (BEWs) along the perimeter of the Plant collect groundwater from the three major fracture zones in the bedrock: the "D-Zone" (0 to 45 feet below top of rock (BTOR), "C-Zone" (55 to 85 feet BTOR), and "B-Zone" (85 to 150 feet BTOR). The extraction well system was designed to create hydraulic containment along the north and west Plant boundary, prevent further off-Site migration of chemicals, and to allow natural groundwater flow to flush chemicals in the bedrock beneath the Plant to the extraction system. Collected groundwater is transferred via a north and south forcemain to the Decanter Tank at the Treatment Facility. The extraction wells include the following:

D-Zone	C-Zone	B-Zone
BEW-701D	BEW-701C	BEW-700B
BEW-702D	BEW-702C	BEW-701B
BEW-703D	BEW-703C	BEW-702B
BEW-704D	BEW-704C	BEW-703B
BEW-705D	BEW-705C	BEW-704B
BEW-706D	BEW-706C	BEW-705B
		BEW-706B

- Only 13 of the extraction wells are currently in use. Six extraction wells were removed from operation as approved by the New York State Department of Environmental Conservation (NYSDEC) since they were no longer required to achieve hydraulic containment. Extraction wells BEW-701/702/703C were turned off on May 22, 2007 and extraction wells BEW-701/702/703D were turned off on October 9, 2008.
- Overburden groundwater is collected from the Flow Zone 1 collection system (002 collection system) located along the south perimeter of the Plant and directed to the Decanter Tank via the south forcemain at extraction well BEW-700B. The 002 collection system consists of two main branches that run along the outer south fence line of the Niagara Plant. The two branches drain to Wet Well 1 (WW1) and Wet Well 2 (WW2) separately, where groundwater is then pumped via a forcemain tied into the forcemain at BEW-700B. Carbon Dioxide (CO_2) is injected at several points in the 002 collection system to maintain a neutral pH and prevent precipitate from forming.
- Overburden groundwater is also collected by the Energy Boulevard Drain Tile System (EBDTS) located along a portion of the Plant's northeast boundary. Groundwater drains to WWA for NAPL separation and then to WWB. From WWB, the groundwater is pumped via forcemain tied into the forcemain at BEW-706C. Groundwater is then directed via the north forcemain to the Decanter Tank.
- Overburden groundwater is collected by the Abandoned Outfall 005 collection system located in the F-Area. Groundwater is collected in a 925-foot section of abandoned gravity sewer that drains to MH-159L. From there, the groundwater is pumped via forcemain to the Decanter Tank.
- Overburden groundwater is collected by an abandoned 360-foot section of sanitary sewer in the D-Area. Collected groundwater drains to MH-301, where it is pumped via forcemain into WWB of the EBDTS.
- Prior to entering the Decanter Tank, groundwater from the south forcemain (BEW-700/701/702B, WW1, and WW2) is pumped through a series of three Sand Filters to remove suspended solids to protect the Air Stripper and Carbon Beds from fouling.
- All groundwater and water from the Treatment Facility sumps is collected in the Decanter Tank. The aqueous phase liquid (APL) Transfer Pumps pump the water through FV201 to the Air Stripper.
- Groundwater flows into the top of the Air Stripper where it is met by a countercurrent airflow supplied by the Air Stripper Blower. As the groundwater flows down through the packing, volatile organics are stripped into the air. The treated water collects in the Air Stripper Sump before the Carbon Feed Pumps pump it through the Carbon Beds.
- The groundwater flow continues to the Carbon Beds. The Carbon Beds are used to remove remaining organic compounds. The spent carbon is periodically removed and regenerated at an off-Site facility.
- At the discharge of the Treatment Facility, measurements of temperature, pH, and flow rate are taken. Effluent water is discharged to Outfall 007 under State Pollution and Discharge Elimination System (SPDES) Permit NY 000 3336. This water may be used for carbon backwash and carbon change-out.

- A Thermal Oxidizer degrades the volatile organics in the air stream, which have been removed from the groundwater by the Air Stripper. The Thermal Oxidizer accepts the air stream and raises it to a temperature that will result in oxidation of the volatile organics.
- The exhaust from the Thermal Oxidizer is discharged through a Scrubber System to remove hydrochloric acid (HCl) vapor from the air stream that results from the oxidation of chlorinated VOC's. The air is introduced at the bottom of the Scrubber column, while softened water flows from the top of the column. The packing inside the column creates surface area for the water to remove the HCl vapor from the air stream before it is discharged to the atmosphere. The water in the column is recirculated and continuously controlled using pH and conductivity. When the water becomes too acidic, the system uses a blowdown line to remove an amount of water and make up the difference with softened city water. The blowdown water is sent to the decanter. Operation and discharge from the Thermal Oxidizer and Scrubber System is conducted in accordance with a minor modification to the Plant's Title V Air Permit (Permit 9-2911-00112/00234), approved by the NYSDEC on October 8, 2015.

A process schematic of the treatment system is shown on Figure 1.2.

1.3 Areas of Responsibility

Utility Operator – CDM Loader

The Utility Operator – CDM Loader (CDM Operator) is primarily responsible for the day-to-day operation and maintenance of the water treatment system such as routine inspections, minor system adjustments, equipment operation, equipment cleaning, and monitoring. The CDM Operator is also responsible for the day-to-day process stewardship to ensure proper maintenance of process quality.

The CDM Operator's duties include, but are not necessarily limited to, the following:

- Operating and maintaining all Site equipment in an efficient manner.
- Performing the day-to-day inspection, monitoring, adjustments, and data compilation, all in accordance with the Site operation requirements.
- Performing the day-to-day non-scheduled maintenance, scheduled maintenance, and equipment servicing for which the operator may be responsible, all in accordance with the Site maintenance requirements.
- Completing all daily, weekly, and monthly operation logs for the Site.
- Being available to report to the Site in order to respond to unusual conditions which may develop when the Site is unmanned.
- Process troubleshooting and adjustments for quality control.
- Reviewing operating and monitoring data.
- Providing technical advice to technician and maintenance personnel.

1.4 Safety Policies and Practices

Based on careful study and experience, safety rules and procedures have been implemented to help protect employees from accidents and injuries. The following minimal personal protective equipment (PPE) must be worn by employees in the F-Area process areas:

- Hard Hat
- Safety Glasses with Side Shields
- Escape Respirator
- Safety Toe Shoes
- Long Sleeve Shirt

In addition, some areas or conditions may require the use of:

- Monogoggles
- Face Shield
- Chemical Resistant Suit
- Chemical Resistant Boots
- Chemical Resistant Gloves
- Pesco Hood
- Full Face Gas Mask with Carbon Canister
- Hearing Protection
- Self-Contained Breathing Apparatus

*See "Niagara Plant Useful Documents – PPE Selection Guide, or c*ontact your supervisor for direction.

Be aware of the Process Safety Information for your process area(s). A current copy of the Site Health and Safety Plan (HASP) is available in the control room for reference 24 hours/day. This includes the following basic safety requirements:

- Know the location of safety showers
- Know the location of fire extinguishers
- Know the location of main utility and process shut-off valves
- Report all injuries to the supervisor immediately
- Report defective equipment immediately
- Maintain good housekeeping every shift
- Wash your hands before using the restroom, before eating or before smoking

The Niagara Plant Safety Policy Statement is posted on the bulletin board of the control room. If there are any questions, the supervisor should be contacted.

1.5 Process Chemical Hazard Information

It is important for every worker to understand the information pertaining to the hazards of the chemicals that are used and dealt with on the job. Workers may be verbally informed about some of this information during training; however, it is recommended that each worker becomes familiar with the following specific hazards:

- Toxicity
- Permissible Exposure Limits (PELs)
- Physical Properties
- Reactivity/Chemical Properties
- Corrosion Data
- Thermal and Chemical Stability
- Effects of Mixing with Other Chemicals on Site

Material Safety Data Sheets (MSDS) provide workers and emergency personnel with procedures for handling or working with the substances and chemicals that are present in the work area in a safe manner. The supervisor can provide the current update of these data sheets for each incoming chemical raw material, chemical intermediate, chemical additive, and product in the work area. The official MSDS files for the Plant are kept by the Safety Department in *Building K-10.* A computer file of the MSDS for each work area is also available 24 hours/day from one's supervisor through the security guard at the Main Gate.

1.6 Safety and Health Consideration - Highly Hazardous Chemicals

In the event of a chemical exposure, each worker needs to know the appropriate, immediate response. Physical contact with a process chemical often requires immediate and thorough washing. Fresh air is often prescribed for exposure to airborne chemicals.

MSDS are the most comprehensive source of chemical hazard information, and are available (24 hours/day) for all chemicals produced and/or used at the Plant through one's supervisor.

It is extremely important to be prepared to respond to a chemical exposure, and to know how to summon immediate assistance. In addition to one's supervisor and co-workers, an Emergency Medical Technician (EMT) is on Site 24 hours/day through the Main Gate. Quick response on everyone's part to a chemical exposure can greatly reduce the severity of a potential injury. **Remember, all such chemical exposures and accidents must be reported immediately**.

1.7 Daily and Weekly Operator Checklists – Operating Equipment

Daily and weekly operator checklists are presented in Appendix A.

1.8 Level III Training

The Job Function List (JFL) is found in Appendix B.

1.9 References

1.9.1 Reference Manuals

- F-Area General Health and Safety Plan (HASP)
- Niagara Plant Emergency Plan
- Health and Safety Program for the Niagara Plant Waste Treatment Facilities
- Calgon Model 10 Granular Carbon Adsorption System Operating Manual
- Layne Air Stripper Operation & Maintenance Information
- Anguil Environmental Systems Operation & Maintenance Manual

1.10 Reference Drawings

The piping and instrumentation diagrams (P&IDs) are presented in Appendix C.

P&ID Description	Drawing #	Rev. #
Legend	NFA-EF-2000	1
Bedrock Extraction Wells	NFA-EF-2001	6
D-Area	NFA-EF-2002	4
Bedrock Extraction Well Detail	NFA-EF-2003	4
Manhole MH159L	NFA-EF-2004	4
Containment and Decanter Area	NFA-EF-2005	5
System Influent	NFA-EF-2006	7
Bleach Addition	NFA-EF-2007	2
Air Stripper and Bag Filters	NFA-EF-2008	6
West Carbon Train	NFA-EF-2009	3
Center Carbon Train	NFA-EF-2010	2
East Carbon Train	NFA-EF-2011	2
System Effluent	NFA-EF-2012	2
Thermal Oxidizer	NFA-EF-2013	5
Plant Utilities	NFA-EF-2014	2
Plant Utilities – Air Distribution	NFA-EF-2015	5
Plant Utilities – City Water	NFA-EF-2016	4
Plant Utilities – Safety Shower System	NFA-EF-2017	2
Plant Utilities – Natural Gas	NFA-EF-2018	3
Sand Filters	NFA-EF-2019	3
Backwash Tank	NFA-EF-2020	3
Thermal Oxidizer	NFA-EF-2021	1
Scrubber System	NFA-EF-2022	1
Stage 1-002 Outfall Conversion Engineering Flowsheet	A-11-22118	11

1.10.1 Definitions

Adsorber - A vessel which uses granular activated carbon as the surface for adsorption of chemicals to take place. Sometimes referred to as a bed or canister.

Adsorption - The adhesion of molecules to the surface of carbon or other solids with which they are in contact.

APL - Aqueous Phase Liquid.

Backwashing - An upflow rinsing of a carbon bed or sand filter.

Carbon Fines - Extremely fine carbon particles, typically generated during carbon transfers and suspended in the transfer waters.

Carbon Trailer - A tank trailer used to transport 20,000 pounds (lbs) of reactivated or spent carbon.

Heel - Any spent carbon not removed from an adsorber before charging it with fresh carbon.

Intermediate Adsorber - The second bed of three carbon adsorbers in series through which a process or waste stream is passed.

Lead Adsorber - The first bed of carbon through which a process or a waste stream is passed.

NAPL - Non-Aqueous Phase Liquid.

Overflow - Line used for backwashing or any overflow discharge of water to a drain.

pH - The negative logarithm of the effective hydrogen-ion concentration in gram equivalents per liter (values run from 0 to 14; 7 is neutral; less than 7, acidic; greater than 7, basic).

Polish Adsorber - The last bed of carbon through which a process or a waste stream is passed.

Reactivated Carbon - Previously used carbon that has been thermally regenerated.

Underdrain - Device designed to permit flow of water but retain carbon in a vessel.

Vent - A pressure relief line from an adsorber or tank.

Water Cushion - The water added to an adsorber or transfer tank before charging it with carbon to protect the underdrain and lining.

2. Operating Specifications and Alarms

2.1 Groundwater Remediation System Overview

The F-Area Groundwater Remediation System is designed to extract and treat the overburden and bedrock groundwater underlying the Plant and discharge the treated water to the 007 outfall in accordance with State Pollution Discharge and Elimination System (SPDES) Permit. The remediation system is composed of the following components:

- Groundwater Extraction System
- Carbon Dioxide (CO_2) Injection System
- Sand Filters
- Decanter Tank
- Bleach Injection System
- Air Stripper

- Carbon Beds
- Groundwater Discharge/Plant Water System
- Knockout Pot
- Thermal Oxidizer
- Scrubber System

2.2 Groundwater Extraction System

The groundwater extraction system consists of a series of 13 extraction wells currently in operation, the 002 collection system comprised of WW 1 and WW 2, the EBDTS comprised of WWB, the D-Area abandoned sanitary collection system comprised of MH-301; and the abandoned Outfall 005 collection system comprised of MH-159L.

The groundwater extraction system pumps groundwater via the various extraction and wet wells through two main forcemains (north and south) to the Treatment Facility.

MH-159L

Manufacturer:	Grundfos
Model:	10E14
Size:	1 hp/3500 rpm
Design:	14 gpm @ 85' TDH, Stainless Steel

Wet Well 1

Manufacturer:	Grundfos
Model:	75S-30-5
Size:	3 hp

Wet Well 2

Manufacturer:	Grundfos
Model:	16E4
Size:	0.75 hp/3450 rpm
Design:	15 gpm @ 85' TDH, Stainless Steel

Wet Well B, MH-301 PUMPS

Manufacturer:	Goulds
Model:	WE1534HH
Size:	1.5 hp/1780 rpm
Design:	20 gpm @ 109' TDH, Carbon Steel

B-Zone Wells (BEW-700B – BEW-705B)

Manufacturer:	Grundfos
Model:	10E104
Size:	1.0 hp/3600 rpm
Design:	5 gpm @ 300' TDH, Stainless Steel

B-Zone Wells (BEW-706B)

Manufacturer:	Grundfos
Model:	16E13
Size:	3.0 hp/3600 rpm
Design:	10 gpm @ 300' TDH, Stainless Steel

C-Zone Wells (BEW-701C, BEW-703C, BEW 704C, BEW-706C)

Manufacturer:	Grundfos
Model:	135S150-7
Size:	15 hp/3600 rpm
Design:	130 gpm @ 265' TDH, Stainless Steel

C-Zone Wells (BEW-702C)

Manufacturer:	Grundfos
Model:	135S150-7
Size:	15 hp/3600 rpm
Design:	130 gpm @ 300' TDH, Stainless Steel

C-Zone Wells (BEW-705C)

Manufacturer:	Grundfos
Model:	230S250-7
Size:	25 hp/3600 rpm
Design:	130 gpm @ 265' TDH, Stainless Steel

D-Zone Wells (BEW-701D, BEW-706D)

Manufacturer:	Grundfos
Model:	75S75-10
Size:	7.5 hp/3600 rpm
Design:	100 gpm @ 230' TDH, Stainless Steel

D-Zone Wells (BEW-702D)

Manufacturer:	Grundfos
Model:	80S75-9
Size:	7.5 hp/3600 rpm
Design:	100 gpm @ 230' TDH, Stainless Steel

D-Zone Wells (BEW-703D)

Manufacturer:	Grundfos
Model:	40S30-9
Size:	3.0 hp/3600 rpm
Design:	15 gpm @ 230' TDH, Stainless Steel

D-Zone Wells (BEW-705D, BEW-706D)

Manufacturer:	Grundfos
Model:	75S75-10
Size:	7.5 hp/3600 rpm
Design:	75 gpm @ 230' TDH, Stainless Steel

2.3 CO2 Injection System

The purpose of the CO_2 injection system is to inject CO_2 at each wet well and select manholes of the 002 collection system to create carbonic acid which in turn maintains a steady pH and prevents calcification in the collection system and treatment system.

The 002 collection system is pH adjusted by CO_2 injections via spargers in WW1, WW2, and MHC. A header runs west off a 6-ton CO_2 storage tank (supplied by Irish Carbonics). There are rotometers for CO_2 controls at each of the above wet wells and manholes. The CO_2 tank is filled once every 5 to 6 weeks. The level in the tank is checked daily. Refill is scheduled when the level in the tank is approximately at 10 percent of its total volume. The dosage at each location is adjusted manually to achieve the required pH (approximately 6 s.u.).

Spargers

Manufacturer:	Custom-made by GSH

CO2 Storage Tank

Manufacturer:	Irish Carbonics

Rotometers

Manufacturer:	Dwyer
Model:	RMB-54

2.4 Sand Filters

Groundwater pumped through the south forcemain (BEW-700/701/702B, WW1, and WW2) passes through a series of three sand filters prior to entering the Decanter Tank. The sand filters are located in the Treatment Facility Building. The filters are piped in parallel to allow one filter to remain in operation while the other filters are backwashing. The sand filters are periodically backwashed to removed solids. When the sand filters go into a backwash cycle, backwash water is pumped to a backwash tank transferring solids from the sand filters. The backwash tank is level controlled. When the tank reaches capacity, it automatically pumps down via the backwash transfer pump to the Decanter Tank.

Sand Filters

Number of Units:	Three beds
Designation:	Bed "A"
	Bed "B"
	Bed "C"
Disposition	Manual removal for off-Site disposal of Spent Sand:
Manufacturer:	Diamond
Model:	VSA-330-5.0-ASME
Design Conditions:	Carbon Steel, 304 Stainless Steel Basket
Flow:	250 gpm
Pressure:	100 psig

Filter Pump

Number of Units:	One
Manufacturer:	Goulds
Model:	3656
Vendor:	Diamond
Design:	250 gpm @ 50' TDH, 5 hp, Ductile Iron

Backwash Pump

Number of Units:	One
Manufacturer:	Goulds
Model:	3196 STX 1 x 1.5 - 6
Vendor:	Estabrook
Design:	65 gpm @ 80' TDH, Ductile Iron

Backwash Tank

Manufacturer:	Highland Tank
Size:	10'-0" Diameter x 18-6"
Volume:	6,000 Gallons
Design:	Carbon Steel

2.5 Decanter Tank

Groundwater produced by the groundwater extraction system is pumped through the north forcemain directly to the Decanter Tank whereas groundwater pumped through the south forcemain goes through the Sand Filters, prior to the Decanter Tank. Effluent from the Decanter Tank is pumped, using either APL Transfer Pump No. 1 or No. 2, to the Air Stripper.

The Decanter Tank is a cylindrical steel vessel, 25 feet in diameter by 40 feet high, with a total capacity of 139,500 gallons. Approximately 5,000 gallons of Decanter Tank space is available at the bottom of the tank for NAPL accumulation. To prevent freezing of the Decanter contents, the tank is electrically heated from the exterior and insulated.

The Decanter Tank is equipped with a safety valve capable of both pressure and vacuum relief in emergency conditions and a vent carbon adsorber. The tank overflow drains into Dike Sump No. 1.

Decanter Tank

Equipment #:	50731-800
Manufacturer:	Fisher Tank Co.
Size:	25'-0" Diameter x 40'-0" Straight Side
Volume:	139,500 Gallons
	5,000 Gallons NAPL
Design:	Carbon Steel, Electric Heated

APL Transfer Pumps No. 1 and No. 2

Equipment #:	50132-800
Manufacturer:	Goulds
Model:	3196

Size:	4 x 6 x 13, 50 hp/1780 rpm
Design:	1200 gpm @ 94' TDH, Ductile Iron

2.6 Decanter Tank Process Vent

The Decanter tank is vented to the atmosphere through a vapor phase carbon adsorber. As the adsorber becomes saturated, it is replaced and the exhausted adsorber canister is stored at the Plant for disposal.

The Decanter has a vent line that passes through one carbon vent adsorber. The tank vent carbon adsorber prevents the atmospheric release of vapors displaced during Decanter operations. The unit is installed within the treatment building but discharges to the atmosphere outside the building.

The unit consists of 2,000 lbs of regenerated activated carbon adsorbent in an epoxy-lined steel canister capable of venting 800 cubic feet per minute (cfm) at 15 pounds per square inch gas (psig) and 140°F.

Atmospheric Tank Vents

Equipment #:	50831-800
Manufacturer:	Evoqua
Model:	VPM-2000
Size:	48" diameter x 90" height
Design:	800 CFM, epoxy-lined steel, 2,000 lbs carbon

2.7 Bleach Injection System

In order to prevent biological growth in the air stripper packing, bleach is injected into the process line between the Decanter Tank and the Air Stripper. The bleach injection system is comprised of a single positive displacement pump and a bleach tote, all of which is monitored by the CDM operator.

Bleach Pump

Manufacturer:	Milton Roy
Model:	C771-24

2.8 Air Stripper

Air stripping is a mass transfer operation that involves the transfer of a solute from the liquid to the gas phase. Volatile organic compound (VOC) removal is accomplished by passing groundwater through the air stripper. In the air stripper, the groundwater comes into contact with a countercurrent air flow which strips VOCs from the water. The Air Stripper Blower is sized based on the air/water ratio required for optimum performance of the air stripper. Packing in the tower increases the contact time between the groundwater and the air stream for greater efficiency.

The Air Stripping System is located in the diked area at the east end of the Treatment Building. The system consists of a packed tower, an air stripper blower, and the carbon adsorber feed pumps. Groundwater from the Decanter Tank is pumped into the top of the Air Stripper. The water flows down through the packed column to the Air Stripper Sump. The water is pumped from the Air Stripper Sump to the carbon beds using either Carbon Adsorber Feed Pump North or South. The two pumps allow either pump to be serviced while maintaining the system's operation by using the stand-by pump. The pumps may also run in parallel to boost the flow rate.

Air Stripper

Equipment #:	50401-800
Manufacturer:	Hydro Group
Model:	PCS 84.30SS
Size:	7'-0" diameter x 43'-0" height
	35,400 lbs
Design Conditions:	1200 gpm, 316 SS

Air Stripper Blower

Equipment #:	50401-800
Manufacturer:	Twin City Fan
Model #:	245 BVC
Size:	5 hp/1800 rpm
Design:	6000 CFM @ 3"H2O, Carbon Steel

Carbon Adsorber Feed Pumps

Equipment #:	50132-800
	50133-800
Manufacturer:	Goulds
Model:	3196
Size:	4 x 3 - 13, 50 hp/1780 rpm
Design:	960 gpm @ 130' TDH, Ductile Iron

2.9 Carbon Beds

The Carbon Beds provide for removal of higher molecular weight organic compounds that are not removed by the Air Stripper**.** Spent carbon from this step is removed from Site by the vendor and regenerated. Fresh regenerated carbon is recharged into these beds as required based on results of VOCs monitoring. When refilled, the valves are changed such that the former lead bed becomes the polishing bed and the former polishing bed becomes the lead bed. This ensures that the polishing bed always contains fresh carbon.

Carbon backwash is performed to remove carbon fines, trapped air pockets, and sediments that build up in the beds. The carbon beds are backwashed to the Carbon Transfer Tank. The water is then pumped to the Decanter Tank using the Backwash Recycle Pump.

The groundwater stream from the Air Stripper passes through one of three Carbon Bed trains piped in parallel. Only two trains are currently in use. Each train consists of two beds valved in series. The purpose of these beds is to remove any dissolved organics that may be present. High differential pressure across a bed indicates the need for a backwash. Carbon effluent is used for backwash water and is pumped by the Backwash Pump.

Carbon Beds

Equipment #:	50833-800 50834-800 50835-800 50836-800 50837-800 50838-800
Manufacturer:	Calgon
Size:	7 - 10' diameter x 12' side wall, 100 psig American Society of Mechanical Engineers (ASME) coded, skid mounted, Epoxy-lined carbon steel adsorbers each capable of containing 20,000 lbs of granular activated carbon
Design Conditions:	2,000 gpm maximum flow

Transfer Pump

Number of Units:	One
Manufacturer:	Goulds
Model:	3642
Vendor:	Diamond
Design:	60 gpm @ 50' TDH, 2 hp, Ductile Iron

Backwash Pump

Equipment No.:	50136-800
Manufacturer:	Goulds
Model:	3996MT
Size:	3" x 4" - 13", 25 hp/1780 rpm
Service:	500 gpm @ 100' TDH, Ductile Iron

Backwash Recycle Pump

Equipment No.:	50137-800
Manufacturer:	Warren Rupp
Size:	2", SB2A
Service:	70 gpm @ 65' TDH, Cast Iron

2.10 Thermal Oxidizer

The off-gas stream from the Air Stripper passes through the Knock-Out Pot before entering the Thermal Oxidizer. Any condensate that drops out in the Knock-Out Pot is pumped back to the Decanter Tank by the Knock-Out Condensate Pump.

The Thermal Oxidizer is designed to destroy greater than 99 percent of organic compound vapors. Using high temperature oxidation, the Thermal Oxidizer converts the organic compounds to carbon dioxide gas, water and hydrochloric acid vapors.

The Thermal Oxidizer consists of insulated twin bed chambers filled with ceramic heat exchanger media. The beds are separated by a central combustion chamber which brings the process stream to its oxidation temperature. The process stream enters the first bed and passes through hot ceramic media which raises the air stream temperature close to the combustion temperature. In the combustion chamber, the process stream is heated to the combustion temperature where destruction of the organic compounds occurs. As the air stream exits the combustion chamber, it passes through the second bed where heat is transferred into the ceramic media, and then exits the Oxidizer. Two poppet valves are used to switch the direction of the process stream through the oxidizer. These valves are operated by two pneumatic actuators which are controlled through the Programmable Logic Controller (PLC) supplied with the unit. This system allows for the 95 percent primary heat recovery.

Knock-Out Pot

Equipment #:	6298060
Manufacturer:	Anguil Environmental Systems
Size:	60" ID x 96"
Capacity:	1200 gal, 200 gal (Liquid)

Knock-Out Condensate Pump

Manufacturer:	Goulds
Model	1^{ST}1D5F4
Size:	1x1 1/4x60.75 hp

Combustion Air Blower

Manufacturer:	Twin City Fans & Blowers
Model:	TCF, SIZE 18N4, TYPE TBNA, CCW ROT, UBD DISCH, ARR-4, ROT. W/ TECO NP0032, 3 HP MOTOR
Service:	320 CFM

Thermal Oxidizer

Equipment #:	6798059
Manufacturer:	Anguil Environmental Systems
Model:	RTO75
Size:	27' by 17'
Design Conditions:	7,500 SCFM flow

2.11 Scrubber System

The purpose of the Scrubber System is to remove the hydrochloric acid vapor from the process air stream exiting the Thermal Oxidizer prior to discharging it to the atmosphere. The process air exiting the Thermal Oxidizer is sent through ductwork to the Scrubber System enclosure building, which houses the unit. Just prior to entering the base of the Scrubber column, the process air flows through a Quench apparatus. This consists of nozzles that spray water pumped from the Scrubber sump at the base of the column. The Quench duct cools the process air down to near the saturation point, which increases the efficiency of the mass transfer occurring inside the column. The process air then enters near the base of the column and flows upward through a section of packing. As the process air flows up, water is distributed over the packing by a nozzle located near the top of the column. The packing increases the amount of surface area for the mass transfer to occur as the water flows downwards to the base or sump of the column. The water absorbs the hydrochloric acid vapor, allowing the process air to continue out of the top of the column. The air is then blown through a stack where it is discharged to the atmosphere. The Scrubber System process water is distributed from the base of the Scrubber to the recirculation nozzle above the packing, the Quench nozzles and a discharge blowdown line by means of a single pump. The water is controlled by pH and conductivity. When the water becomes too acidic, the system discharges process water by means of a blowdown line controlled by an automated solenoid valve. This water is sent back to the decanter. New water is introduced to raise the pH and account for the volume difference. City water is sent through a water softener located inside the Scrubber System enclosure prior to entering the column in order to reduce the effects of hard water buildup in the system. The makeup water is also controlled by an automated solenoid valve.

Quench System

Manufacturer:	Verantis Corp.
Model:	36" Diameter FRP Quench Duct
Design:	10,282 ACFM

Blowdown Pump

Manufacturer:	KM ANSIMAG
Model:	KM2156-C-04-AB-1-1-1-1-1-5-0
Size:	2x1.5x6, 7.5 hp

Water Softener

Manufacturer:	Marlo Inc.
Model:	MATC-150-1
Design:	25 gpm (continuous max.)

Process Fan

Manufacturer:	Verantis Corp.
Model:	CMHR-20, Class IV, CCW Rot, TAU, Arr-9H
Size:	365T, 75 hp
Service:	8,668 CFM

2.12 Dike Sump No. 1

Dike Sump No. 1 is located in the diked area surrounding the Decanter Tank. Rain water, Decanter Tank overflow, and any liquid spilled in the diked area is collected by the sump. The diked area encompasses 4,511 square feet. The sump has the following dimensions: 5 feet length x 3 feet 8 inches width x 5 feet depth.

Dike Sump No. 1 is pumped out to the Decanter Tank based on level in the sump. A high level in the Decanter Tank prevents the Dike Sump No. 1 Pump from operating. Dike Sump No. 1 Heater is provided to prevent freezing of the dike sump contents.

Dike Sump No. 1 Pump

Equipment #:	50131-800
Manufacturer:	Goulds
Model:	3171S
Size:	1 1/2" x 2" - 11", 5 hp, 1750 rpm
Service:	100 gpm @ 70'TDH

Dike Sump No. 1 Heater

Equipment #:	59901-800
Manufacturer:	Chromalox
Model:	TLS-360A-060
Service:	6 KW/460 V

2.13 Dike Sump No. 2

Dike Sump No. 2 is located in the diked area surrounding both the Air Stripper and the Thermal Oxidizer. Rain water and any liquid spilled in the diked area are collected by the sump. The diked area encompasses 2,137 square feet. The sump has the following dimensions: 4 feet length x 4 feet width x 3 feet depth.

Dike Sump No. 2 is pumped out to the Decanter Tank based on level in the sump. A high level in the Decanter Tank prevents the Dike Sump No. 2 Pump from operating. Dike Sump No. 2 Heater is provided to prevent freezing of the dike sump contents.

Dike Sump No. 2 Pump

Manufacturer:	Goulds
Model:	3171ST
Size:	1" x 1 1/2" - 6"
Service:	30 gpm @ 80' TDH

Dike Sump No. 2 Heater

Manufacturer:	Chromalox
Model:	TLS-360A-060
Service:	6 KW/460V

2.14 Building Sump

The Building Sump is centered at the west end of the building. Liquid spills or spent cleaning water are collected in the Building Sump. The sump has the following dimensions: 5 feet long by 7 feet wide by 6 feet deep.

Groundwater from the Building Sump is pumped out to the Decanter Tank based on level in the sump. A high level in the Decanter Tank prevents the Building Sump Pump from operating.

Building Sump Pump

Equipment #:	50135-800
Manufacturer:	Goulds
Model:	3171ST
Size:	1 1/2" x 2" - 11", 5 hp, 1750 rpm
Service:	50 gpm @ 70' TDH

3. Standard Operating Procedures (SOPS) - Normal Start-Up Routine Operation, And Normal Shutdown

This section of the F-Area Operational Procedures Manual contains the routine procedures used to operate the groundwater remediation system. The procedures are presented in a "Checklist Format".

In the instance of the occurrence of maintenance and repairs, refer to process start-up procedures after any repairs have been made and equipment has been returned to normal operating conditions.

The basic Plant PPE is listed in Section 1.3. In the following sections, additional PPE required beyond the basic PPE is listed under "Special Safety Considerations".

For Emergency Operating Procedures, see Section 4 of this manual.

3.1 Standard Operating Procedure - Start-Up/Shutdown of Extraction Wet Wells – Normal Operations

Responsibility: CDM Operator

Objective: This procedure outlines the steps necessary to start up and shutdown the wet wells.

Special Safety Considerations Leather Gloves

Procedure:

Start Up

1. Ensure valve properly valved in pump vault. Consists of pump discharge valve being opened and second valve in forcemain being opened (manual valves).
2. Ensure well is powered in appropriate motor control panel (MCC). Check to make sure breaker is set (not tripped).
3. Hand/off/auto switch moved to "auto" in vault.
4. Ensure appropriate forcemain valve in F-52 is open.
5. In control room, in SCADA screen, check that Interlock No. 1 and Interlock No. 2 are clear (Appendices D & G). Acknowledge alarms, clear interlocks as necessary. By clicking on each interlock, a list of parameters that need to be met in order to clear the interlock will appear.
6. On appropriate SCADA screen (B-Zone well screen, C-Zone well screen, or D-Zone well screen), click "enable" button. Should observe power flow.
7. Return to vault, check for leaks, pressure problems, etc. before closing vault.

Note: 702B and 703B run once per week manually. Remaining wells are run 24 hours.

Running 702B and 703B:

1. Open discharge valve.
2. Take initial totalizer readings.
3. Enable pump – set "hand/off/auto" valve switch to "hand" position.
4. Run pump
    - 702B – run for 10 minutes
    - 703B – run for 30 minutes
5. Set hand/off/auto valve switch to "off".
6. Take final totalizer readings.
7. Record readings in control room log book (both wells).

Shut Down

1. Click on "disable" button on SCADA screen.
2. If maintenance required, shut valves that were opened during the start-up procedure.
3. Lock out following Niagara Plant procedures.

At WW1 and WW2, CO_2 injections run continuously. At each rotometer there are valves to shut off the CO_2 to a particular well if maintenance is required.

3.2 Standard Operating Procedure - Process Start-Up/Shutdown – Normal Operations

Responsibility: CDM Operator

Objective: This procedure outlines the steps for starting up the process operation.

Special Safety Considerations: Leather Gloves

If decanter level is below 50 percent, wells should be started first (referring to Wet Well start-up procedure [Section 3.1]). If the decanter level is above 50 percent, the process should be started as per the following procedure prior to BEW/Wet Well start-up.

Procedure:

General Comments:

- Compressor must be running in order to proceed with process start-up – refer to compressor start-up procedure (Section 3.3).
- Oxidizer and scrubber must be running in order to proceed with process start-up - refer to oxidizer start-up procedure (Sections 3.4 and 3.5).
- Set decanter level set point. Decanter level is generally set at 30-50 percent, but can vary based on process needs, such as carbon changes and backwashing.
- There are three carbon trains in F-Area process; only two are in use at one time. Auto valves should split the flow evenly between carbon trains. The third train remains manually valved out but can be put into service if necessary.

- During normal operation sand filters will automatically backwash once every 24 hours. Backwash water goes to the backwash transfer tank. The tanks are controlled by level and the backwash transfer pump will pump that tank back to the decanter when level setpoint is achieved.
- Ensure that decanter dike sump and oxidizer dike sump are powered in "auto" (set hand/off/auto switch to "auto") and discharge valves are open.
- During cold weather months, ensure that heaters are functioning.

Pre-Start-up

1. Ensure manual valving is correct throughout the process by walking lines and checking all manual valves.
2. Check power to sand filter panel, APL transfer pump, carbon feed pumps, air stripper blower, and backwash transfer pump.
3. Ensure the backwash transfer pump hand/off/auto switch is set to "auto" position.
4. Ensure the manual block valve is open. If it is not, open it.
5. Ensure carbon feed pump hand/off/auto switch is set to "auto" position.
6. Check all interlocks on SCADA screen, acknowledge alarms, clear interlocks as necessary. By clicking on each interlock, a list of parameters that need to be met in order to clear the interlock will appear.
7. Check for sufficient bleach supply (1 tote/250 gallons). If not, call main gate for delivery.

Start Up

1. Energize APL transfer pump by local switch on southeast corner of decanter dike.
2. Check flow transmitter on north wall to ensure proper flow. The F-Area process generally runs between 400 and 500 gpm. Monitor the level of the air stripper on the SCADA screen. Once the air stripper level reaches 50 percent, the carbon feed pump should automatically start up. If it does not, check to make sure it is in Auto mode at the hand-switch.
3. Automatic valve 300, 305, 315 should maintain level in air stripper at 40 percent.
4. Check effluent flow transmitter on south wall for indication of flow. This should closely match what is coming in on the north wall transmitter.
5. Ensure pH values are within the 6 to 9 s.u. range. The pH measurements at F-Area are generally consistent. However, it may raise slightly after a carbon change. Most pH problems indicate a problem with the probe that may require maintenance.
6. Enable bleach pump on the SCADA screen. Check to make sure pump is pumping. If not pumping, check to make sure primed. If primed and not pumping, call maintenance.
7. Walk lines, check for leaks, and check pressure on carbon beds (see backwash procedure [Section 3.9]).

Shut Down

1. Shut off APL transfer pump. Set hand/off/auto switch to "off".
2. Air stripper tank will pump down to 25 percent, shutting down carbon feed pumps.

3. Shut down all BEWs/Wet Wells (refer to Wet Well shutdown procedure [Section 3.1]).
4. The bleach pump will automatically go to "disable" once the APL transfer pump is shut down.
5. If the oxidizer or scrubber system needs to be shut down, refer to the shutdown procedures (Section 3.4 & 3.5).

Follow Up

1. Walk the system and make sure all pumps are off. If they are not, set all pump hand/off/auto switches to the "off" position.

3.3 Standard Operating Procedure - Air Compressor Start Up/Shut Down - Normal Operations

Responsibility: CDM Operator

Objective: This procedure outlines the steps for the start-up and shutdown of the air compressor.

Special Safety Considerations: Leather Gloves

Procedure:

Start Up

1. Make sure there is power to the unit by observing the front panel display. If there is not, check the motor control center to ensure that power supply is engaged.
2. Ensure manual discharge valve to receiver tank is open.
3. Ensure receiver discharge valve is open to air header.
4. Energize unit. Push the green button on the control panel.
5. Monitor air pressure locally at the compressor panel. Pressure should build to 100 psi.

Shut Down

1. Shut down compressor by depressing red "stop" button on the front control panel.
2. Close gate valves to and from receiver on the process building north wall.

3.4 Standard Operating Procedure – Start-Up/Shutdown and Operation of Thermal Oxidizer – Normal Operations

Responsibility: CDM Operator

Objective: This Procedure Describes the Steps Necessary to Start up, shutdown, and operate the Thermal Oxidizer

Special Safety Considerations: Leather Gloves

Procedure:

Refer to Anguil Environmental Systems Operation and Maintenance Manual (Appendices E & G of this manual) or located in F-Area Control Room (October 2015).

3.5 Standard Operating Procedure – Start-Up and Operation of Scubber System – Normal Operations

Responsibility: CDM Operator

Objective: This Procedure Describes the Steps Necessary to Start up, shutdown, and operate the Scrubber System

Special Safety Considerations: Leather Gloves

Procedure:

Refer to Anguil Environmental Systems Operation and Maintenance Manual (Appendices F & G of this manual) or located in F-Area Control Room (October 2015).

3.6 Standard Operating Procedure – Start Up Air Stripper – Normal Operations

Responsibility: CDM Operator

Objective: This Procedure Describes the Steps Necessary to Start the Air Stripper

Procedure:

Perform the following to ensure that the Air Stripper is ready to receive groundwater:

1. Check the vent line to Thermal Oxidizer. Verify that the Thermal Oxidizer is ready to receive process air.
2. Start Air Stripper Blower.
3. Close Air Stripper drain valve.
4. Close Carbon Feed Pump drain valves.
5. Open the three valves between the Air Stripper Sump and Carbon Feed Pumps.
6. Open the valves between the Carbon Feed Pump and the Sand Filters.
7. Open the valves between the Sand Filters and Carbon Beds.
8. Start APL Transfer Pump.
9. Turn Carbon Feed Pump of choice to Auto.

3.7 Standard Operating Procedure – Air Stripper Preparation for Routine Maintenance and Inspection – Normal Operations

Responsibility: CDM Operator

Objective: This procedure outlines the steps necessary to take the Air Stripper out of service and prepare for inspection.

Special Safety Considerations: Full Face Respirator, Rubber Boots, Saranex Coverall, Pesco Hood, Nitrile Gloves

Procedure:

Drain the Air Stripper Tower

1. Stop all flow to the Air Stripper.
2. Use the Carbon Feed Pump to pump the water through the system.
3. At low sump level, the Carbon Feed Pumps will shut down.
4. After all water has drained from the tower, turn the Air Stripper Blower off.
5. Shut down Thermal Oxidizer.

Inspect Blower and Accessories

1. Correct the alignment of the sheaves.
2. Tighten loose belts.
3. Replace worn or cracked belts.
4. Clean and/or change the air filters.
5. Lubricate motor and fan bearings.
6. Replace worn or cracked flexible ductwork connections.

Inspect Tower Foundation

1. Check foundation for evidence of settling (cracking, buckling, etc.).
2. Check anchoring system for stability.
3. Examine condition of the clear well.

Inspect Tower

1. Check shell and piping for leaks and wear.
2. Clean air outlet screens.
3. Tighten bolts on flanged connections.
4. Replace worn, cracked, or leaking gasket material.
5. Clean the mist eliminator of large particles.
6. Inspect packing for staining and/or deposition.

7. Examine the distributor tray and sump for staining and/or deposition.
8. Remove debris from the distributor tray and sump areas.

3.8 Standard Operating Procedure - Manual Sand Filter Backwash – Normal Operations

Responsibility: CDM Operator

Objective: This procedure outlines the steps for conducting a manual sand filter backwash.

Special Safety Considerations: Leather Gloves

During normal operation, the sand filters automatically backwash once every 24 hours.

If high pressure observed between cycles, backwash can be forced in two ways via the following procedure:

Procedure:

There are two possible ways to force a backwash:

1. Left click on "initiate backwash" button in the control room.
2. At the sand filter control, depress and hold the "initiate backwash" button for 15 seconds.

3.9 Standard Operating Procedure - Lead Carbon Bed Backwash Procedure with Backwash Pump – Normal Operations

Responsibility: CDM Operator

Objective: This procedure outlines the steps for conducting a lead carbon bed backwash using the backwash pump.

Special Safety Considerations: Leather Gloves

General Comment:

Carbon beds need to be periodically be backwashed when the lead bed pressure is greater than 15 psi.

Procedure:

1. Connect backwash discharge 4" hose to forcemain into decanter line and open backflush valve.
2. Manually valve in polish bed from air stripper feed pump (open V-1).
3. Manually valve out lead bed from air stripper feed pump (close V-2 and close V-3).
4. Open top valve for backwash water out (open V-4).
5. Open bottom valve for backwash water in to lead bed on south wall of process building (open V-5).
6. Open discharge valve of backwash water totalizer on south wall.

7. Start backflush water pump. Set hand/off/auto switch to "auto" position.
8. Manually cut back on effluent discharge valve to approximately 150 gallons.
9. Backflush lead bed 5,000 to 8,000 gallons, using the backwash line totalizer on the south wall to keep track of gallons used.
10. Manually open effluent discharge valve located on the south wall before the effluent totalizer.
11. Close valve discharge side of flow totalizer.
12. Close top valve for backwash water out (close V-4).
13. Close bottom valve for backwash water (close V-5).
14. Open carbon bed feed valve to lead bed.
15. Close valve to polish bed carbon feed.
16. Close butterfly valves on both sides of backwash discharge hose and disconnect hose.

3.10 Standard Operating Procedure –Lead Carbon Bed Backwash Procedure Without Backwash Pump – Normal Operations

Responsibility: CDM Operator

Objective: This procedure outlines the steps necessary to backwash the lead carbon bed without using the backwash pump.

Special Safety Considerations: Leather Gloves

Procedure:

Prepare Lead Bed for Backwash

1. Open the feed valve to the second carbon bed.
2. Close the valve in the transfer line between the first and second carbon beds.
3. Close the feed valve to the first carbon bed.
4. Adjust flows to the carbon beds to equalize flows.

Begin Backwash of Lead Bed

1. Open the backwash water-out valve on the first carbon bed.
2. Open the backwash water-in valve on the first carbon adsorber.
3. Open the valve in the backwash water line to the transfer tank. This valve should already be open.
4. Open the vent valve on the carbon transfer tank. This valve should already be open.
5. Open the two valves by the backwash pump meter.
6. Cut back on the effluent discharge valve until the effluent flow drops by 400 to 500 gpm (example: from 750 gpm to 250-350 gpm).

7. Check the backwash water meter to be sure the carbon adsorber is backwashing.
8. After backwashing for 7 minutes, open the effluent discharge valve fully.

Stop Backwash of Lead Bed

1. Close the two valves by the backwash water meter.
2. Close the backwash water-in valve on the first carbon bed.
3. Close the backwash water-out valve on the first carbon bed.
4. Open the feed valve to the first carbon bed.
5. Open the feed valve in the transfer line between the first and second carbon bed.
6. Close the feed valve to the second carbon bed.
7. Equalize flows to the carbon beds.

3.11 Standard Operating Procedure – Change Rupture Disks In Carbon Beds – Normal Operations

Responsibility: CDM Operator

Objective: This procedure outlines the steps needed to change the rupture discs on the Carbon Beds.

Special Safety Considerations: Rain Suit/Saranex, Rubber Footwear, Face Shield, Nitrile Gloves

Procedure:

Prerequisites

1. Ensure that the Treatment Process is shut down. Refer to Treatment Process Shutdown Procedure.
2. Open vent valve to drain the rupture disc valve. **Note**: No water should be seen in the site glass if the rupture disk is blown.
3. Put on PPE.

Lock Out The Following

1. Carbon Bed Feed Pumps
2. Carbon Bed feed valves
3. Carbon Bed effluent valves
4. Carbon Bed backwash inlet valves
5. Carbon Bed backwash outlet valves

Change Rupture Disc

1. Loosen four bolts on rupture disc flange.
2. Remove two bolts facing away from Bed.
3. Slide out rupture disc and inspect.

4. Inspect gaskets and replace if necessary.
5. If rupture disc is blown, replace with new 6" Zook 75 psig graphite disc.
6. Replace bolts and tighten, taking care not to over tighten since polyvinyl chloride (PVC) fittings can be easily cracked.
7. Take off PPE.
8. Close the Carbon Bed vent valve.

Unlock Valves and Pumps and Set For Normal Operation

Refer to Treatment Process Start-up Procedure

Follow-Up

1. After the Treatment Process is in operation, check flanges for leaks and tighten bolts if necessary.
2. Make sure there is no flow through the rupture disc line sight glass.

Note: If the F-52 Building sump fills and shuts down the treatment system, start the Carbon Adsorber Feed Pumps again and check the rupture disk site glass for water flow. If there is water flow, have maintenance check the rupture discs.

3.12 Standard Operating Procedure – Transfer of Spent Carbon Into The Carbon Storage Tank – Normal Operations

Responsibility: CDM Operator

Objective: This procedure outlines the steps necessary to transfer spent carbon to the Carbon Transfer Tank.

Special Safety Considerations: Rubber Footwear, Face Shield, Leather Gloves, Rain Suit/Saranex

Procedure:

Backwash the Lead Bed on the Second Carbon Train

1. Check the vent valve on the side of the Carbon Transfer Tank. If there is enough water in the transfer tank to provide a water cushion over the underdrains, water should flow out this vent line. If not, backwash the lead bed on the second carbon train for 2-3 more minutes to add more water to the Carbon Transfer Tank.
2. Close the valve in the "backwash water out" line to the Carbon Transfer Tank.
3. Close the valve in the "backwash water in" line to the Carbon Transfer Tank. This valve should be already closed.
4. Open the vent valve on the Carbon Transfer Tank. This valve should be already open.

Transfer Spent Carbon From Bed To Carbon Transfer Tank

1. Open the feed valve on the polish bed on the first carbon bed train.

2. Close the valve in the transfer line between the lead and polish carbon beds on the first carbon train.
3. Close the feed valve on the lead carbon bed on the first carbon bed train.
4. Adjust flows to the carbon bed trains to equalize flows.
5. Run a 4-inch carbon transfer hose from the bottom carbon-out transfer line on the spent carbon bed to the top carbon-in transfer line on the transfer tank. Wire all Camlock connections closed.
6. Open the two valves on the regulated air supply line at the pressure regulator by the transfer tank.
7. Open the "top" air valve on the spent carbon bed to pressurize the adsorber.
8. Open the valve in the top carbon-in transfer line at the transfer tank.
9. Open the valve at the bottom carbon-out transfer line at the spent carbon bed. Carbon should now be transferring from the spent bed to the transfer tank.
10. Monitor the carbon transfer by observing the flow of carbon and water in the site glass in the transfer line. The spent carbon transfer should take from 30 to 45 minutes.
11. Monitor the level in the building sump. Start the sump pump as needed to keep the building sump pumped out. **NOTE:** A high level in the building sump will shut the process down. Stop the carbon transfer by closing the valve in the bottom carbon-out transfer line at the spent carbon bed if necessary.
12. When carbon is no longer observed in the site glass, the carbon transfer is complete. Close the "top" air valve on the now empty carbon bed.
13. Close the valve in the bottom carbon-out transfer line at the empty carbon bed.
14. Slowly open the vent valve on the empty carbon bed to depressurize the adsorber.
15. Open the feed valve on the empty bed to add water to the bed to wash down any remnants of carbon in the bed.
16. After 2 to 2½ minutes, close the feed valve on the empty bed.
17. Close the vent valve on the empty bed.
18. Open the "top" air valve on the empty bed to re-pressurize the adsorber.
19. When the air pressure on the empty bed reaches 30 psi, open the valve in the bottom carbon-out transfer line to transfer the wash water to the transfer tank.
20. Observe the water in the site glass. If few or no carbon granules are observed in the site glass, all spent carbon has been removed from the bed. If large amounts of carbon granules are observed in the site glass, complete transferring the wash water and repeat steps 12 to 19 as many times as necessary to remove all spent carbon from the bed.

Stop Carbon Transfer

1. After the final wash water has been transferred from the empty bed, close the "top" air valve on the empty bed.
2. Close the valves in the carbon transfer lines at the empty bed and at the transfer tank.

3. Slowly open the vent valve on the empty bed to depressurize the bed.
4. Remove the carbon transfer hose(s) and replace the caps on the carbon transfer lines.
5. Close the two valves on the regulated air supply line at the air regulator.

3.13 Standard Operating Procedure – Transfer of New Carbon Into An Empty Carbon Bed – Normal Operations

Responsibility: CDM Operator

Objective: This procedure outlines the steps necessary to transfer new carbon from the tank trailer to an empty carbon bed.

Special Safety Considerations: Rubber Footwear, Face Shield, Leather Gloves, Rain Suit/Saranex

Procedure:

Open the Vent Valve on the Empty Carbon Bed

Charge the Empty Carbon Bed

1. Add about 3,500 gallons of treated water to the empty bed using the procedure for backwashing lead bed without backwash pump, steps 6 and 9 through 14.
2. Check the vent valve on the side of the bed. If there is enough water to provide a water cushion over the underdrains, water should flow out of this vent line. If not, add more water to the bed.

Transfer the Carbon from the Trailer to the Empty Carbon Bed

1. Install four wheel chocks on the carbon trailer.
2. Run a 4-inch carbon transfer hose from the process water supply line to the carbon trailer carbon fill line. When instructed to do so by the driver, begin to add water to the carbon trailer using the backwash pump or city water. Wire all Camlock connections closed.
3. Run a 4-inch carbon transfer hose from the trailer carbon discharge line to the empty bed top carbon-in transfer line on the empty bed.
4. Open the valve on the top carbon-in transfer line on the empty bed.
5. Run a 1-inch air hose from the regulated pressure air supply line to the carbon trailer air connection located in front of the trailer on the driver's side.
6. Run a 1-inch water hose from the City water supply line to the carbon trailer chase water connection.
7. Shut off the water to the carbon trailer when instructed to do so by the driver.
8. Open the air valves to pressurize the carbon trailer when instructed to do so by the driver.
9. The driver will transfer new carbon from the carbon trailer into the empty bed.
10. Monitor the carbon transfer by observing the flow of carbon and water in the site glass in the transfer line. The carbon transfer should take from 45 to 75 minutes.

11. Monitor the level in the building sump. Start the sump pump as needed to keep the building sump pumped out. **NOTE:** A high level in the building sump will shut the process down. Stop the carbon transfer by closing the valve in the bottom carbon-out transfer line at the spent carbon bed if necessary.

12. When the carbon is no longer observed in the site glass, the carbon transfer is complete. Shut off the air and chase water to the empty carbon trailer when instructed to do so by the driver.

13. Close the valve in the top carbon-in transfer line on the now filled carbon bed.

14. After the driver has vented the carbon trailer, disconnect and remove all hoses from the trailer. Store hoses properly.

15. Replace caps on all open connections.

16. Close the vent valve on the new carbon bed.

17. Put the new bed on-line in the polish position.

18. Change the "lead" and "polish" signs on the carbon beds to indicate the new bed positions.

19. Move the sample signs to the new positions.

3.14 Standard Operating Procedure – Transfer of Spent Carbon from Carbon Transfer Tank To Tank Trailer– Normal Operations

Responsibility: CDM Operator

Objective: This procedure outlines the steps necessary to transfer spent carbon from Carbon Transfer Tank to a Tank Trailer.

Special Safety Considerations: Rubber Footwear, Face Shield, Leather Gloves, Rain Suit/Saranex

Procedure:

Prepare Trailer for Transfer

1. Install four wheel chocks on carbon trailer.

Connect Hoses

1. Run a 4-inch carbon transfer hose from the carbon fill line on the carbon trailer to the bottom carbon-out transfer line on the transfer tank. Wire all Camlock connections closed.

2. Close the valve in the "backwash water-in" line to the transfer tank. This valve should be already closed.

3. Close the valve in the "backwash water-out" line to the transfer tank.

4. Close the vent valve on the transfer tank.

5. Open the two valves on the regulated air supply line at the pressure regulator by the transfer tank.

6. Open the air valve to the transfer tank.

7. Run a 1-inch water hose connection on the carbon-out transfer line to supply chase water.

Transfer Spent Carbon from Tank to Tank Trailer

1. Open the valve in the bottom carbon-out transfer line at the carbon transfer tank when instructed to do so by the driver. Carbon should be now transferring from the transfer tank to the carbon trailer.
2. Monitor the carbon transfer by observing the flow of carbon and water in the site glass in the transfer line. The carbon transfer should take 30-45 minutes.
3. Begin to de-water the carbon trailer when instructed to do so by the driver.
4. Monitor the level in the building sump. Start the sump pump as needed to keep the building sump pumped out. **NOTE:** A high level in the building sump will shut the process down.
5. When carbon is no longer observed in the site glass, the carbon transfer is complete. Close the air valve to the transfer tank.

Stop Carbon Transfer

1. Close the valve in the bottom carbon-out transfer line at the transfer tank.
2. Slowly open the vent valve on the transfer tank to depressurize the transfer tank.
3. Add about 500 gallons of water to the transfer tank, to wash any remnants of carbon out of the transfer tank.

3.15 Standard Operating Procedure – Bleach Addition System – Normal Operations

Responsibility: CDM Operator

Objective: This procedure describes the process for operating the bleach addition system.

Special Safety Considerations: Rubber Gloves

Procedure:

Start Up

1. Plug in bleach pump to 110 outlet.
2. Enable pump on SCADA screen.
3. Pump will automatically start up.
4. Open the drain to floor.
5. Let pump until pump primes itself, then close drain valve.
6. Ensure discharge to APL transfer line is open.

Shut Down

1. Disarm pump on SCADA screen.
2. Unplug from 110 outlet.

Tote Replacement

1. Switch suction tote from empty tote to full tote.
2. Replace fill cap on empty tote.
3. Call main gate at 7794 for bleach tote refill.

3.16 Standard Operating Procedure – Auto Dialer – Normal Operations

Responsibility: CDM Operator

Objective: This procedure describes the procedure for arming/disarming the auto dialer.

The auto dialer is located in the F-Area Motor Control Room.

The auto dialer notifies the Main Gate that there is a potential problem in the F-Area. The Main Gate will notify the shift supervisor to investigate. During the day shift, the shift supervisor notifies CDM Operator. During the night shift, the shift supervisor notifies facility supervisor.

Procedure:

Start Up

1. Ensure there is power to the auto dialer (that it is plugged in).
2. Press "power on" button.
3. Press "arm/disarm" button to arm auto dialer. Ensure it is in "arm" mode (will display on the auto dialer screen).

Shut Down

1. Press "arm/disarm" button to disarm the auto dialer. Ensure it is in the "disarm" mode (this will display on screen).

4. Emergency Procedures

4.1 Groundwater Extraction System

Who Can Institute an Emergency Shutdown:

- CDM Operator

Conditions Which Could Necessitate an Emergency Shutdown:

- Utility failure (compressed air, power, electrical, natural gas, etc.)
- Major leak of decanter or process vessels or piping
- Flooded sumps (decanter, building, and oxidizer)
- Sump failure
- Oxidizer problem
- Scrubber problem

- Malfunctioning alarms or interlocks
- Ruptured forcemain
- Overflowing decanter
- Faulty sparger

Procedure:

Extraction and Wet Wells

1. Go to each individual well screen and put the pump in disable mode for each individual well.
2. Valve wells out from the forcemain individually if necessary at their respective locations.

CO_2 Injection System

1. Close the two feed valves at the 6-ton tank that feed CO_2 header.
2. To restart, open the two feed valves.

4.2 Sand Filters

Who Can Institute an Emergency Shutdown:

- CDM Operator

Conditions Which Could Necessitate an Emergency Shutdown:

- Utility failure (compressed air, power, electrical, natural gas, etc.)
- Major leak of decanter or process vessels or piping
- Flooded sumps (decanter, building, and oxidizer)
- Sump failure
- High-high decanter level
- Low-low decanter level
- Effluent pH <6 or >9 s.u.
- Oxidizer problem
- Malfunctioning alarms or interlocks
- Low air flow
- Blower failure
- High differential

Procedure:

In the event of an emergency, an automatic interlock shutdown will occur that will shut down the sand filter unit. Interlock No. 2 tripping will shut down the South forcemain which runs through the sand filters. This will shut the sand filter unit down. Other interlocks may cause a cascade effect, ultimately tripping Interlock No. 2. The reasons for the interlock shutting down the sand filters can be determined by clicking on the "Interlock" tab on the SCADA screen. Any parameters that have caused the interlock(s) to trip will be displayed in red. These issues must be addressed before the interlock can be cleared and normal operations resumed.

1. Notify Supervisor
2. Isolate inlet/discharge valves
3. Verify automatic interlock shutdown has occurred
4. If shutdown has not occurred, manually shut down:
    - City of Niagara Falls water supply
    - Power at sand filter control box (turn off)
    - Air supply valve (turn off)
5. Wait for direction from Supervisor

4.3 Sand Filter Backwash Tank

Who Can Institute an Emergency Shutdown:

- CDM Operator

Conditions Which Could Necessitate an Emergency Shutdown:

- Utility failure (compressed air, power, electrical, natural gas, etc.)
- Major leak of decanter or process vessels or piping
- Flooded sumps (decanter, building, and oxidizer)
- Sump failure
- High-high decanter level
- Low-low decanter level
- Effluent pH <6 or >9 s.u.
- Oxidizer problem
- Malfunctioning alarms or interlocks
- Low air flow
- Blower failure
- High differential

Procedure:

In the event of an emergency, an automatic interlock shutdown will occur that will shut down the sand filters and operation of the Backwash Tank. A high-high level in the backwash tank will prevent the sand filters from backwashing. A low-low level in the tank will prevent the Backwash Transfer Pump from operating properly. High or low level problems must be addressed before the Backwash Tank can be returned to normal operations.

1. Notify Supervisor.
2. Verify automatic interlock shutdown has occurred.

3. If shutdown has not occurred. If shutdown has not occurred, shut off the backwash tank transfer pump with the hand off/auto switch.

4. Wait for direction from Supervisor.

4.4 Decanter Tanks

Who Can Institute an Emergency Shutdown:

- CDM Operator

Conditions Which Could Necessitate an Emergency Shutdown:

- Utility failure (compressed air, power, electrical, natural gas, etc.)
- Major leak of decanter or process vessels or piping
- Flooded sumps (decanter, building, and oxidizer)
- Sump failure
- Low-low decanter level
- Oxidizer problem
- Malfunctioning alarms or interlocks

Procedure:

In the event of an emergency, an automatic interlock shutdown will occur that will shut down all field pumps and potentially cause the decanter to go to a low level.

- Interlock 1 will shut down the North Forcemain. Potentially caused by a high-high decanter alarm, or well leak-detection.
- Interlock 2 will shut down the South Forcemain. Potentially caused by a high-high decanter alarm or well leak detection.
- Interlock 4 will trip if the decanter goes to a low level, shutting the entire process down.
    1. Notify Supervisor
    2. Shut down inlet/discharge valves
    3. Isolate leaking area
    4. Verify Wet Well and APL pumps are shut down
    5. Wait for direction from Supervisor

The automatic interlock shutdown will go into effect in all cases except the following:

- Leaking line in decanter dikes
- Transfer line leak

4.5 APL Transfer Pumps No. 1 and No. 2

Who Can Institute an Emergency Shutdown:

- CDM Operator

Conditions Which Could Necessitate an Emergency Shutdown:

- Utility failure (compressed air, power, electrical, natural gas, etc.)
- Major leak of decanter or process vessels or piping
- Flooded sumps (decanter, building, and oxidizer)
- Sump failure
- High-high decanter level
- Low -ow decanter level
- Effluent pH <6 or >9 s.u.
- Oxidizer problem
- Malfunctioning alarms or interlocks

Procedure:

In the event of an emergency, an automatic interlock shutdown will occur that will shut down the transfer pumps. Interlock No. 4 will shut these pumps down. Other interlocks may cause a cascade effect, ultimately tripping Interlock No. 4. The reasons for the interlock shutting down the pump can be determined by clicking on the "Interlock" tab on the SCADA screen. Any parameters that have caused the interlock(s) to trip will be displayed in red. These issues must be addressed before the interlock can be cleared and normal operations resumed.

1. Notify Supervisor.
2. Verify automatic interlock shutdown has occurred.
3. If shutdown has not occurred, manually press the Start/Stop button to shut down the pumps.
4. Wait for direction from Supervisor.

4.6 Bleach Injection System

Who Can Institute an Emergency Shutdown:

- CDM Operator

Conditions Which Could Necessitate an Emergency Shutdown:

- Utility failure (compressed air, power, electrical, natural gas, etc.)
- Major leak of decanter or process vessels or piping
- Flooded sumps (decanter, building, and oxidizer)
- Sump failure
- Oxidizer problem
- Malfunctioning alarms or interlocks

Procedure:

1. Disable bleach pump on main SCADA screen.
2. Valve out bleach pump if necessary.

4.7 Process Vent

No emergency procedure is necessary for the process vent because the vent does not contain any process controls or valves. It is simply a vent line from the storage tank, to the carbon bed.

4.8 Air Stripper

Who Can Institute an Emergency Shutdown:

- CDM Operator

Conditions Which Could Necessitate an Emergency Shutdown:

- Utility failure (compressed air, power, electrical, natural gas, etc.)
- Major leak of decanter or process vessels or piping
- Flooded sumps (decanter, building, and oxidizer)
- Sump failure
- High-high decanter level
- Low-low decanter level
- Effluent pH <6 or >9 s.u.
- Oxidizer problem
- Malfunctioning alarms or interlocks
- Low air flow
- Blower failure
- High differential

Procedure:

In the event of an emergency, an automatic interlock shutdown will occur. Any number of process interlocks may occur to ultimately shut down the air stripper. Other interlocks may cause a cascade effect, ultimately tripping Interlock No. 6. The reasons for the interlock shutting down the Air Stripper can be determined by clicking on the "Interlock" tab on the SCADA screen. Any parameters that have caused the interlock(s) to trip will be displayed in red. These issues must be addressed before the interlock can be cleared and normal operations resumed.

1. Notify Supervisor
2. Verify automatic interlock shutdown has occurred
3. If shutdown has not occurred, manually shut down:
    - APL transfer pump
    - Carbon bed feed pump
    - Air stripper blower
4. Wait for direction from Supervisor

4.9 Carbon Beds

Who Can Institute an Emergency Shutdown:

- CDM Operator

Conditions Which Could Necessitate an Emergency Shutdown:

- Utility failure (compressed air, power, electrical, natural gas, etc.)
- Major leak of decanter or process vessels or piping
- Flooded sumps (decanter, building, and oxidizer)
- Sump failure
- High-high decanter level
- Low-low decanter level
- Effluent pH <6 or >9 s.u.
- Oxidizer problem
- Malfunctioning alarms or interlocks
- Low air flow
- Blower failure
- High differential
- Blown rupture disk

Procedure:

In the event of an emergency, an automatic interlock shutdown will occur that will shut down all pumps. Any interlock affecting process operations can potentially affect normal operation of the carbon beds. Interlocks may cause a cascade effect, ultimately shutting down the carbon bed operation. Interlocks involved can include Interlock Nos. 1, 2, 4, 6, 7, 10, and 11. The interlock directly affecting the carbon feed pumps is Interlock No. 7. This can be triggered by another interlock, but may also be the result of the Air Stripper going into a Low-Low condition, or the Building Sump being in a High Level Condition. The reasons for the interlock shutting down the process can be determined by clicking on the "Interlock" tab on the SCADA screen. Any parameters that have caused the interlock(s) to trip will be displayed in red. These issues must be addressed before the interlock can be cleared and normal operations resumed.

1. Notify Supervisor
2. Verify automatic interlock shutdown has occurred
3. If shutdown has not occurred. If shutdown has not occurred, manually turn off the following:
   - Carbon bed feed pump
   - Carbon bed feed valve
4. Wait for direction from Supervisor

4.10 Thermal Oxidizer

Who Can Institute an Emergency Shutdown:

- CDM Operator

Conditions Which Could Necessitate an Emergency Shutdown:

- Utility failure (compressed air, power, electrical, natural gas, etc.)
- Major leak of decanter or process vessels or piping
- Flooded sumps (decanter, building, and oxidizer)
- Sump failure
- High-high decanter level
- Low-low decanter level
- Effluent pH <6 or >9 s.u.
- Oxidizer problem
- Malfunctioning alarms or interlocks
- Low air flow
- Blower failure
- High pressure differential
- Internal interlock
- Over pressurization

Procedure:

In the event of an emergency, an automatic interlock shutdown will occur that will shut down the Thermal Oxidizer. A Startup, Shutdown, and Malfunction Plan for the Thermal Oxidizer is presented in Appendix H. The Oxidizer has its own PLC control unit, and a number of internal interlocks. "Faults" noted on the SCADA screen may appear as a code on the local display on the Oxidizer Control Panel, located inside the scrubber enclosure. These fault numbers can be troubleshot by referring to the Anguil Operations Manual located in the F-Area control room or in Appendices E & G of this manual. Also, the Oxidizer SCADA screen displays many alarm parameters that may be holding the Oxidizer out from normal operation. The alarms that are lit in red indicate what parameters are at fault. Normally, the alarm screen will only display green during normal operation. The Oxidizer interlock alarm/faults include:

- Low Temperature
- High Delta Temp
- High Exhaust Air Temperature
- High Fuel Gas Pressure
- High Combustion Temperature
- Low Process Air
- Low Compressed Air

- Power Failure
- Low Bed Differential Pressure
- Low Fuel Gas Pressure
- Fan Failure
- Flame Safeguard
- Temperature Stuck

The following must be addressed before the interlock can be cleared and normal operations resumed:

1. Notify Supervisor
2. Verify automatic interlock shutdown has occurred. Check the following:
   - Gas valve in "off" position
   - Air valve in "off" position
   - Power at control panel is off
3. Verify that the carbon process treatment is not running. If the process is still running, manually shut down the following:
   - APL transfer feed pump
   - Carbon feed pump
4. Wait for direction from Supervisor, schedule maintenance as necessary

Special Safety Considerations

- Natural gas feed can create a potentially explosive condition
- Extreme high temperature exists at the oxidizer (1650-1700°F)

Refer to Appendix H of this manual – Operating Sequence & Setpoints and Alarm Condition, also found in the Anguil O&M Manual in control room.

4.11 Scrubber System

Who Can Institute an Emergency Shutdown:

- CDM Operator

Conditions Which Could Necessitate an Emergency Shutdown:

- Utility failure (compressed air, power, electrical, natural gas, etc.)
- Major leak of decanter or process vessels or piping
- Flooded sumps (decanter, building, and oxidizer)
- Sump failure
- High-high decanter level
- Low-low decanter level

- Effluent pH <6 or >9 s.u.
- Oxidizer problem
- Scrubber problem
- Malfunctioning alarms or interlocks
- Low air flow
- Blower failure
- High pressure differential
- Internal interlock
- Over pressurization

Procedure:

In the event of an emergency or an alarm, the Scrubber System will either continue to recirculate water through the column or shut down. A Startup, Shutdown, and Malfunction Plan for the Scrubber System is presented in Appendix H. The scrubber blowdown pump may continue to run in order to protect the contents of the column, such as the packing, such as in the event of a high temperature situation. The Scrubber System is controlled by a PLC unit located in the control room of the Scrubber enclosure. All alarms/faults will be displayed on the SCADA screen. Refer to the Anguil Operations Manual located in the F-Area control room or Appendices F & G of this manual to troubleshoot these issues. Potential alarm/faults of the Scrubber System include:

- System pressure high/low
- Knockout Pot Drain Pump
- Knockout Pot Level High
- System fan problem
- System Temperature high/low
- Loss of plant air
- Blowdown pump problem
- pH high/low
- Conductivity high/low
- Quench flow high/low
- Quench temperature high/low
- Scrubber flow high/low
- Scrubber water level high/low

1. Notify Supervisor
2. Verify that the carbon process treatment is not running. If the process is still running, manually shut down the following:
    - APL transfer feed pump
    - Carbon feed pump

3. Wait for direction from Supervisor, schedule maintenance as necessary

Refer to Appendix H of this manual – Operating Sequence & Setpoints and Alarm Condition, also found in the Anguil O&M Manual in control room.

Special Considerations

- Do NOT turn blowdown/recirculation pump off while the Thermal Oxidizer is still on, as this may expose the Quench to damaging high temperatures.

4.12 Dike Sump No. 1 (Decanter Sump) and No. 2 (Oxidizer/Air Stripper Sump)

Who Can Institute an Emergency Shutdown:

- CDM Operator

Conditions Which Could Necessitate an Emergency Shutdown:

- Utility failure (compressed air, power, electrical, natural gas, etc.)
- Major leak of decanter or process vessels or piping
- Heater failure

Procedure:

In the event of an emergency, an automatic interlock shutdown will occur that will shut down the dike sump pumps. High-High Level alarm in the Decanter tank will prevent these sump pumps from pumping. Once the alarm is cleared, generally by pumping the decanter down to a normal operating level, the sump pumps may be restarted.

1. Notify Supervisor.
2. Verify automatic interlock shutdown has occurred.
3. If shutdown has not occurred, manually shut down the sump(s) (hand auto/off switch).
4. Wait for direction from Supervisor.

4.13 Building Sump

Who Can Institute an Emergency Shutdown:

- CDM Operator

Conditions Which Could Necessitate an Emergency Shutdown:

- High-high level

Procedure:

1. Notify Supervisor.
2. Operate strictly in manual (this sump is usually off and only run as needed).
3. Turn on sump if necessary.
4. Wait for direction from Supervisor.

5. Quality Control

5.1 Process Sampling

Process sampling is conducted at a weekly, monthly, and quarterly frequency to verify that the treatment system is operating efficiently. Please refer to the process sampling schematic in Appendix I for details on the locations and types of process samples collected. A summary is presented below.

Both the CDM Operator and GHD are responsible for collecting the process samples.

Sample bottles are provided by the contract laboratories. The samples are transferred or shipped to the contract laboratory using standard chain of custody procedures.

Weekly

The effluent is sampled at a weekly frequency for VOCs and Monochlorotolune (MCT).

The effluent sample is collected by utilizing the sample tap located on the south wall of F-52 as follows:

1. Turn on the tap
2. Fill bottle(s)
3. Close tap

Monthly

The GHD representative collects the following samples:

- Effluent sample for phenol
- Air Stripper feed for VOCs, MCT, and phenol

The CDM Operator collects the following samples:

- Carbon bed feed for VOCs and MCT
- Carbon train interstage samples for VOCs and MCT and phenol

The effluent sample is collected by utilizing the sample tap located on the south wall of F-52 as follows:

1. Turn on the tap
2. Fill bottle(s)
3. Close tap

The carbon bed feed sample is collected by utilizing the carbon bed feed pump tap located in the oxidizer dike as follows:

1. Turn on the tap
2. Fill bottle(s)

3. Close tap

The carbon bed interstage sample is collected from the tap located on discharge side of each lead carbon bed as follows:

1. Turn on the tap
2. Fill bottle(s)
3. Close tap

The Air Stripper feed sample is collected from a tap located by APL feed pump in the decanter dike by APL transfer pump as follows:

1. Turn on the tap
2. Fill bottle(s)
3. Close tap

Quarterly

The quarterly sampling is the same as the monthly, with the addition that the carbon bed feed, carbon interstage, and air stripper feed samples are also analyzed for semi-volatile organic compounds (SVOCs) and hexachlorocyclohexanes (C-66).

Following Carbon Change

An effluent sample is collected from the train where the carbon was changed out and analyzed for VOCs and MCT.

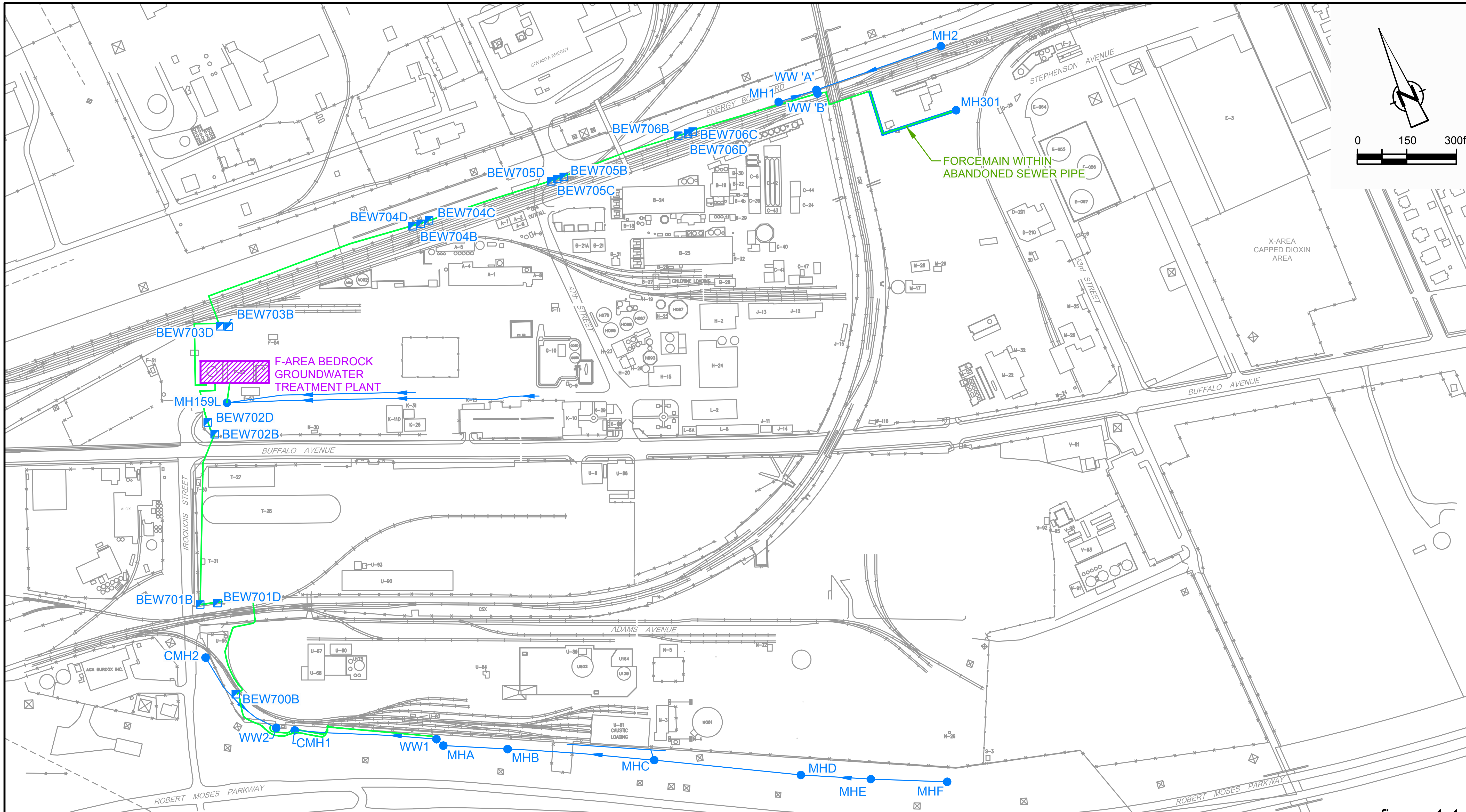

figure 1.1

SITE PLAN
F-AREA GROUNDWATER REMEDIATION SYSTEM
BUFFALO AVENUE PLANT
OCCIDENTAL CHEMICAL CORPORATION
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York

LEGEND

FORCEMAIN
OVERBURDEN GROUNDWATER COLLECTOR
BEW700B BEDROCK EXTRACTION WELL
MH1 MANHOLE
WW1 WET WELL

GHD

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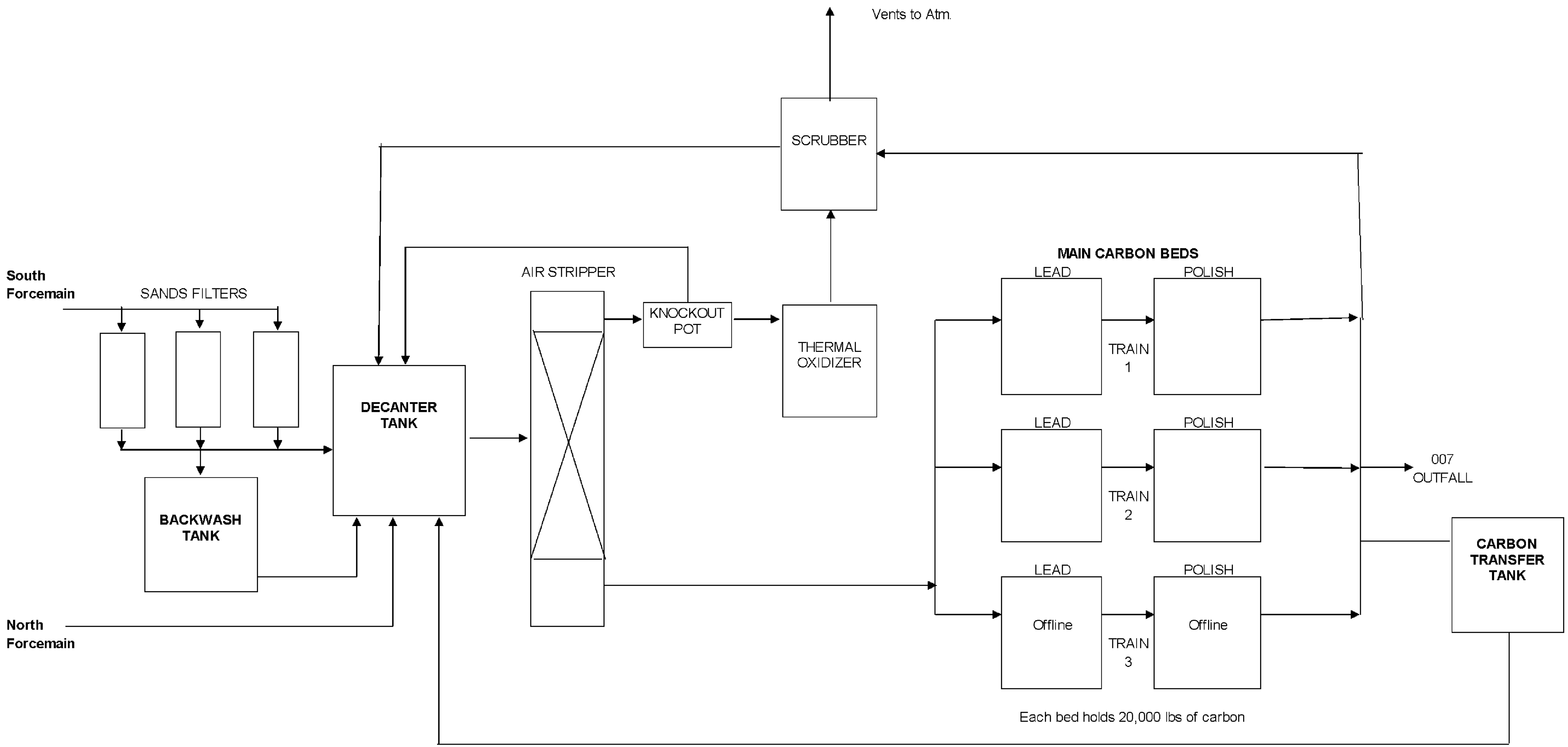

figure 1.2

PROCESS SCHEMATIC
F-AREA GROUNDWATER REMEDIATION SYSTEM
BUFFALO AVENUE PLANT
OCCIDENTAL CHEMICAL CORPORATION
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York

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Appendices

Appendix A
Daily And Weekly Operator Checklists

F-Area Daily Inspection Sheet

Well Checks*

Date: ____________ Time: ____________ Shift: ____________________ Operator: ______________________

(Operators, Complete Inspections Every Shift, New Sheets for Each Shift):

	Completed? Yes/No
Tuesday Day Shift: Open all well vaults and inspect for leaks, damage, flooding & arrange maintenance	
****Weds Day Shift: Pump BEW 702B & BEW 703B and record flows in log book.**	

	Flow Rate	Enabled? Yes/No	Comments	Actions Taken
BEW700B				
BEW701B				
BEW702B**				
BEW703B**				
BEW704B				
BEW704C				
BEW704D				
BEW705B				
BEW705C				
BEW705D				
BEW706B				
BEW706C				
BEW706D				
MH-159L				
WW 1				
WW 2				
WW B				
MH301				

* Any pumps that are disabled and will not re-set, submit emergency work order for repair & notify GHD within 8 hours

* Any pumps that are enabled and running with no flow, submit work order for repair

* Day shift log all previous day's downtime on downtime spreadsheet including specific causes & times.

F-Area Daily Inspection Sheet

Process Check & Housekeeping*

	Completed? Yes/No	Comments	Actions Taken
Samples Collected (Wednesday day shift)			
Carbon Beds Backwashed if high pressure			
Check for Leaks in Process Building			
Check for Leaks In Decanter Dike			
Check for Leaks in Air Stripper Dike			
Check Bleach Pump for Prime			
Check Bleach Tote for Sufficient Supply			
Check Sand Filters for Leaks			
Check Air Compressor for leaks, etc.			
Check Pipe Insulation, Coverings			
Check Walkways for Snow, Salt & Shovel			
Heat Trace Indicators Lit (Dec-March)			
General Housekeeping, Garbage, Cleanup**			
General Maintenance, Doors, Overhead, etc.			
Decanter Dike Functioning & Clear of Debris			
Air Stripper Dike Fucntioning & Clear of Debris			
Building Sump Checked			
CO2 Tank Level - Call if below 15% (Day Shift)			
CO2 flow at WW1 & WW2 (Day Shift)			

* Any issues should be reported immediately to Rich Kyler or John Neri for a work order, and followed up with the shift supervisor to ensure that all work is completed in a timely manner. If work is not completed in a sufficient amount of time, please follow up to ensure that it gets completed

** Aisles clean and accessible, doorways not blocked, no trip hazards

F-Area Treatment System Operating Data

Week of:													
		Decanter		Air Stripper			Oxidizer			Bleach Addition			
		Decanter Level	Flow Rate	Air Flow CFM	pH	Level	Ave Temp	Exit Temp	Gas Tot	Dose Duration	Dose Delay	N. Tote Level	S Tote Level
Date	Operator	L-200	FIT-201	FIT-507	AIT-514	LI-502		TI-131A					

		West Carbon Train			Center Carbon Train			East Carbon Train			Effluent		
Date	Operator	Flow FIT-300	Lead Diff. Pressure	Polish Diff. Press.	Flow FIT-305	Lead Diff. Press.	Polish Diff. Press.	Flow FIT-315	Lead Diff. Press	Polish Diff. Press.	Flow FIT-407	pH AIT 405	Flow Totalizer

F-Area Treatment System Operating Data

Week of:

		HCl Scrubber			Quench	
Date	Operator	pH AIT-802	Conduct. AIT-803	Level LT-832	Temp. TI-835A	Water Flow FIT-811

Appendix B
Job Function List

F-AREA JOB FUNCTION LIST

Name:________________________ Job Title: Environmental Operations Technician

Date:________________________ Function: Decanter

SUPERVISOR	TRAINEE	TRAINER	#	TASK DESCRIPTION
			1.	Decanter inspection and leak detection
			2.	Lines from bedrock wells, dike sumps, and building sump
			3.	Well feed auto valve, LV-200
			4.	Differential Pressure, DPT-209
			5.	Line to Air Stripper
			6.	APL Transfer Pumps 1 and 2
			7.	Decanter level indicator, LI-200
			8.	Carbon vent adsorber drum and Hnu readings procedure
			9.	Level indicator on loop controller in control room
			10.	Level indicator on Citect screen in control room
			11.	Preparation for maintenance
			12.	Treatment start-up / shutdown procedure
			13.	Interlocks: 01 Shutdown APL Transfer Pumps 07, 08, 09 Shutdown Sump Pumps
			14.	Air Stripper feed auto valve, FV-201
			15.	pH indicator, AIT-250

F-AREA JOB FUNCTION LIST

Name:______________________ Job Title: EnvironmentalOperationsTechnician

Date:_______________________ Function: AirStripper

SUPERVISOR	TRAINEE	TRAINER	# TASK DESCRIPTION
			1. Air Stripper inspection and leak detection
			2. Line from Decanter
			3. Carbon Feed Pumps 1 and 2
			4. Air Stripper level indicators, PIT-502 and PIT-503
			5. Air Stripper Effluent level valve, LV-502
			6. Level indicator on loop controller in control room
			7. Level indicator on screen in control room
			8. Air Stripper Differential Pressure, PIT-503 and PIT-520
			9. Differential Pressure indicator on screen in control room
			10. Air Stripper Sump pH, AIT-514
			11. Interlocks 02 Shutdown Air Stripper Blower 03 Shutdown Carbon Feed Pumps
			12. Line from Air Stripper Effluent to Knock Out Pot
			13. Air Flow from Air Stripper Effluent on Citect screen in control room
			14. Start up / shutdown procedure
			15. Preparation for maintenance

F-AREA JOB FUNCTION LIST

Name:________________________ Job Title: EnvironmentalOperationsTechnician

Date:________________________ Function: SandFilters

SUPERVISOR	TRAINEE	TRAINER	#	TASK DESCRIPTION
			1	Sand filter inspection
			2.	Line from extraction/wet wells
			3.	Line to Decanter
			4.	Differential Pressure across filters, PDAH-594
			5.	Differential Pressure on loop controller
			6.	Differential Pressure on screen
			7.	Alarm displays on annunciator board and screen
			8.	Interlocks 03 Shutdown Carbon Feed Pumps
			9.	Start-up / shutdown procedure
			10.	Vent valves and pressure gauges

F-AREA JOB FUNCTION LIST

Name:________________________ Job Title: EnvironmentalOperationsTechnician

Date:_________________________ Function: Carbon

SUPERVISOR	TRAINEE	TRAINER	#	TASK DESCRIPTION
			1.	Carbon Bed inspection and leak detection
			2.	Bed sequence lines and valves
			3.	Backflush lines to Carbon Transfer Tank
			4.	Lines to Discharge
			5.	Start-up / shutdown procedure
			6.	Backflush procedure
			7.	Vent lines
			8.	Treated water lines for backflush
			9.	Fresh carbon feed lines and carbon change procedure
			10.	Lines to transfer spent carbon
			11.	Pressure gauges
			12.	Process sample procedure
			13.	Prepare system for maintenance
			14.	West and East Carbon Influent Flowmeters, FIT-300, FIT-315
			15.	Flowmeter display on screens
			16.	pH indicator, AIT-405
			17.	Effluent flowmeter, FIT-407
			18.	Effluent temperature transmitter, TIT-406
			19.	Annunciator and screen alarms

F-AREA JOB FUNCTION LIST

Name:________________________ Job Title: EnvironmentalOperationsTechnician

Date:_________________________ Function: ThermalOxidizer

SUPERVISOR	TRAINEE	TRAINER	#	TASK DESCRIPTION
			1.	Start-up / Shutdown Procedure
			2.	Emergency stop
			3.	Annunciator and screen alarms
			4.	Thermocouples, TT-103 – TT-109
			5.	Button Resets
			6.	Air storage tank and lines
			7.	Shutdown sequences and faults
			8.	Interlocks 04 Close Oxidizer Process Inlet Valve
			9.	Knock Out Pot inspection and leak detection
			10.	Poppet valve alternation
			11.	Gas train inspection and leak detection
			12.	Prepare system for maintenance
			13.	Exit Temperature, TI-131A

F-AREA JOB FUNCTION LIST

Name:______________________ Job Title: EnvironmentalOperationsTechnician

Date:______________________ Function: Scrubber System

SUPERVISOR	TRAINEE	TRAINER	# TASK DESCRIPTION
			1. Start-up / Shutdown Procedure
			2. Emergency stop
			3. Annunciator and screen alarms
			4. Button Resets
			5. Shutdown sequences and faults
			6. Interlocks 04
			7. Prepare system for maintenance
			8. Record Data requested by F-Area Treatment Operating Data Log Sheets
			9. pH indicator, AIT-802
			10. Conductivity, AIT-803
			11. Level transmitter, LIT-832
			12. Quench Temperature indicator, TI-835A
			13. Softened Water Flow, FIT-811
			14. Preventive Maintenance Backwash Procedure

F-AREA JOB FUNCTION LIST

Name:________________________ Job Title: EnvironmentalOperationsTechnician

Date:_________________________ Function: BuildingSump

SUPERVISOR	TRAINEE	TRAINER	#	TASK DESCRIPTION
			1.	Sump and pump inspection and leak detection
			2.	Discharge line to Decanter
			3.	Annunciator and screen alarm
			4.	Interlocks 09 Shutdown Building Sump Pump
			5.	Pump starter
			6.	Level controller and probes

F-AREA JOB FUNCTION LIST

Name:________________________ Job Title: EnvironmentalOperationsTechnician

Date:_________________________ Function: DikeSump

SUPERVISOR	TRAINEE	TRAINER	#	TASK DESCRIPTION
			1.	Sump and pump inspection and leak detection
			2.	Discharge line to Decanter
			3.	Annunciator and screen alarm
			4.	Interlocks 07 Shutdown Dike Sump Pump
			5.	Pump starter
			6.	Sump heater / heater starter
			7.	Level controller and probes
			8.	Temperature controller and probes

F-AREA JOB FUNCTION LIST

Name:________________________ Job Title: EnvironmentalOperationsTechnician

Date:_________________________ Function: OxidizerDikeSump

SUPERVISOR	TRAINEE	TRAINER	#	TASK DESCRIPTION
			1.	Sump and pump inspection and leak detection
			2.	Discharge line to Decanter
			3.	Annunciator and screen alarm
			4.	Interlocks 08 Shutdown Oxidizer Dike Sump
			5.	Pump starter
			6.	Sump heater / heater starter
			7.	Level controller and probes
			8.	Temperature controller and probes

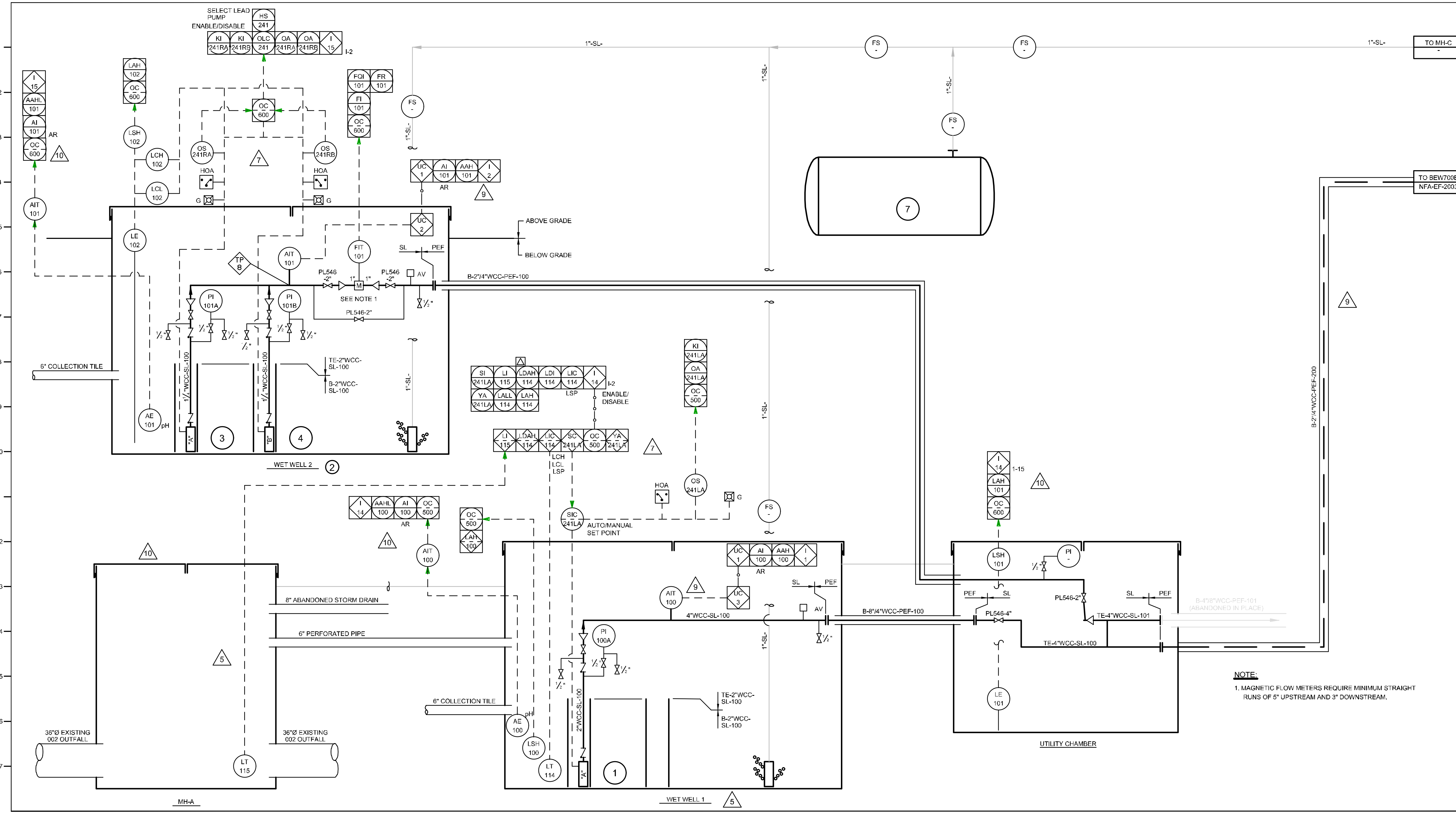
F-AREA JOB FUNCTION LIST

Name:______________________ Job Title: Environmental Operations Technician

Date:_______________________ Function: VentSystemCarbonDrums

SUPERVISOR	TRAINEE	TRAINER	#	TASK DESCRIPTION
			1.	Hnu readings procedure carbon vent adsorber drum
			2.	Decanter to carbon vent drum and line
			3.	Carbon vent change out procedure
			4.	Safety precautions upon drum removal
			5.	Proper drum labeling
			6.	Preparation for maintenance

Appendix C
Piping and Instrumentation Diagrams



PLANT ID.		1	2	3	4	5	6	7
NAME		STAGE 4 WET WELL 1 SUMP PUMP		STAGE 4 WET WELL 2 SUMP PUMP 'A'	STAGE 4 WET WELL 2 SUMP PUMP 'B'			CO2 TANK
DESCRIPTION	MATERIAL	-		S.S./TEFLON	S.S./TEFLON			
	SIZE	2" SS/TEFLON		1 1/4"	1 1/4"			6 TON
	CAPACITY	80 GPM @ 100'		15 GPM @ 85'H	15 GPM @ 85'H			
	TEMP/PRESS	104°F		104°F	104°F			
	HP/V/RPM	3HP/3450 RPM		0.75/460/3450	0.75/460/3450			
	WEIGHT	64 LBS		27 LBS.	27 LBS.			
	MANUFACTURER	GRUNDFOS		GRUNDFOS	GRUNDFOS			
	MODEL	75S-30-5		REDI-FL04 16E4	REDI-FL04 16E4			
	VENDOR		5			10		

REVISIONS

NO.	DESCRIPTION	MADE BY	APPR. BY	DATE
11	AS BUILT	LVN	MP	05/16
10	U-AREA/F-AREA CONSOLIDATION PHASE 2	MRG	JJE	7/09
9	FLOW ZONE 1 DIVERSION	BDL	JJJ	3/08
8	AS BUILT	LVN		2/04
7	U-67 2003 PROCESS/PLC UPGRADE	LVN		2/03
6	AS BUILT	DLS		5/02
5	REVISED WET WELL 1	ZM		3/02
4	FLOW ZONE 1, STAGE 4	ZM		10/97
3	AS BUILT	ZM		7/97
2	CERTIFIED FOR CONSTRUCTION	BAB		10/96
1	ISSUED FOR BID: U-67 pH ADJUSTMENT SYSTEM	BAB		9/96
0	ISSUED FOR BID	BAB		-

FILE NAME : 07478-00(068)EF-BU008

TreaTek – CRA™ COMPANY

DRAWN BY B.A. BEEBE
DATE 10-4-95
DESIGNED BY DAS/BAB
DATE 10-3-95
APPROVED BY DCM
DATE 10-30-95

OXY: BUFFALO AVENUE PLANT
NIAGARA FALLS, NEW YORK

DWG. A-11-22118 SHT.

STAGE 1 - 002 OUTFALL CONVERSION ENGINEERING FLOWSHEET

PROCESS / INSTRUMENT LINES

- MAIN PROCESS LINE
- SECONDARY PROCESS LINE
- UNDEFINED SIGNAL
- PNEUMATIC SIGNAL
- ELECTRICAL SIGNAL
- CAPILLARY TUBE
- ELECTROMAGNETIC OR SONIC SIGNAL (GUIDED)
- ELECTROMAGNETIC OR SONIC SIGNAL (NOT GUIDED)
- INTERNAL SYSTEM LINK/RADIO
- HYDRAULIC SIGNAL
- MECHANICAL LINK
- ELECTRICAL BINARY SIGNAL
- MAIN PROCESS FLOW INDICATION
- SECONDARY PROCESS FLOW INDICATION
- TO / FROM SHEET No. — OFF PAGE CONNECTOR
- UTILITY — UTILITY IN/OUT

LINE SYMBOLS

- BA- — BALL VALVE
- BU- — BUTTERFLY VALVE
- GA- — GATE VALVE
- GL- — GLOBE VALVE
- THREE WAY VALVE (FAIL OPEN TO PATH A–C)
- FOUR WAY VALVE (FAIL OPEN TO PATH A–C AND B–D)
- CH- — CHECK VALVE
- REDUCER
- FLEXIBLE PIPE
- BLIND FLANGE
- HOSE CONNECTION
- SCREWED CAP, CLEANOUT
- Y–LINE STRAINER
- SPECIFICATION CHANGE
- LEVEL DEVICE, FLOAT TYPE
- BB — BLOCK & BLEED VALVE SETUP
- TP — TIE POINT TO EXISTING SYSTEM
- RESTRICTION ORIFICE
- DRAIN
- FLOW STRAIGHTENING VANE
- SP — SPECIALTY PART
- STATIC MIXER
- AV — AIR VENT, AUTOMATIC
- FILTER/REGULATOR/LUBRICATOR
- T — THERMOSTAT

- FILTER/REGULATOR
- DAMPER OR LOUVER
- X" — EQUIPMENT INSULATED WITH X" OF INSULATION
- PULSATION DAMPER

INSTRUMENT SYMBOLS

- LOCALLY MOUNTED INSTRUMENTS
- PNL A — PANEL MOUNTED INSTRUMENTS A = PANEL No. WHEN MORE THAN ONE PANEL IS PRESENT
- BEHIND BOARD MOUNTED INSTRUMENTS
- IN LINE INSTRUMENTS AS INDENTIFIED
- SG — SIGHT GLASS
- RUPTURE DISC
- PRESSURE RELIEF VALVE
- VACUUM RELIEF VALVE
- V P — CONSERVATION VENT
- PRESSURE REDUCING REGULATOR (SELF CONTAINED)
- BACKPRESSURE REGULATOR (SELF CONTAINED)
- LEVEL REGULATOR WITH MECHANICAL LINKAGE
- TE — TEMPERATURE ELEMENT WITH THERMOWELL
- DIAPHRAM ACTUATOR, SPRING–OPPOSED
- CYLINDER ACTUATOR SPRING – OPPOSED
- M — ROTARY MOTOR ACTUATOR
- S — SOLENOID ACTUATOR
- HAND ACTUATOR OR HANDWHEEL
- AIR ACTUATED VALVE W/POSITIONER
- ATO/FC

- TARGET TYPE FLOW SENSOR
- SINGLE PORT PITOT TUBE
- AVERAGING PITOT TUBE
- M — MAGNETIC FLOWMETER
- TURBINE OR PROPELLER FLOWMETER
- POSITIVE–DISPLACEMENT FLOWMETER
- FI — VARIABLE AREA FLOWMETER
- PI — DIAPHRAM SEAL WITH PRESSURE LEAD LINE
- PI — DIAPHRAM SEAL (LINE–MOUNTED)
- XY — SIGNAL CONVERTER (INPUT/OUTPUT)
  - [*E – VOLTAGE P – PNEUMATIC
  - [I – CURRENT B – BINARY (MODBUS, R5232...)
- PL COLOR — PILOT LIGHT
  - A – AMBER
  - G – GREEN
  - R – RED

ELECTRICAL SYMBOLS

- SINGLE PUSHBUTTON/LIGHT
- DUAL PUSHBUTTON/LIGHT

VALVE FAIL SYMBOLS

- ATO – AIR TO OPEN
- ATC – AIR TO CLOSE
- FO – FAIL OPEN
- FC – FAIL CLOSED
- FL – FAIL LOCKED (LAST POSITION)
- FI – FAIL INDETERMINATE

PROCESS EQUIPMENT NOMENCLATURE

- CO – CLEAN OUT
- LD – LEAK DETECTION
- MH – MAN HOLE

SUBSCRIPTS

LIGHTS

- A = AMBER
- B = BLUE
- C = CLEAR
- G = GREEN
- R = RED
- W = WHITE
- Y = YELLOW

PUSHBUTTONS / SWITCHES

- ES = EMERGENCY STOP
- J = JOG
- L = LOCAL PANEL
- LO = LOCK OUT
- SP = STOP
- ST = START
- EN = ENABLE
- DIS = DISABLE
- O = OFF
- A = AUTO
- H = HAND

TYPICAL ISA LETTER COMBINATIONS

First-Letters	Initiating or Measured Variable	Controllers: Recording	Controllers: Indicating	Controllers: Blind	Self-Actuated Control Valves	Readout Devices: Recording	Readout Devices: Indicating	Switches and Alarm Devices *: High **	Switches and Alarm Devices *: Low	Switches and Alarm Devices *: Comb	Transmitters: Recording	Transmitters: Indicating	Transmitters: Blind	Solenoids, Relays, Computing Devices	Primary Element	Test Point	Well or Probe	Viewing Device, Glass	Safety Device	Final Element
A	Analysis	ARC	AIC	AC		AR	AI	ASH	ASL	ASHL	ART	AIT	AT	AY	AE	AP	AW			AV
B	Burner/Combustion	BRC	BIC	BC		BR	BI	BSH	BSL	BSHL	BRT	BIT	BT	BY	BE		BW	BG		BZ
C	User's Choice																			
D	User's Choice																			
E	Voltage	ERC	EIC	EC		ER	EI	ESH	ESL	ESHL	ERT	EIT	ET	EY	EE					EZ
F	Flow Rate	FRC	FIC	FC	FCV, FICV	FR	FI	FSH	FSL	FSHL	FRT	FIT	FT	FY	FE	FP		FG		FV
FQ	Flow Quantity	FQRC	FQIC			FQR	FQI	FQSH	FQSL			FQIT	FQT	FQY	FQE					FQV
FF	Flow Ratio	FFRC	FFIC	FFC		FFR	FFI	FFSH	FFSL						FE					FFV
G	User's Choice																			
H	Hand		HIC	HC						HS										HV
I	Current	IRC	IIC			IR	II	ISH	ISL	ISHL	IRT	IIT	IT	IY	IE					IZ
J	Power	JRC	JIC			JR	JI	JSH	JSL	JSHL	JRT	JIT	JT	JY	JE					JV
K	Time	KRC	KIC	KC	KCV	KR	KI	KSH	KSL	KSHL	KRT	KIT	KT	KY	KE					KV
L	Level	LRC	LIC	LC	LCV	LR	LI	LSH	LSL	LSHL	LRT	LIT	LT	LY	LE		LW	LG		LV
M	User's Choice																			
N	User's Choice																			
O	User's Choice																			
P	Pressure/Vacuum	PRC	PIC	PC	PCV	PR	PI	PSH	PSL	PSHL	PRT	PIT	PT	PY	PE	PP			PSV, PSE	PV
PD	Pressure, Differential	PDRC	PDIC	PDC	PDCV	PDR	PDI	PDSH	PDSL		PDRT	PDIT	PDT	PDY	PE	PP				PDV
Q	Quantity	QRC	QIC			QR	QI	QSH	QSL	QSHL	QRT	QIT	QT	QY	QE					QZ
R	Radiation	RRC	RIC	RC		RR	RI	RSH	RSL	RSHL	RRT	RIT	RT	RY	RE		RW			RZ
S	Speed/Frequency	SRC	SIC	SC	SCV	SR	SI	SSH	SSL	SSHL	SRT	SIT	ST	SY	SE					SV
T	Temperature	TRC	TIC	TC	TCV	TR	TI	TSH	TSL	TSHL	TRT	TIT	TT	TY	TE	TP	TW		TSE	TV
TD	Temperature, Differential	TDRC	TDIC	TDC	TDCV	TDR	TDI	TDSH	TDSL		TDRT	TDIT	TDT	TDY	TE	TP	TW			TDV
U	Multivariable					UR	UI							UY						UV
V	Vibration/Machinery Analysis					VR	VI	VSH	VSL	VSHL	VRT	VIT	VT	VY	VE					VZ
W	Weight/Force	WRC	WIC	WC	WCV	WR	WI	WSH	WSL	WSHL	WRT	WIT	WT	WY	WE					WZ
WD	Weight/Force, Differential	WDRC	WDIC	WDC	WDCV	WDR	WDI	WDSH	WDSL		WDRT	WDIT	WDT	WDY	WE					WDZ
X	Unclassified																			
Y	Event/State/Presence		YIC	YC		YR	YI	YSH	YSL				YT	YY	YE					YZ
Z	Position/Dimension	ZRC	ZIC	ZC	ZCV	ZR	ZI	ZSH	ZSL	ZSHL	ZRT	ZIT	ZT	ZY	ZE					ZV
ZD	Gauging/Deviation	ZDRC	ZDIC	ZDC	ZDCV	ZDR	ZDI	ZDSH	ZDSL		ZDRT	ZDIT	ZDT	ZDY	ZDE					ZDV

Note: This table is not all–inclusive.
* A, alarm, the annunciating device, may be used in the same fashion as S, switch, the actuating device.

** The letters H and L may be omitted in the undefined case.

Other Possible Combinations:

FO	(Restriction Orifice)	TJR	(Scanning Recorder)	PFR	(Ratio)	WKIC	(Rate–of–Weight–Loss Controller)
FRK, HIK	(Control Stations)	LLH	(Pilot Light)	KQI	(Running Time Indicator)	HMS	(Hand Momentary Switch)
FX	(Accessories)	LCH	(Level Control High)	QQI	(Indicating Counter)	LCL	(Level Control Low)

DISTRIBUTED CONTROL / SHARED DISPLAY INSTRUMENTS

INDICATOR/CONTROLLER/RECORDER OR ALARM POINTS – USUALLY USED TO INDICATE VIDEO DISPLAY
* NORMALLY ACCESSIBLE TO OPERATOR

DISTRIBUTED CONTROL INTERCONNECTING LOGIC CONTROLLER OR PC WITH BINARY OR SEQUENTIAL LOGIC FUNCTIONS
* NORMALLY ACCESSIBLE TO OPERATOR

PAH / PAL / dP/dT / PDA — XAH / XAL / d/dT / PR

INPUT ALARMS
- PAH – HIGH
- PAL – LOW
- dP/dT – RATE CHANGE
- PDA – DEVIATION

OUTPUT ALARMS
- XAH – HIGH
- XAL – LOW
- d/dT – RATE CHANGE

MISCELLANEOUS
- PR – TREND

* NORMALLY ACCESSIBLE TO OPERATOR

OLC SP —

- OLC – OPERATIONAL LIGHTED CONTROL
- OA – OPERATIONAL ALARM (STATUS)
- SP – STOP/INHIBIT FUNCTION FROM CRT
- ST – START/ENABLE FUNCTION FROM CRT
- A – AUTO ON/OFF FUNCTION FROM CRT
- O – OFF FUNCTION FROM CRT
- H – HAND/MANUAL FUNCTION FROM CRT

NORMALLY BLIND OPERATION
* NOT NORMALLY ACCESSIBLE TO OPERATOR

I 99 — DISTRIBUTED CONTROL INTERCONNECTING LOGIC CONTROLLER OR PC WITH BINARY OR SEQUENTIAL LOGIC FUNCTIONS NUMBER IN DIAMOND REFERS TO SEQUENCE NUMBER

INSTRUMENT / PROCESS LINES DESIGNATIONS

CS	CARBON STEEL PIPE
CSVD	CARBON STEEL VENT DUCT (12 GAUGE)
DVW	DRAIN VENT WASTE PIPE
HDPE	HIGH DENSITY POLYETHYLENE PIPE
KYA	KYNAR
PDE	CPVC, SOLID
PVC	POLYVINYL CHLORIDE PIPE SCHEDULE 40
PVE	POLYVINYL CHLORIDE PIPE SCHEDULE 80
PPL	POLYPROPYLENE LINED/LINED DUCTILE PIPE
SS	STAINLESS STEEL
TFD	TEFLON LINED CARBON STEEL
B	BARE
I	INSULATED
J	JACKETED AND INSULATED
TE	ELECTRICALLY TRACED AND INSULATED

NOTES

- OC100 LOCATED IN F–53 MCC ROOM
- OC200 LOCATED IN T–31
- OC300 LOCATED IN A–10
- OC400 LOCATED IN F–53 CONTROL ROOM
- OC500 LOCATED AT MH–301
- OC600 LOCATED AT WET WELL B

CONESTOGA-ROVERS & ASSOCIATES

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
2	01/16	JW	AS BUILT
1	10/06	J. GEE	AS BUILTS

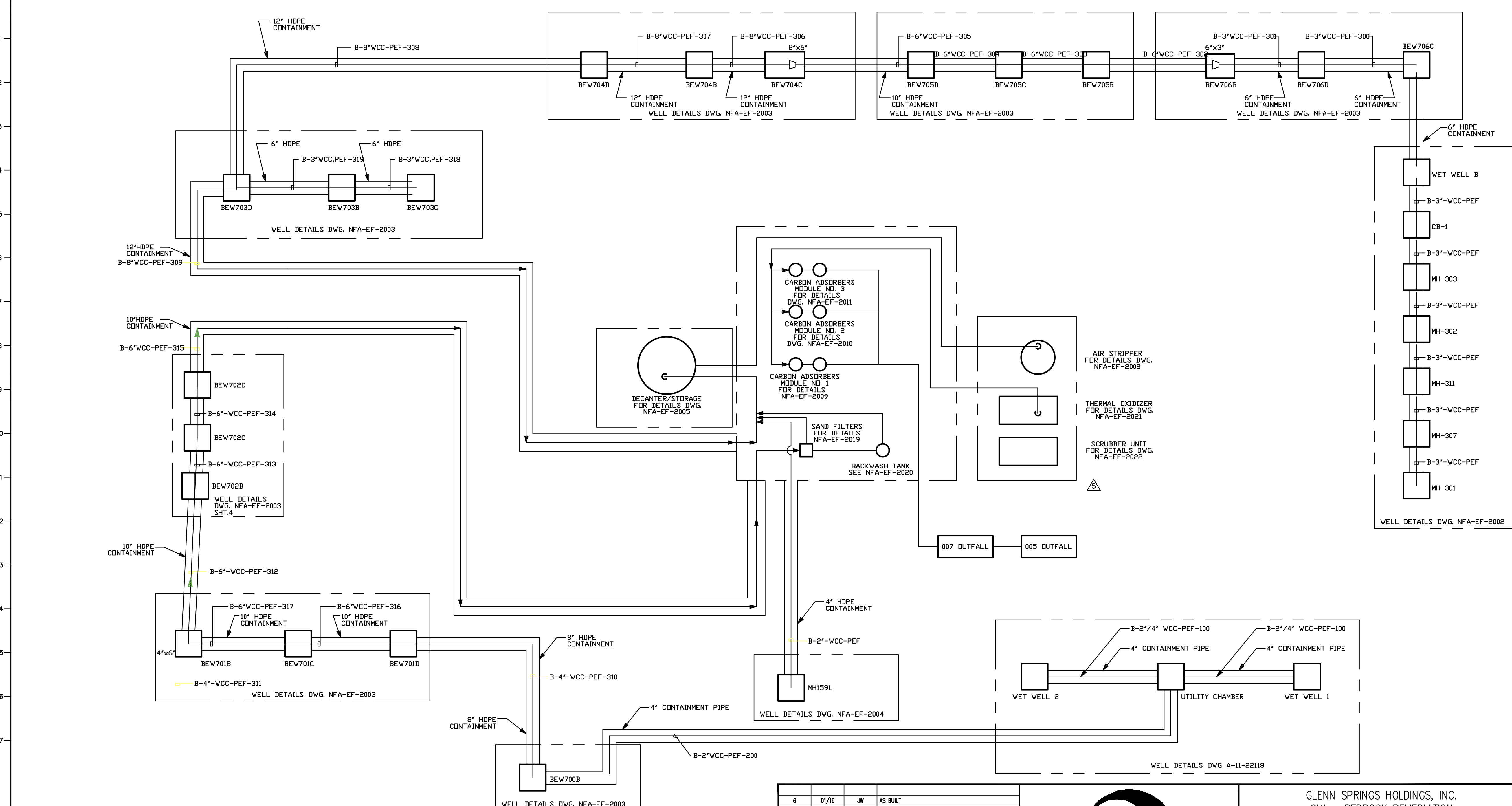
GLENN SPRINGS HOLDINGS, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
LEGEND

DRAWN | DATE | SCALE NONE | CHK'D | APPROVED | PROJ. NO 07478–00 | DRAWING NUMBER NFA–EF–2000 | REV 2

07478–00(068)EF\NFA–EF–2001 JUN 02/2016

PLANT ID.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME	—																							
DESCRIPTION: MATERIAL	—																							
SIZE	—																							
CAPACITY	—																							
TEMP/PRESS	—																							
HP/V/RPM	—																							
WEIGHT	—																							
MANUFACTURE	—																							
MODEL	—																							
VENDOR	—																							



REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
6	01/16	JW	AS BUILT
5	06/15	JW	REPLACED OXIDIZER
4	4/09	JJ	AS BUILT
3	3/08	JJJ	FLOW ZONE 1 DIVERSION
2	10/06	J. GEE	AS BUILTS
1	8/05	J. GEE	PLC REPLACEMENT

CRA CONESTOGA-ROVERS & ASSOCIATES

OXY

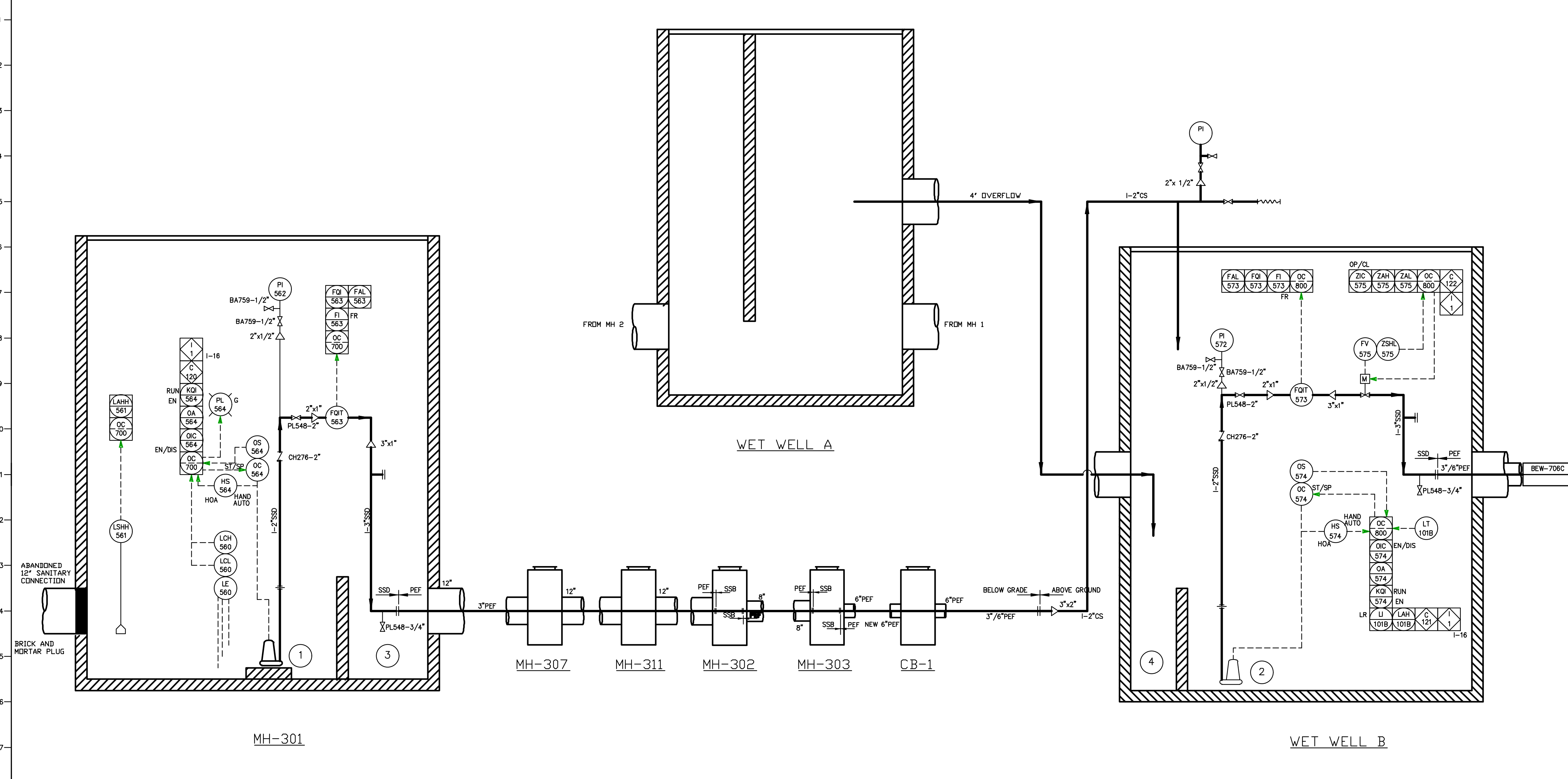
GLENN SPRINGS HOLDINGS, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
BEDROCK EXTRACTION WELLS

DRAWN | SCALE NONE | APPROVED | DRAWING NUMBER NFA-EF-2001 | REV 6
DATE | CHK'D | PROJ. NO 07478-00

07478-00(068)EF\NFA-EF-2001 JUN 02/2016

PLANT ID.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME		MH-301 PUMP	WET WELL B PUMP	NAPL COLLECTION CHAMBER	NAPL COLLECTION CHAMBER																			
DESCRIPTION	MATERIAL	CS	CS	CONC	CONC																			
	SIZE	3885	3885	5'x5'x11.3'	7' DIA x 16.5'																			
	CAPACITY	20 GPM	20 GPM	34" HGT WEIR	34" HGT WEIR																			
	TEMP/PRESS	–	–																					
	HP/V/RPM	1.5/480/3600	1.5/480/3600																					
	WEIGHT	80 LBS	80 LBS																					
	MANUFACTURE	GOULDS	GOULDS																					
	MODEL	WE1534HH	WE1534HH																					
	VENDOR	ESTABROOK	ESTABROOK																					



REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
4	9/10	J. EZAK	AS BUILT
3	07/09	J. GEE	U-AREA/F-AREA CONSOLIDATION PHASE 1
2	10/06	J.GEE	AS BUILTS
1	8/05	J.GEE	PLC REPLACEMENT

CONESTOGA-ROVERS & ASSOCIATES

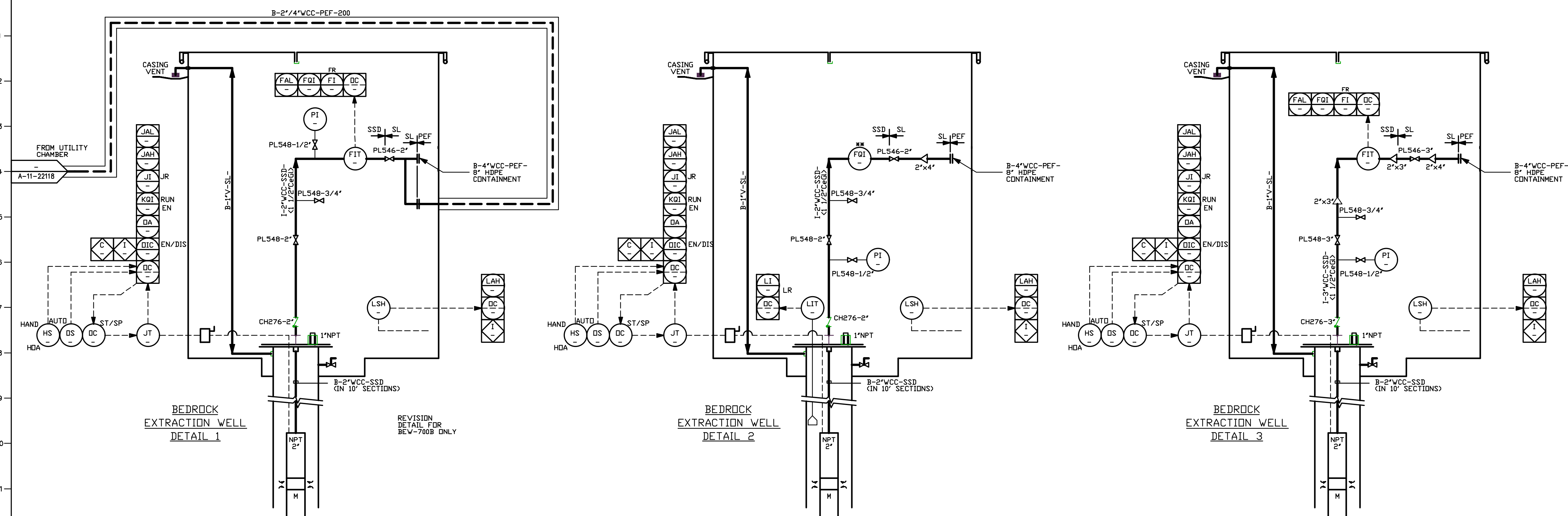
MILLER SPRINGS REMEDIATION MANAGEMENT, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
D AREA

DRAWN	SCALE NONE	APPROVED	DRAWING NUMBER	REV
DATE	CHK'D	PROJ. NO 07478-00	NFA-EF-2002	4

07478-00(068)EF\NFA-EF-2002 JUN 02/2016

PLANT ID.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME	SEE TABLE BELOW																							
DESCRIPTION: MATERIAL / SIZE / CAPACITY / TEMP/PRESS / HP/V/RPM / WEIGHT / MANUFACTURE / MODEL / VENDOR																								



EXTRACTION WELL	MANUFACTURER	PUMP MODEL	ELECTRIC	MOC	DESIGN	PI	FIT/FQI/LIT	JT/HS/OS	INTERLOCK	COMPLEX LOOP	LEAK ALARM(S) LSH	DETAIL No.	TIE-POINT No.	PLC
BEW-700B	GRUNDFOS	10E14	1/460/3600	304SS/TFE	5GPM @ 300' TDH 152'	7015	7016	321	2	100	7011	1	1,2	300
BEW-701B	GRUNDFOS	10E14	1/460/3600	304SS/TFE	5GPM @ 300' TDH 150'	7115	7116	311	2	101	7111	1	3,4	300
BEW-701C	GRUNDFOS	135S150-7	15/460/3600	304SS/TFE	130GPM @ 265' TDH 106'	7125	7126	313	2	102	7121	3	5,6	300
BEW-701D	GRUNDFOS	75S75-10	7.5/460/3600	304SS/TFE	100GPM @ 230' TDH 65'	7135	7136	315	2	103	7131	1	7,8	300
BEW-702B	GRUNDFOS	10E14	1/460/3600	304SS/TFE	5GPM @ 300' TDH 153'	7215	7216	141	2	104	7211	2	9,10	100
BEW-702C	GRUNDFOS	135S150-7	15/460/3600	304SS/TFE	130GPM @ 300' TDH 112'	7225	7226	143	2	105	7221	3	11,12	100
BEW-702D	GRUNDFOS	80S75-9	7.5/460/3600	304SS/TFE	100GPM @ 230' TDH 65'	7235	7236	145	2	106	7231	1	13,14	100
BEW-703B	GRUNDFOS	10E14	1/460/3600	304SS/TFE	5GPM @ 300' TDH 158'	7315	7316	151	1	107	7311	2	15,16	100
BEW-703C	GRUNDFOS	135S150-7	15/460/3600	304SS/TFE	130GPM @ 265' TDH 114'	7325	7326	153	1	108	7321	3	17,18	100
BEW-703D	GRUNDFOS	40S30-9	3/460/3600	304SS/TFE	15GPM @ 230' TDH 65'	7335	7336	155	1	109	7331	1	19,20	100
BEW-704B	GRUNDFOS	10E14	1/460/3600	304SS/TFE	5GPM @ 300' TDH 150'	7415	7416	211	1	110	7411	1	21,22	200
BEW-704C	GRUNDFOS	135S150-7	15/460/3600	304SS/TFE	130GPM @ 265' TDH 112'	7425	7426	213	1	111	7421	3	23,24	200
BEW-704D	GRUNDFOS	75S75-10	7.5/460/3600	304SS/TFE	75GPM @ 230' TDH 69'	7435	7436	215	1	112	7431	1	25,26	200
BEW-705B	GRUNDFOS	10E14	1/460/3600	304SS/TFE	5GPM @ 300' TDH 154'	7515	7516	221	1	113	7511	1	27,28	200
BEW-705C	GRUNDFOS	230S250-7	25/460/3600	304SS/TFE	130GPM @ 265' TDH 114'	7525	7526	223	1	114	7521	3	29,30	200
BEW-705D	GRUNDFOS	75S75-10	7.5/460/3600	304SS/TFE	75GPM @ 230' TDH 66'	7535	7536	225	1	115	7531	1	31,32	200
BEW-706B	GRUNDFOS	16E13	3/460/3600	304SS/TFE	10GPM @ 300' TDH 153'	7615	7616	231	1	116	7611	1	33,34	200
BEW-706C	GRUNDFOS	135S150-7	15/460/3600	304SS/TFE	130GPM @ 265' TDH 110'	7625	7626	233	1	117	7621	3	35,36	200
BEW-706D	GRUNDFOS	75S75-10	7.5/460/3600	304SS/TFE	100GPM @ 230' TDH 63'	7635	7636	235	1	118	7631	1	37,38	200

NOTES

1. ** EXISTING INSTRUMENTATION TO BE INSTALLED IN NEW PIPELINE

CONESTOGA-ROVERS & ASSOCIATES

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
5	06/02/16	MP	AS BUILT
4	4/09	JJ	AS BUILT
3	3/08	JJJ	FLOW ZONE 1 DIVERSION
2	10/06	J. GEE	AS BUILTS
1	8/05	J. GEE	PLC REPLACEMENT- REPLACE "FIT"

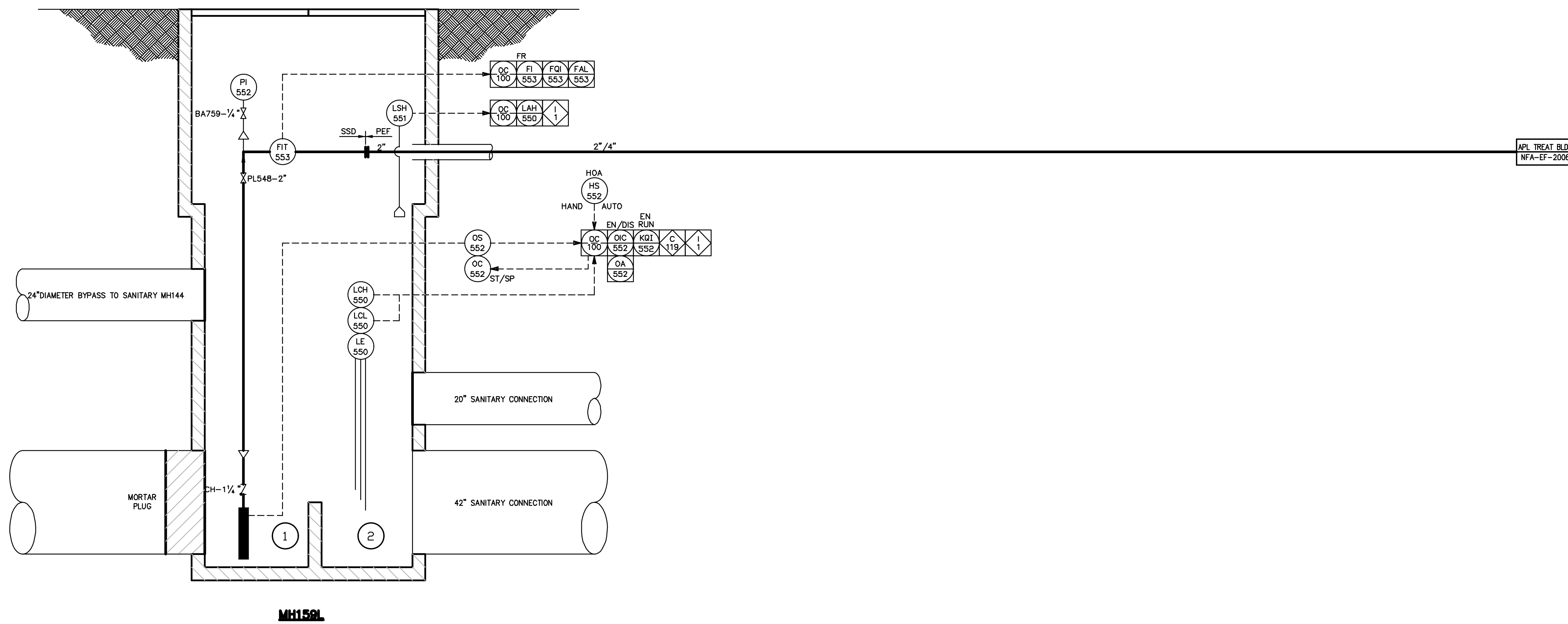
MILLER SPRINGS REMEDIATION MANAGEMENT, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
BEDROCK EXTRACTION WELL DETAIL

DRAWN | DATE | SCALE NONE | CHK'D | APPROVED | PROJ. NO 07478-00 | DRAWING NUMBER NFA-EF-2003 | REV 5

07478-00(068)EF\NFA-EF-2003 JUN 02/2016

PLANT ID.		P-552 (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
NAME		MH159L PUMP	NAPL COLLECTION CHAMBER																					
DESCRIPTION	MATERIAL	SS	CONC																					
	SIZE	1 1/4"	5'x5'x17.9'																					
	CAPACITY	14 GPM	34" HGT WEIR																					
	TEMP/PRESS	–																						
	HP/V/RPM	1/480/3500																						
	WEIGHT	–																						
	MANUFACTURE	GRUNDFOS																						
	MODEL	10E14																						
	VENDOR	–																						



4	9/10	J. EZAK	AS BUILT
3	4/09	JJ	AS BUILT
2	10/06	J. GEE	AS BUILTS
1	8/05	J. GEE	PLC REPLACEMENT
REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION

CONESTOGA-ROVERS & ASSOCIATES

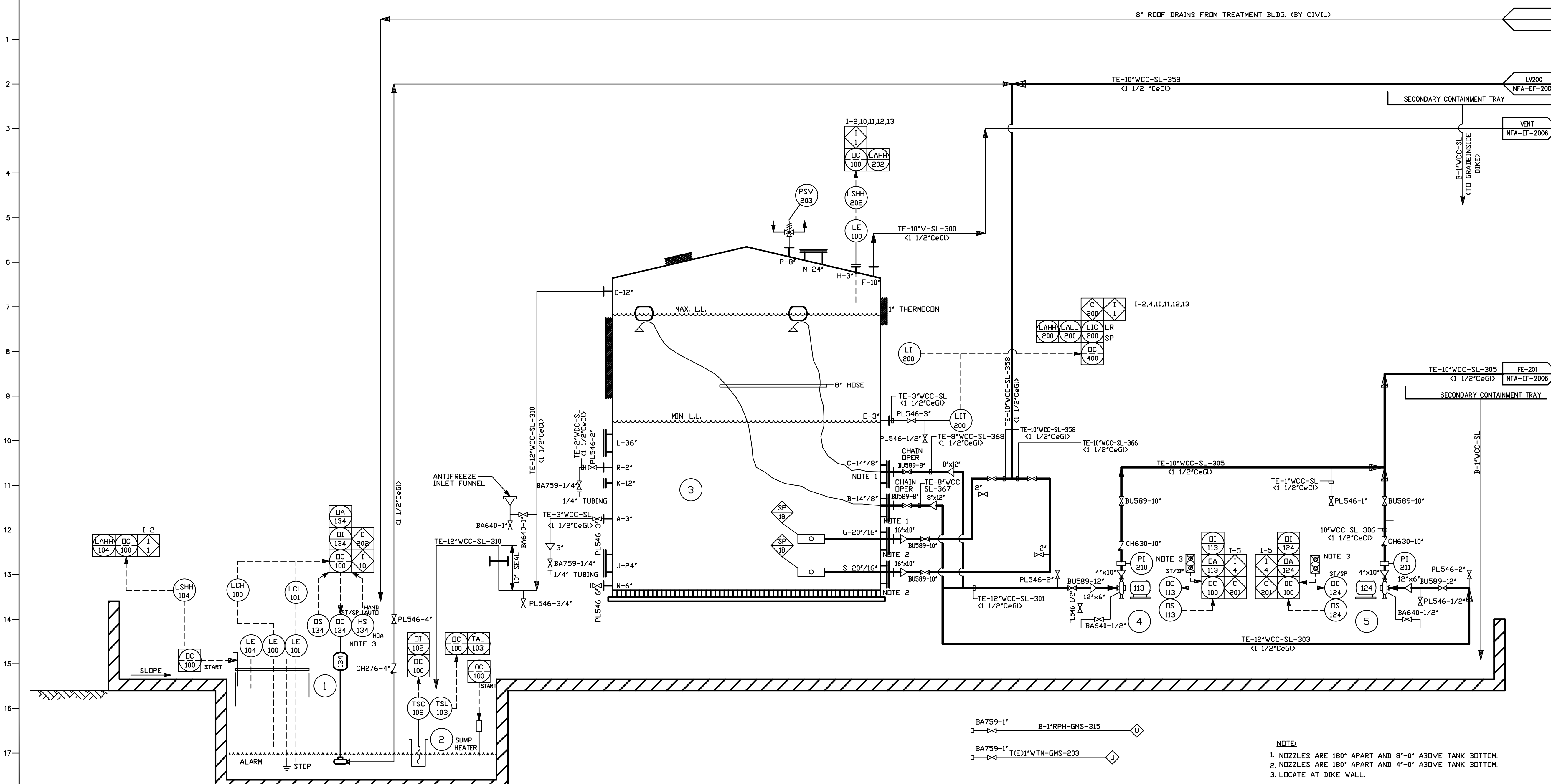
MILLER SPRINGS REMEDIATION MANAGEMENT, INC.
ABANDONED OUTFALL 005 GROUNDWATER COLLECTION

PIPING AND INSTRUMENTATION DIAGRAM
MANHOLE MH159L

DRAWN	SCALE NONE	APPROVED	DRAWING NUMBER	REV
DATE	CHK'D	PROJ. NO 07478-00	NFA-EF-2004	4

07478-00(068)EF\NFA-EF-2004 JUN 02/2016

PLANT ID.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME		DECANTER DIKE SUMP PUMP	DECANTER DIKE SUMP HEATER	DECANTER	SOUTH APL TRANSFER PUMP # 1	NORTH APL TRANSFER PUMP # 2																		
DESCRIPTION	MATERIAL	CI	SS	CS	DI	DI																		
	SIZE	1 1/2"x2'-11"	–	25'x40'H	4"x6"-13" IMP	4"x6"-13" IMP																		
	CAPACITY	100GPM @ 70'TDH	–	139500 GAL.	1200GPM @ 93'TDH	1200GPM @ 93'TDH																		
	TEMP/PRESS	–	–	55°F/ATM.	–	–																		
	HP/V/RPM	5HP/440/3500	6KW/460V	NAPL 5000 GAL.	50/460/1780	50/460/1780																		
	WEIGHT	–	–	APL 72000 GAL.	–	–																		
	MANUFACTURE	GOULDS	CHROMALOX	–	GOULDS	GOULDS																		
	MODEL	3171S	TLS-360A-060	–	3196MTX	3196MTX																		
	VENDOR	–	–	–	–	–																		



NOTE:
1. NOZZLES ARE 180° APART AND 8'-0" ABOVE TANK BOTTOM.
2. NOZZLES ARE 180° APART AND 4'-0" ABOVE TANK BOTTOM.
3. LOCATE AT DIKE WALL.

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
5	9/10	J. EZAK	AS BUILT
4	4/09	JJ	AS BUILT
3	3/08	JJJ	FLOW ZONE 1 DIVERSION
2	10/06	J. GEE	AS BUILTS
1	8/05	J. GEE	PLC REPLACEMENT-REMOVE "FE" & PUMP RECYCLE

CONESTOGA-ROVERS & ASSOCIATES

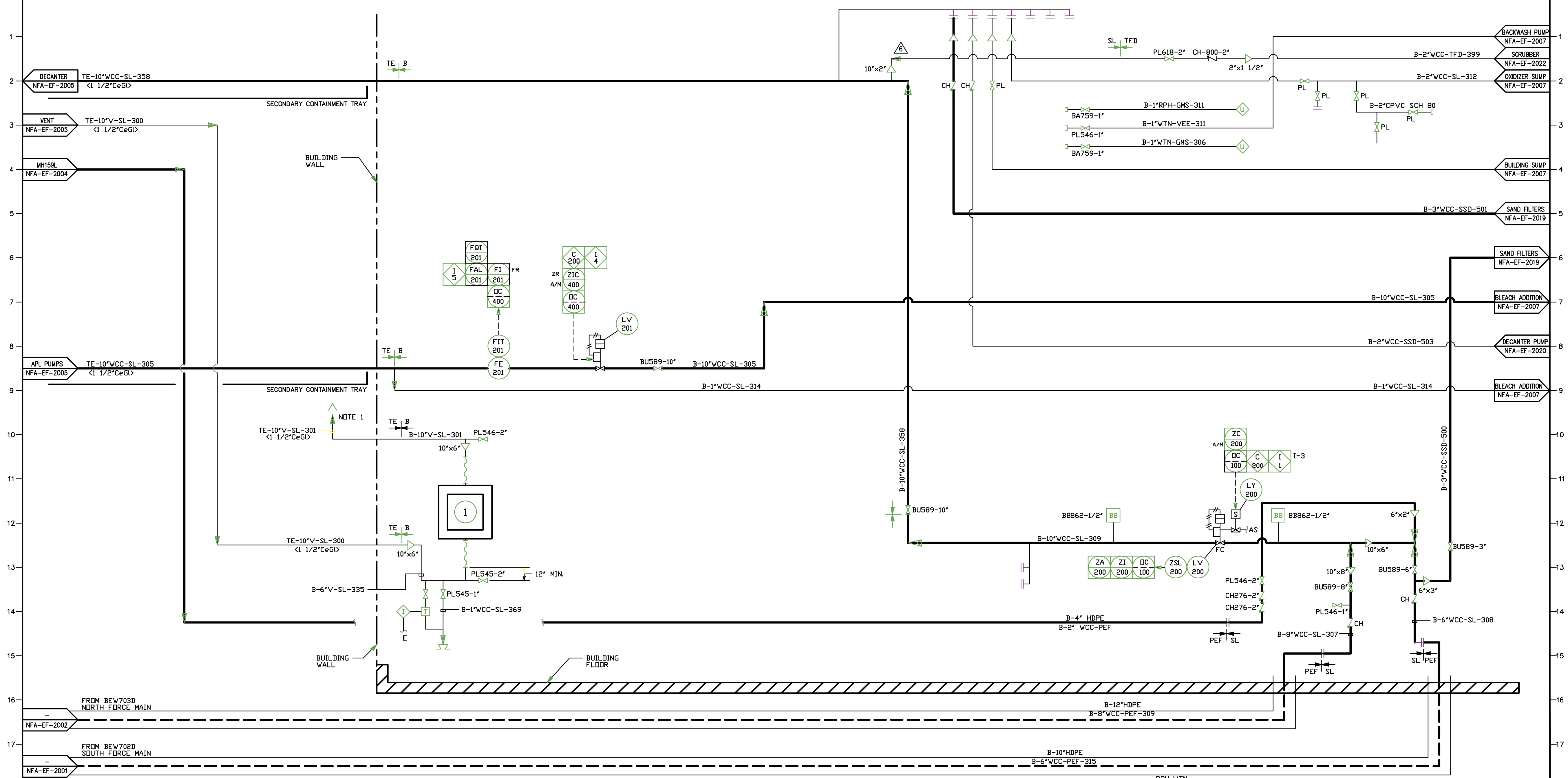
MILLER SPRINGS REMEDIATION MANAGEMENT, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
CONTAINMENT AND DECANTER AREA

DRAWN	SCALE NONE	APPROVED	DRAWING NUMBER	REV
DATE	CHK'D	PROJ. NO 07478-00	NFA-EF-2005	5

07478-95(051)EF\NFA-EF-2005 JUN 02/2016

PLANT ID.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME	DECANTER VENT ADSORBER																						
DESCRIPTION MATERIAL	POLYETHYLENE																						
SIZE	–																						
CAPACITY	500CFM																						
TEMP/PRESS	–																						
HP/V/RPM	–																						
WEIGHT	–																						
MANUFACTURE	TIGG																						
MODEL	N500 PHD																						
VENDOR	–																						



NOTE:

1. THE TOP OF THE VENT PUMP 12" ABOVE GROUND.

CONESTOGA-ROVERS & ASSOCIATES

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
7	06/02/16	MP	AS BUILT
6	06/15	JW	ADDED 2" WCC-FRP LINE
5	9/10	J. EZAK	AS BUILT
4	4/09	JJ	AS BUILT
3	3/08	JJJ	FLOW ZONE 1 DIVERSION
2	10/06	J. GEE	AS BUILTS
1	8/05	J. GEE	PLC REPLACEMENT-REPLACE "LV-200"

OXY

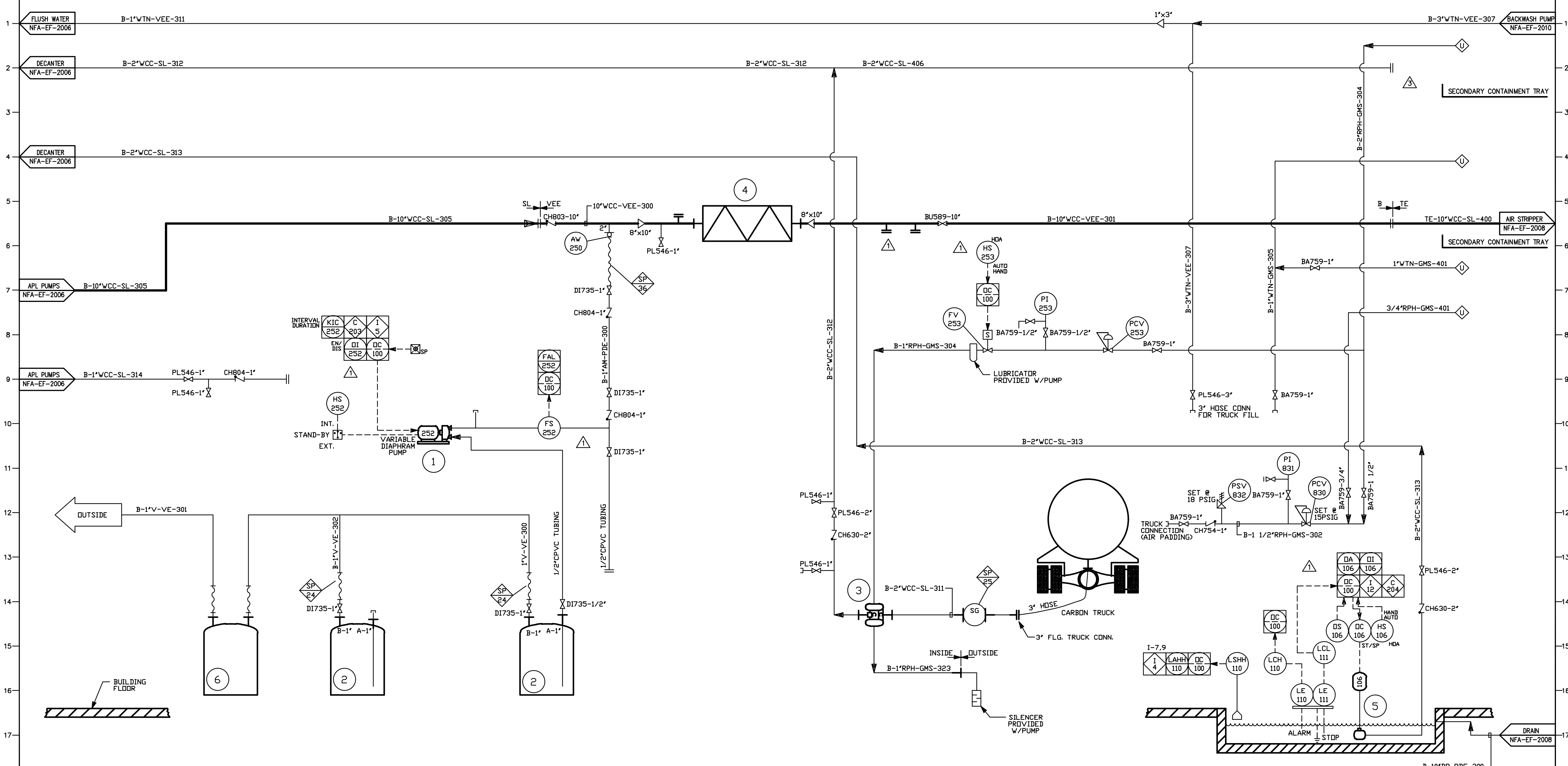
GLENN SPRINGS HOLDINGS, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
SYSTEM INFLUENT

DRAWN	SCALE NONE	APPROVED	DRAWING NUMBER	REV
DATE	CHK'D	PROJ. NO 07478-00	NFA-EF-2006	7

07478-00(068)EF\NFA-EF-2006 JUN 02/2016

PLANT ID.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME		BLEACH FEEDER	BLEACH TOTE TANK	CARBON TRUCK DRAIN PUMP	STATIC MIXER	BUILDING SUMP PUMP	VENT ABSORBER																	
DESCRIPTION	MATERIAL	POLYETHYLENE	POLYETHYLENE	CI	FRP	CI																		
	SIZE	–	–	–	8"	1 1/2"x2-11																		
	CAPACITY	0-10 GPH	300 GAL.	70GPM @ 65'TDH	–	50GPM @ 70'TDH																		
	TEMP/PRESS	–	–	–	80/150	–																		
	HP/V/RPM	–	–	–	–	5/460/1750																		
	WEIGHT	–	–	–	–	–																		
	MANUFACTURE	STRANCO	KERRCO	WARREN RUPP	LIGHTNIN	GOULDS																		
	MODEL	CF50-10N	300 DOT	SB2A-DN-3-CI	TYPE 11	3171S																		
	VENDOR	–	–	–	–	–																		



4	06/02/16	MP	AS BUILT
3	06/15	JW	REMOVED 2"WCC-SL-406
2	10/06	J. GEE	AS BUILTS
1	8/05	J. GEE	PLC REPLACEMENT-REMOVE "AE-250"
REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION

CONESTOGA-ROVERS & ASSOCIATES

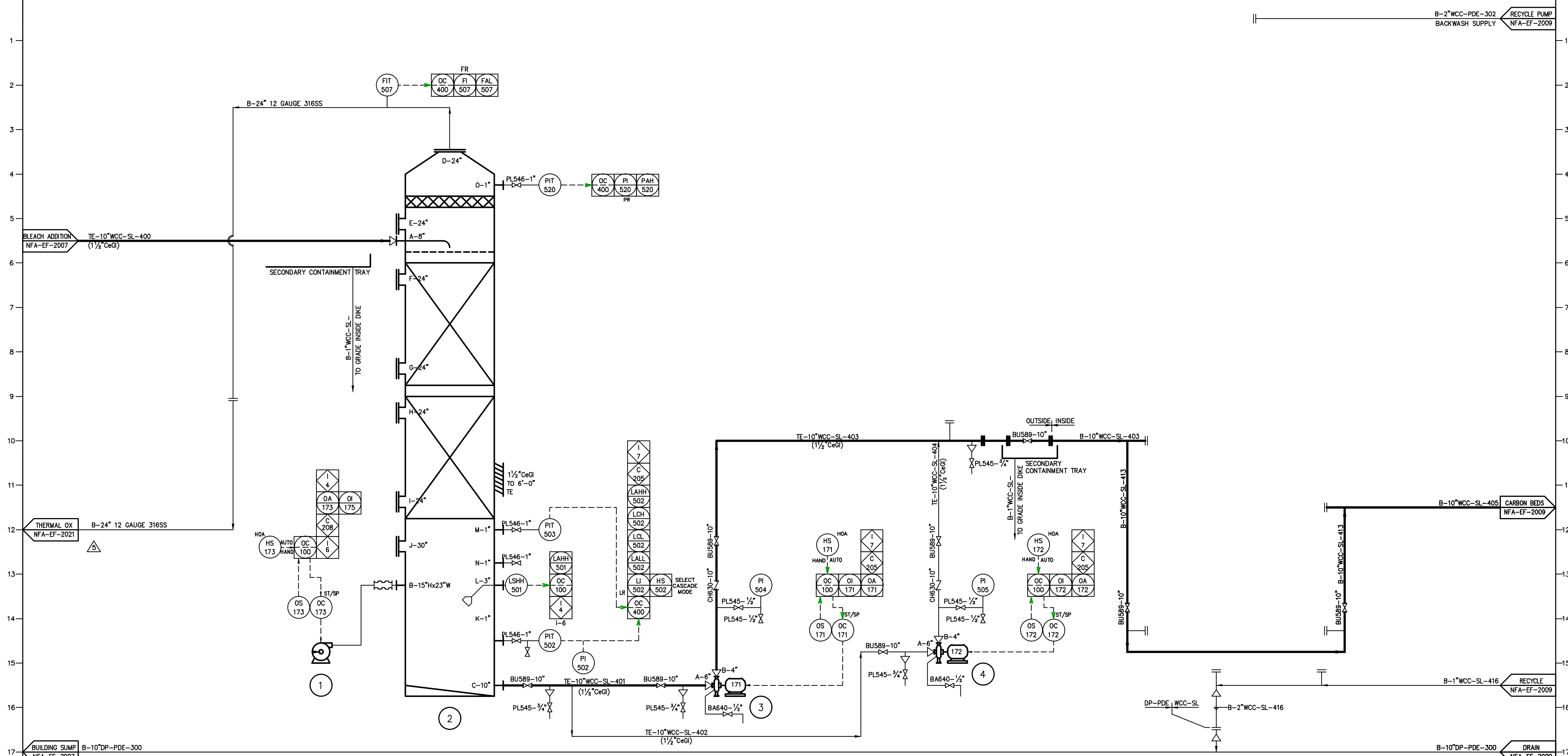
MILLER SPRINGS REMEDIATION MANAGEMENT, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
BLEACH ADDITION

DRAWN	SCALE NONE	APPROVED	DRAWING NUMBER NFA-EF-2007	REV 4
DATE	CHK'D	PROJ. NO 07478-00		

07478-00(068)EF\NFA-EF-2007 JUN 02/2016

PLANT ID.	50401-800 (1)	50401-800 (2)	50132-800 (3)	50133-800 (4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
NAME	AIR STRIPPER BLOWER	AIR STRIPPER	CARBON ADSORBER FEED PUMP NORTH	CARBON ADSORBER FEED PUMP SOUTH																			
DESCRIPTION: MATERIAL	STEEL	316L SS	DI	DI																			
SIZE		7'-0" DIA x 43'-0"H	4"X6"-13	4"X6"-13																			
CAPACITY	6000 CFM @ 3" H_2O	960 GPM	960 GPM @ 130' HD	960 GPM @ 130' HD																			
TEMP/PRESS																							
HP/V/RPM	5/460/1800		50/460/1700	50/460/1700																			
WEIGHT		35400 POUNDS																					
MANUFACTURE	TWIN CITY FAN	HYDRO GROUP	GOULDS	GOULDS																			
MODEL	245 BCV	PCS 84.30SS	3196MTX	3196MTX																			
VENDOR	HYDRO GROUP	ENVIRONMENTAL																					



CONESTOGA-ROVERS & ASSOCIATES

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
6	01/16	JW	AS BUILT
5	06/15	JW	REMOVED REDUCER, 24" WAS 18"
4	4/09	JJ	AS BUILT
3	3/08	JJJ	FLOW ZONE 1 DIVERSION
2	10/06	J. GEE	AS BUILTS
			PLC REPLACEMENT-REMOVE LV-502, AE-514
1	8/05	J. GEE	AND ISOLATE BAG FILTERS

OXY

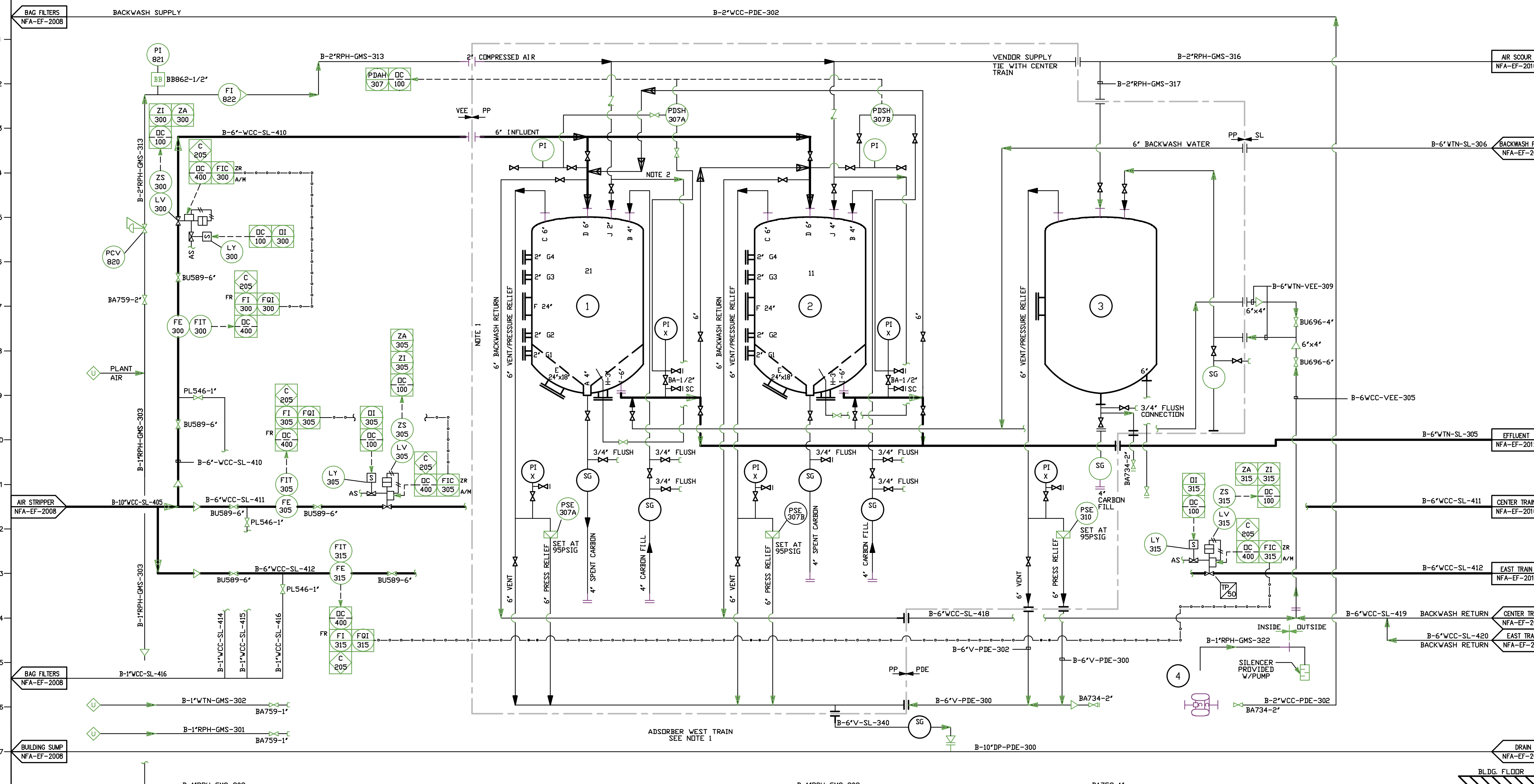
GLENN SPRINGS HOLDINGS, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
AIR STRIPPER AND BAG FILTERS

DRAWN	SCALE NONE	APPROVED	DRAWING NUMBER NFA-EF-2008	REV 6
DATE	CHK'D	PROJ. NO 07478-00		

07478-00(068)EF\NFA-EF-2008 JUN 02/2016

PLANT ID.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME	WEST TRAIN NORTH CARBON BED	WEST TRAIN SOUTH CARBON BED	CARBON TRANSFER TANK	BACKWASH RECYCLE PUMP																			
DESCRIPTION: MATERIAL	EPOXY–LINED CS	EPOXY–LINED CS	EPOXY–LINED CS	CI																			
SIZE	10'D x 12' T–T	10'D x 12' T–T	10'D x 12' T–T	–																			
CAPACITY	20,000 LBS	20,000 LBS	20,000 LBS	70GPM @ 65' TDH																			
TEMP/PRESS	150°F/100 PSIG	150°F/100 PSIG	150°F/100 PSIG	–																			
HP/V/RPM	–	–	–	–																			
WEIGHT	–	–	–	–																			
MANUFACTURE	CALGON CARBON	CALGON CARBON	CALGON CARBON	WARREN RUPP																			
MODEL	–	–	–	–																			
VENDOR	–	–	–	–																			



NOTE:

1. ITEMS ENCLOSED IN THE DASHED LINE ARE VENDOR SUPPLIED.

WTN RPH

CONESTOGA-ROVERS & ASSOCIATES

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
3	4/09	JJ	AS BUILT
2	10/06	J. GEE	AS BUILTS
			PLC REPLACEMENT– ISOLATE BACKWASH RECYCLE PUMP
1	8/05	J. GEE	AND ADDED LV-300, 305, 315

OXY

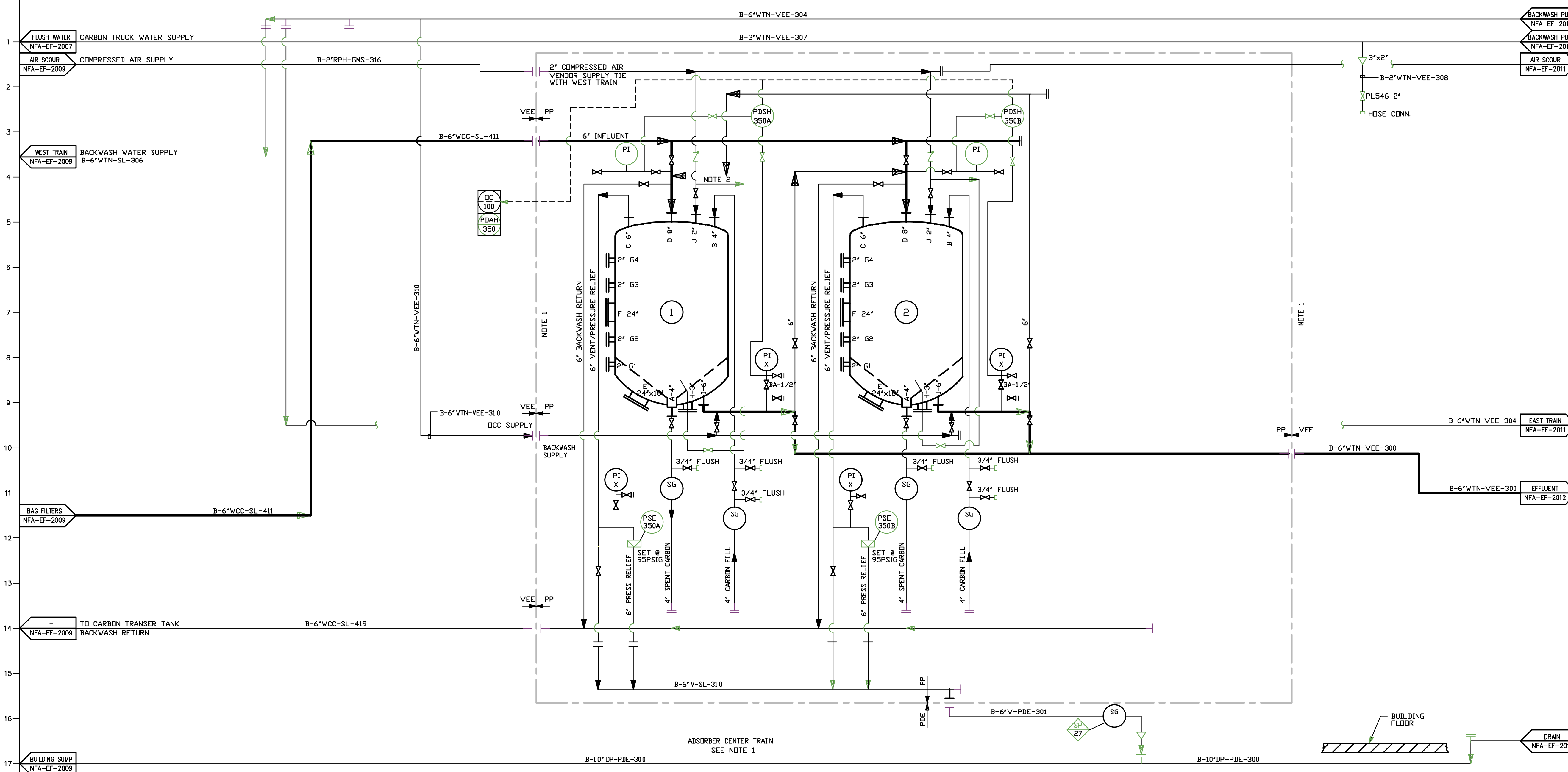
MILLER SPRINGS REMEDIATION MANAGEMENT, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
WEST CARBON TRAIN

DRAWN	SCALE NONE	APPROVED	DRAWING NUMBER	REV
DATE	CHK'D	PROJ. NO 07478-00	NFA-EF-2009	3

07478-00(068)EF\NFA-EF-2009 JUN 02/2016

PLANT ID.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME		CENTER TRAIN NORTH CARBON BED	CENTER TRAIN SOUTH CARBON BED																					
DESCRIPTION	MATERIAL	EPOXY–LINED CS	EPOXY–LINED CS																					
	SIZE	10'D x 12' T–T	10'D x 12' T–T																					
	CAPACITY	20,000 LBS	20,000 LBS																					
	TEMP/PRESS	150°F/100 PSIG	150°F/100 PSIG																					
	HP/V/RPM	–	–																					
	WEIGHT	–	–																					
	MANUFACTURE	CALGON CARBON	CALGON CARBON																					
	MODEL	–	–																					
	VENDOR	–	–																					



NOTE:

1. ITEMS ENCLOSED IN THE DASHED LINE ARE VENDOR SUPPLIED.

CONESTOGA-ROVERS & ASSOCIATES

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
2	10/06	J. GEE	AS BUILTS
1	8/05	J. GEE	PLC REPLACEMENT

OXY

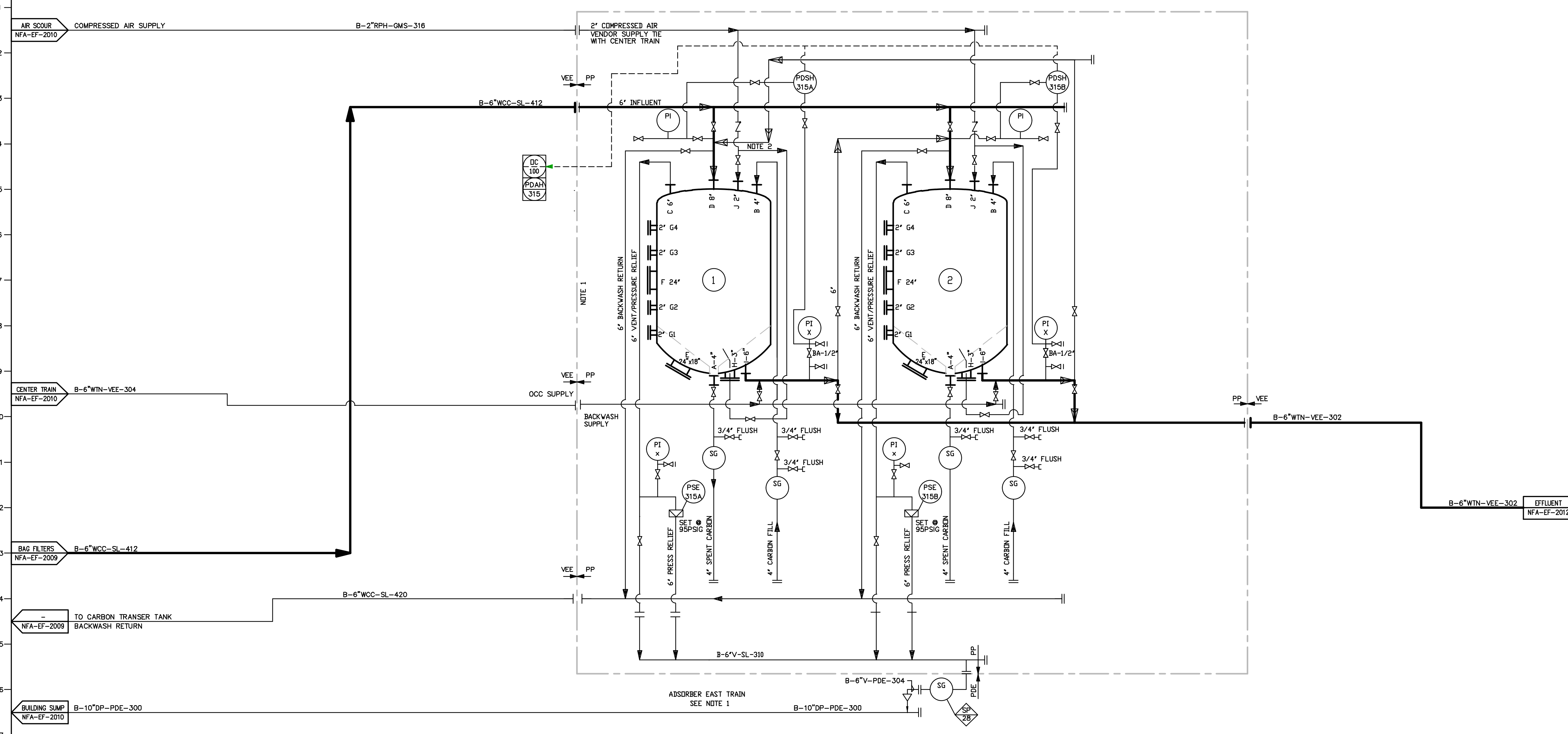
MILLER SPRINGS REMEDIATION MANAGEMENT, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
CENTER CARBON TRAIN

DRAWN	SCALE NONE	APPROVED	DRAWING NUMBER NFA–EF–2010	REV 2
DATE	CHK'D	PROJ. NO. 07478–00		

07478-00(068)EF\NFA-EF-2010 JUN 02/2016

PLANT ID.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME		EAST TRAIN NORTH CARBON BED	EAST TRAIN SOUTH CARBON BED																					
DESCRIPTION	MATERIAL	EPOXY–LINED CS	EPOXY–LINED CS																					
	SIZE	10'D x 12' T–T	10'D x 12' T–T																					
	CAPACITY	20,000 LBS	20,000 LBS																					
	TEMP/PRESS	150°F/100 PSIG	150°F/100 PSIG																					
	HP/V/RPM	–	–																					
	WEIGHT	–	–																					
	MANUFACTURE	CALGON CARBON	CALGON CARBON																					
	MODEL	–	–																					
	VENDOR	–	–																					



NOTE:

1. ITEMS ENCLOSED IN THE DASHED LINE ARE VENDOR SUPPLIED.

CONESTOGA–ROVERS & ASSOCIATES

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
2	10/06	J. GEE	AS BUILTS
1	8/05	J. GEE	PLC REPLACEMENT

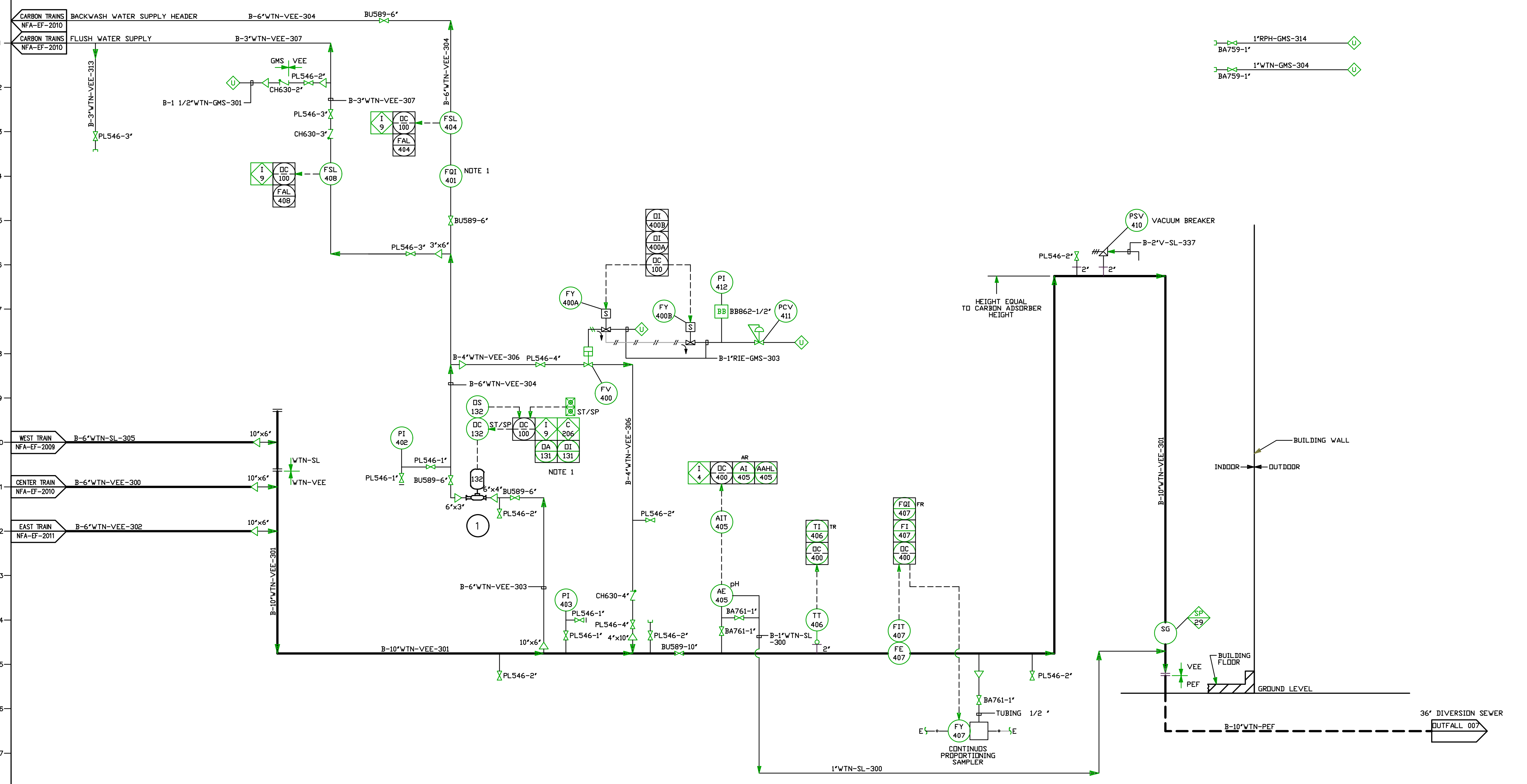
MILLER SPRINGS REMEDIATION MANAGEMENT, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
EAST CARBON TRAIN

DRAWN	SCALE NONE	APPROVED	DRAWING NUMBER	REV
DATE	CHK'D	PROJ. NO 07478–00	NFA–EF–2011	2

07478–00(068)EF\NFA–EF–2011 JUN 02/2016

PLANT ID.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME	BACKWASH PUMP																						
DESCRIPTION – MATERIAL	DI																						
SIZE	3x4–13																						
CAPACITY	500GPM @ 100'																						
TEMP/PRESS	–																						
HP/V/RPM	25/460/1780																						
WEIGHT	–																						
MANUFACTURE	GOULDS																						
MODEL	3996MT																						
VENDOR	–																						



NOTE:

1. THE BACKWASH WATER SUPPLY WILL BE CONTROLLED BY A TIMER.

RIE

WTN

CONESTOGA–ROVERS & ASSOCIATES

RIE

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
2	10/06	J. GEE	AS BUILTS
1	8/05	J. GEE	PLC REPLACEMENT

OXY

WTN RPH

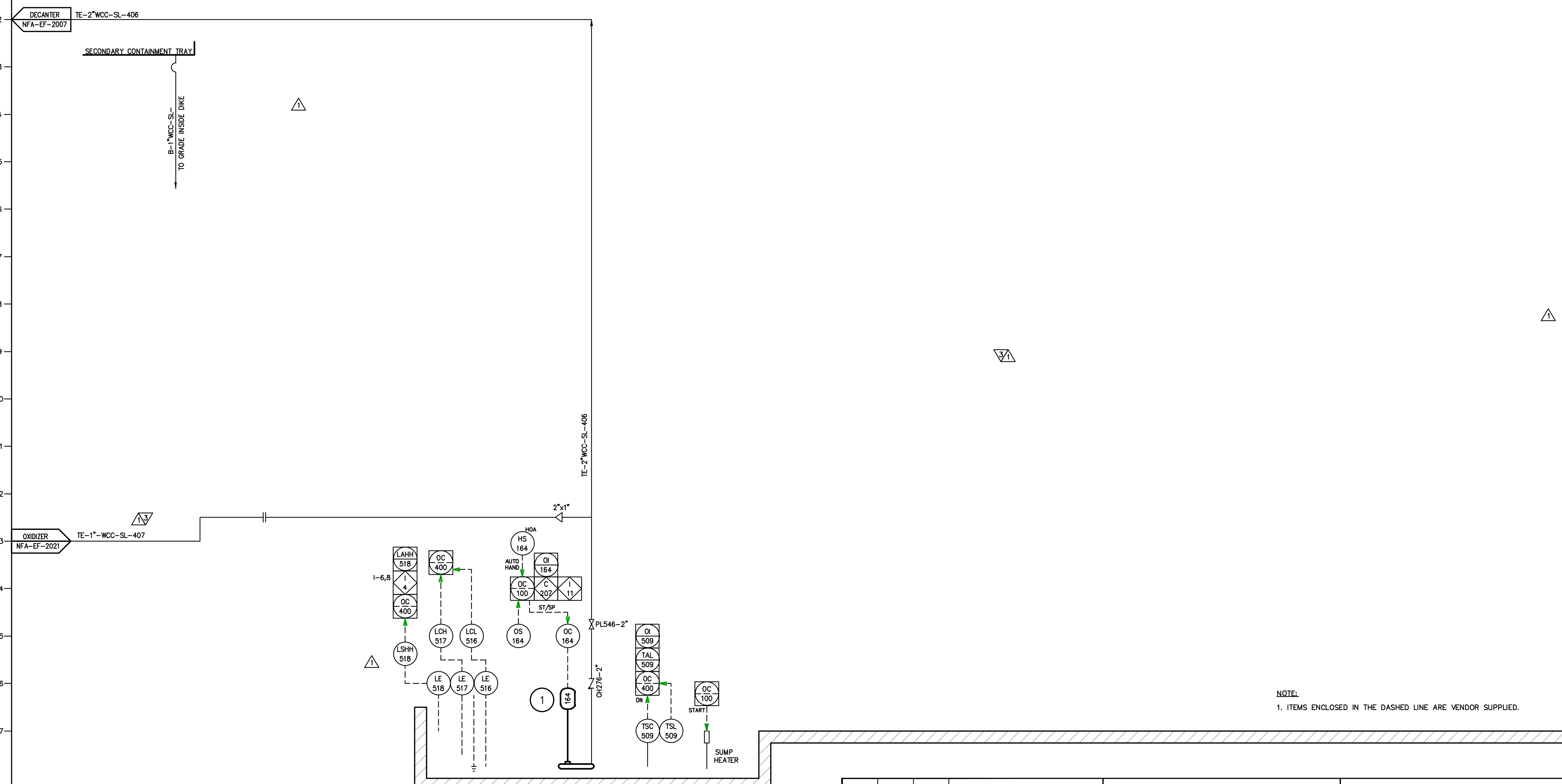
MILLER SPRINGS REMEDIATION MANAGEMENT, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
SYSTEM EFFLUENT

DRAWN	SCALE NONE	APPROVED	DRAWING NUMBER	REV
DATE	CHK'D	PROJ. NO 07478–00	NFA–EF–2012	2

07478–00(068)EF\NFA–EF–2012 JUN 02/2016

PLANT ID.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME		OXIDIZER DIKE SUMP PUMP																						
DESCRIPTION	MATERIAL																							
	SIZE	1x1.5–6																						
	CAPACITY	30 GPM @ 80'																						
	TEMP/PRESS																							
	HP/V/RPM	2/460/3500																						
	WEIGHT	POUNDS																						
	MANUFACTURE	GOULDS																						
	MODEL	3171ST																						
	VENDOR	ESTABROOK																						



NOTE:

1. ITEMS ENCLOSED IN THE DASHED LINE ARE VENDOR SUPPLIED.

CONESTOGA-ROVERS & ASSOCIATES

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
5	01/16	JW	AS BUILT
4	06/15	JW	REMOVED OXIDIZER
3	9/10	J. EZAK	AS BUILT
2	4/09	JJ	AS BUILTS
1	8/05	J. GEE	PLC REPLACEMENT

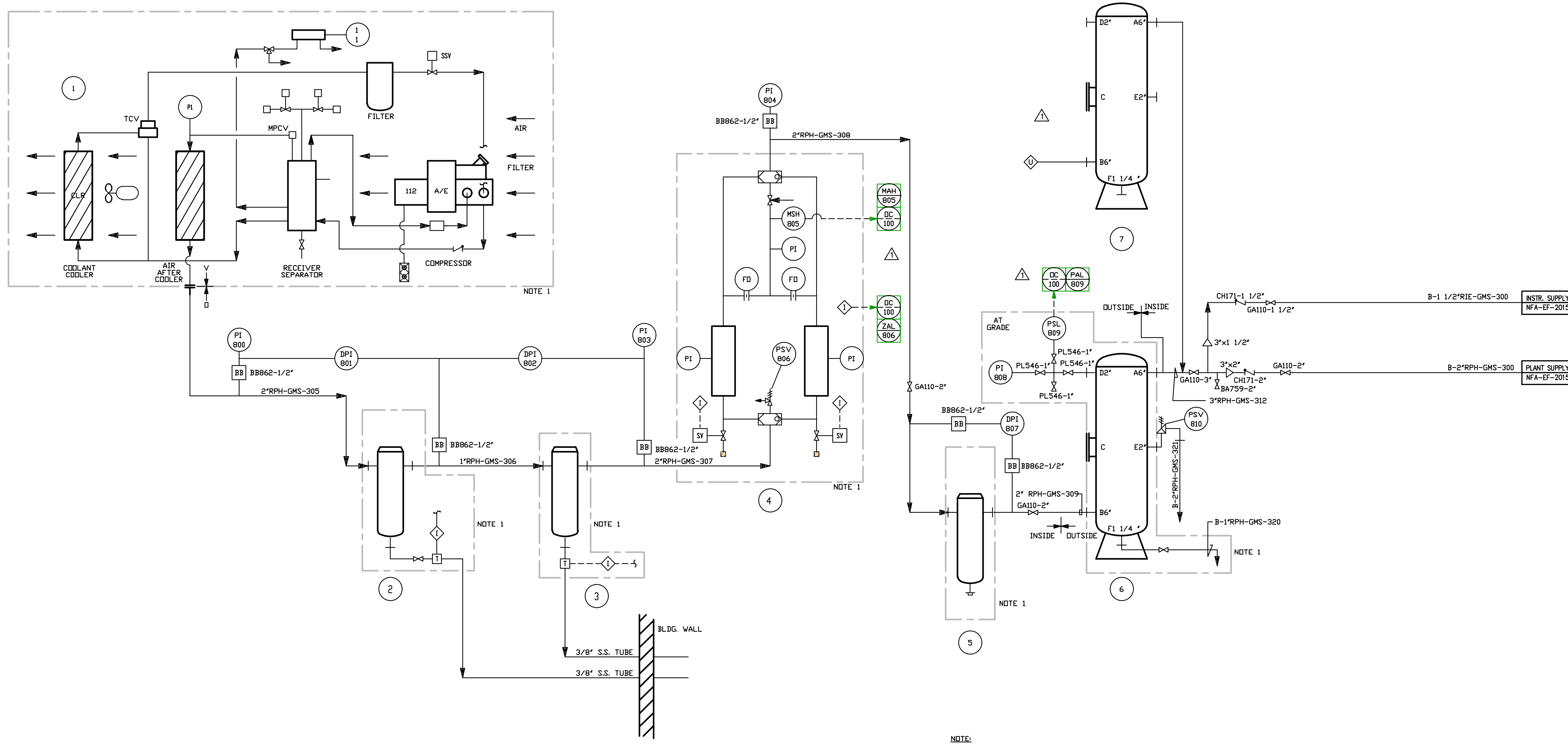
GLENN SPRINGS HOLDINGS, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
THERMAL OXIDIZER

DRAWN	SCALE NONE	APPROVED	DRAWING NUMBER	REV
DATE	CHK'D	PROJ. NO 07478-00	NFA-EF-2013	5

07478-00(068)EF\NFA-EF-2013 JUN 02/2016

PLANT ID.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME		ROTARY SCREW AIR COMPRESSOR	AIR DRYER PRE-FILTER	AIR DRYER PRE-FILTER	REGENERATIVE COMPRESSED AIR DRYIER	AIR DRYER AFTER-FILTER	VERT AIR RECEIVER W/PRESS RELIEF VALVE & PRESS INDICATOR	BOOSTER AIR COMPRESSOR																
DESCRIPTION	MATERIAL	CS	CS	CS	CS	CS	CS	CS																
	SIZE	–	–	–	–	–	60"DIA x 185" HIGH	–																
	CAPACITY	125 SCFM	–	–	–	–	2000 GAL	116 SCFM																
	TEMP/PRESS	100°F/150 PSIG	–	–	–	–	–	/200 PSIG																
	HP/V/RPM	40HP/460V	–	–	–	–	–	40HP/460V/3																
	WEIGHT	–	–	–	–	–	–	–																
	MANUFACTURE	INGERSOLL RAND	INGERSOLL RAND	INGERSOLL RAND	INGERSOLL RAND	INGERSOLL RAND	INGERSOLL RAND	INGERSOLL RAND																
	MODEL	HXP40SE	IR125C-G	IR125C-G	HRD 10	IR100-PD-G	–	HXP40SE																
	VENDOR	–	–	–	–	–	–	–																



NOTE:
1. ITEMS ENCLOSED IN THE DASHED LINES ARE VENDOR SUPPLIED ITEMS.

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
2	10/06	J. GEE	AS BUILTS
1	8/05	J. GEE	PLC REPLACEMENT-ADDED AIR COMPRESSOR.

CONESTOGA-ROVERS & ASSOCIATES

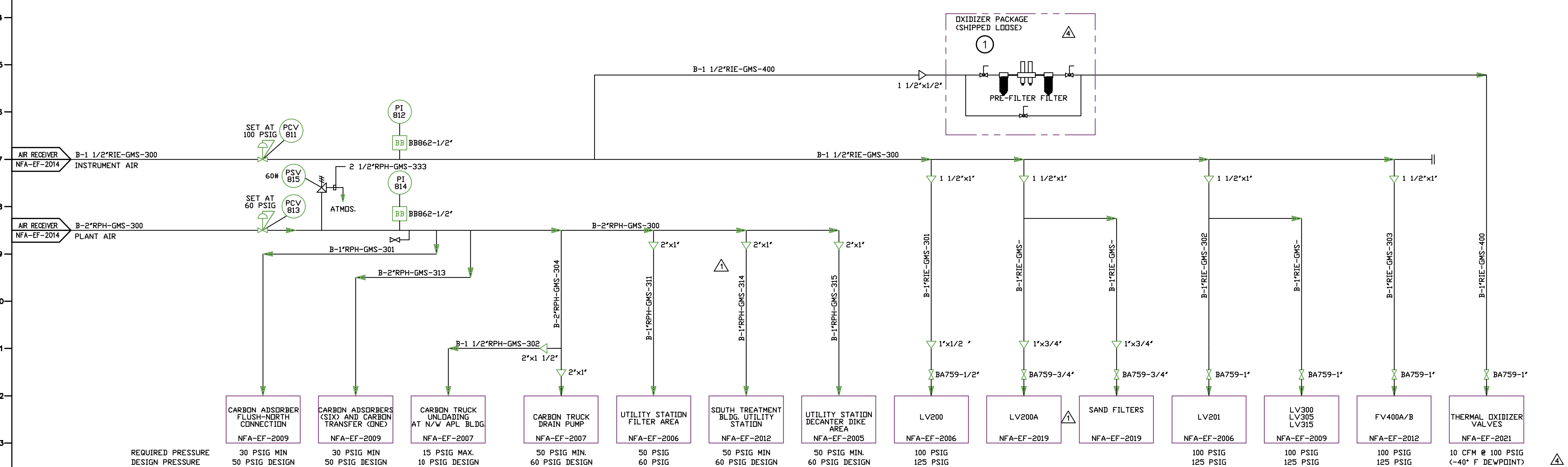
MILLER SPRINGS REMEDIATION MANAGEMENT, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
PLANT UTILITIES – COMPRESSED AIR SYSTEM

DRAWN	SCALE NONE	APPROVED	DRAWING NUMBER	REV
DATE	CHK'D	PROJ. NO 07478-00	NFA-EF-2014	2

07478-00(068)EF\NFA-EF-2014 JUN 02/2016

PLANT ID.	–	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME	–																							
DESCRIPTION: MATERIAL	–																							
SIZE	–																							
CAPACITY	–																							
TEMP/PRESS	–																							
HP/V/RPM	–																							
WEIGHT	–																							
MANUFACTURE	–																							
MODEL	–																							
VENDOR	–																							



CONESTOGA-ROVERS & ASSOCIATES

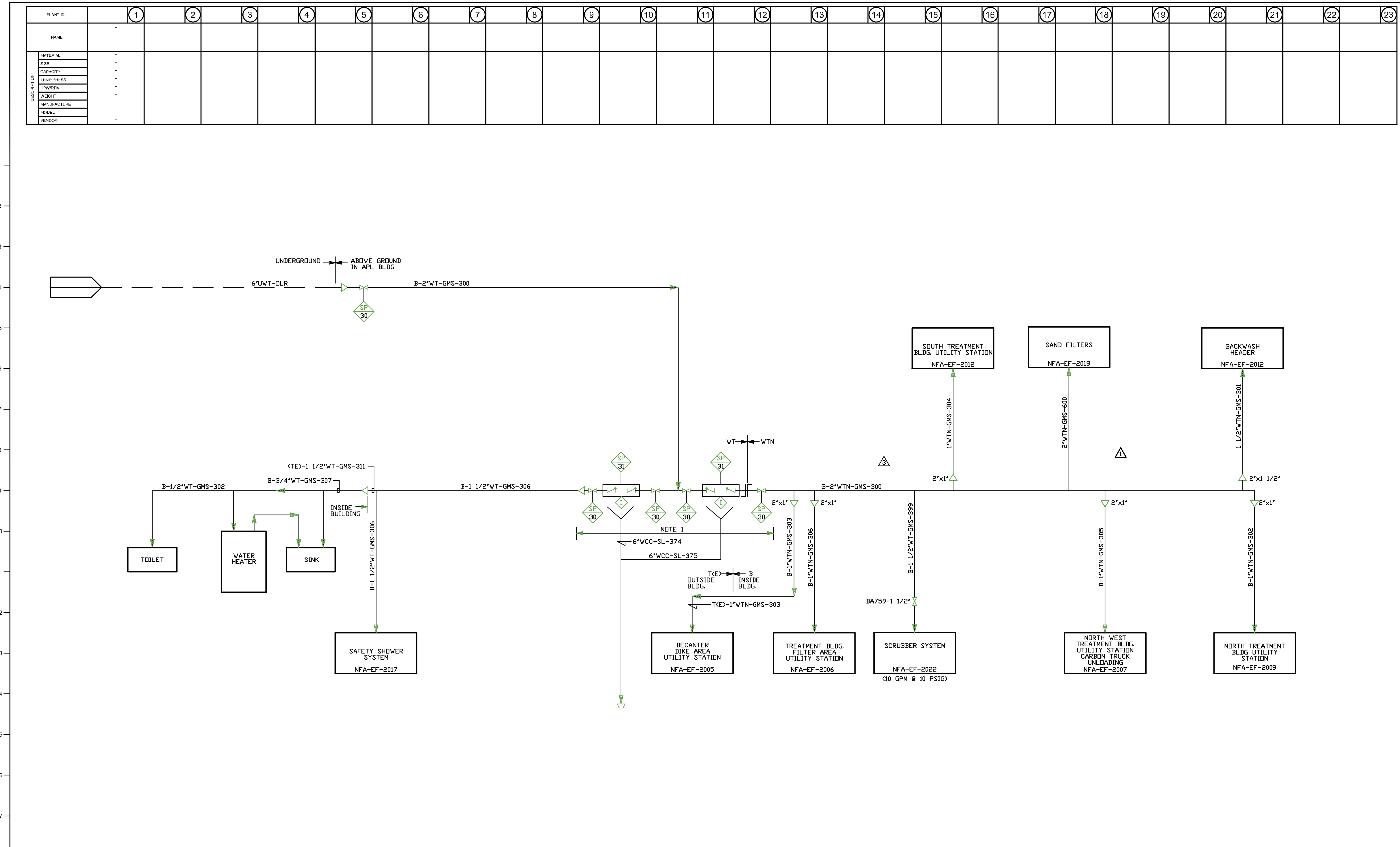
REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
5	01/16	JW	AS BUILT
4	06/15	JW	ADDED AIR DRYER
3	4/09	JJ	AS BUILT
2	10/06	J. GEE	AS BUILTS
1	9/04	J. GEE	PLC REPLACEMENT- REMOVED BACKWASH RECYCLE PUMP AND ADDED LV-300, 305, 315

GLENN SPRINGS HOLDINGS, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
PLANT UTILITIES – AIR DISTRIBUTION

DRAWN	SCALE NONE	APPROVED	DRAWING NUMBER	REV
DATE	CHK'D	PROJ. NO 07478-00	NFA-EF-2015	5

07478-00(068)EF\NFA-EF-2015 JUN 02/2016



CONESTOGA-ROVERS & ASSOCIATES

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
4	01/16	JW	AS BUILT
3	06/15	JW	ADDED 1 1/2"-WT-GMS LINE
2	4/09	JJ	AS BUILT
1	6/08	JJJ	FLOW ZONE 1 DIVERSION

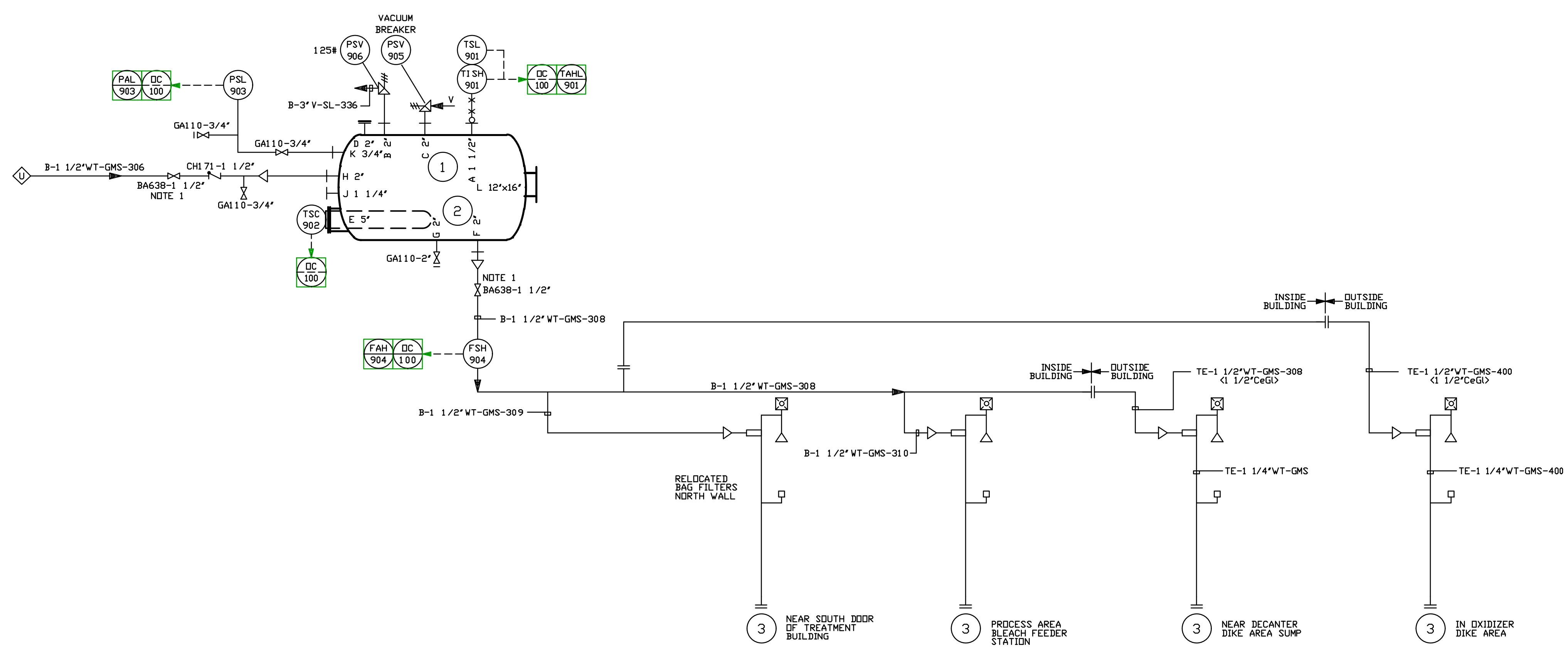
GLENN SPRINGS HOLDINGS, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
PLANT UTILITIES – CITY WATER

DRAWN | SCALE NONE | APPROVED | DRAWING NUMBER NFA-EF-2016 | REV 4
DATE | CHK'D | PROJ. NO 07478-00

07478-00(068)EF\NFA-EF-2016 JUN 02/2016

PLANT ID.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME		SAFETY SHOWER HEAD TANK	SAFETY SHOWER HEAD TANK HEATER	SAFETY SHOWER /EYEWASH																				
DESCRIPTION	MATERIAL	GALV. CS	COPPER/STEEL	–																				
	SIZE	–	5" FLANGE	–																				
	CAPACITY	379 GAL.	–	–																				
	TEMP/PRESS	100°F/125 PSIG	–	–																				
	HP/V/RPM	–	18KW/480V	–																				
	WEIGHT	–	–	–																				
	MANUFACTURE	ADAMSON	CHROMALOX	–																				
	MODEL	G72H	TM-6185E4	–																				
	VENDOR	–	–	–																				



NOTES:
1. VALVES TO BE LOCKED OPEN.

WT

CONESTOGA-ROVERS & ASSOCIATES

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
2	10/06	J. GEE	AS BUILTS
1	8/05	J. GEE	PLC REPLACEMENT

OXY

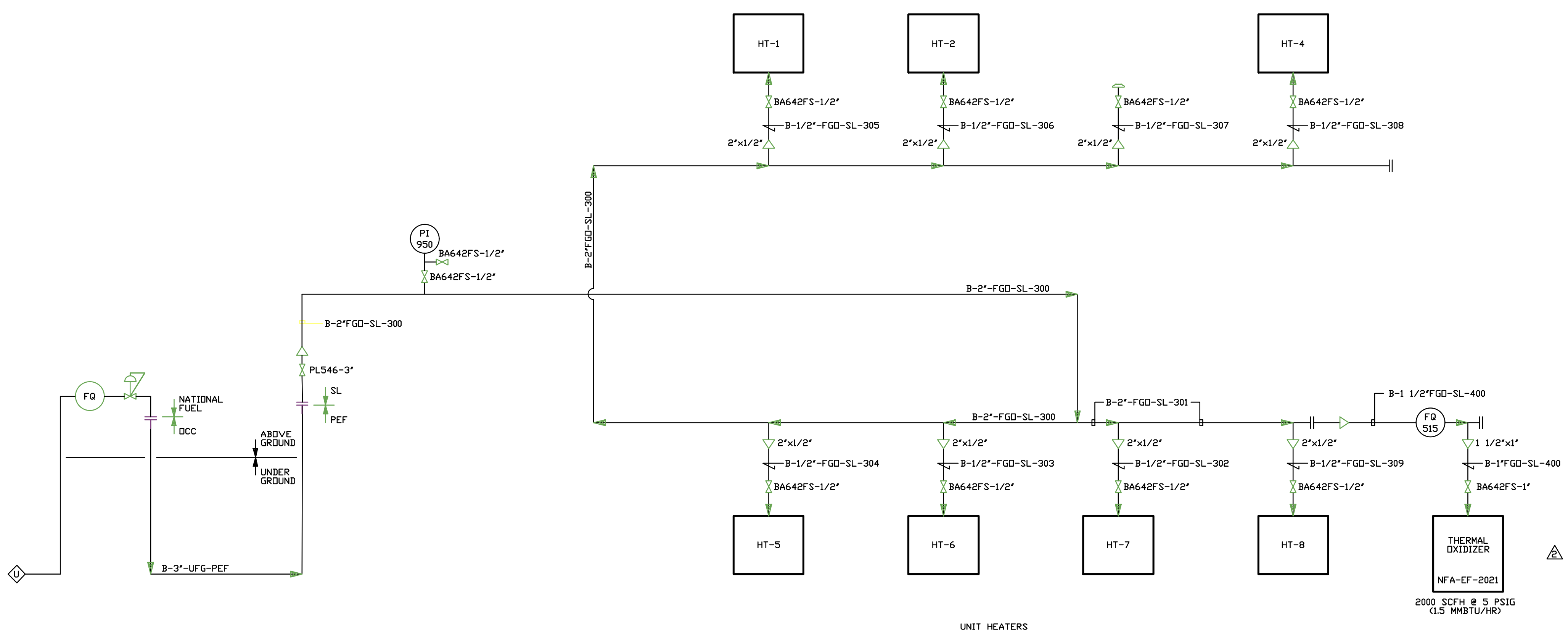
MILLER SPRINGS REMEDIATION MANAGEMENT, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
PLANT UTILITIES – SAFETY SHOWER SYSTEM

DRAWN	SCALE NONE	APPROVED	DRAWING NUMBER NFA-EF-2017	REV 2
DATE	CHK'D	PROJ. NO. 07478-00		

07478-00(068)EF\NFA-EF-2017 JUN 02/2016

PLANT ID.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME	–																							
DESCRIPTION: MATERIAL	–																							
SIZE	–																							
CAPACITY	–																							
TEMP/PRESS	–																							
HP/V/RPM	–																							
WEIGHT	–																							
MANUFACTURE	–																							
MODEL	–																							
VENDOR	–																							



CONESTOGA-ROVERS & ASSOCIATES

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
3	01/16	JW	AS BUILT
2	06/15	JW	REPLACED OXIDIZER
1	10/06	J. GEE	AS BUILTS

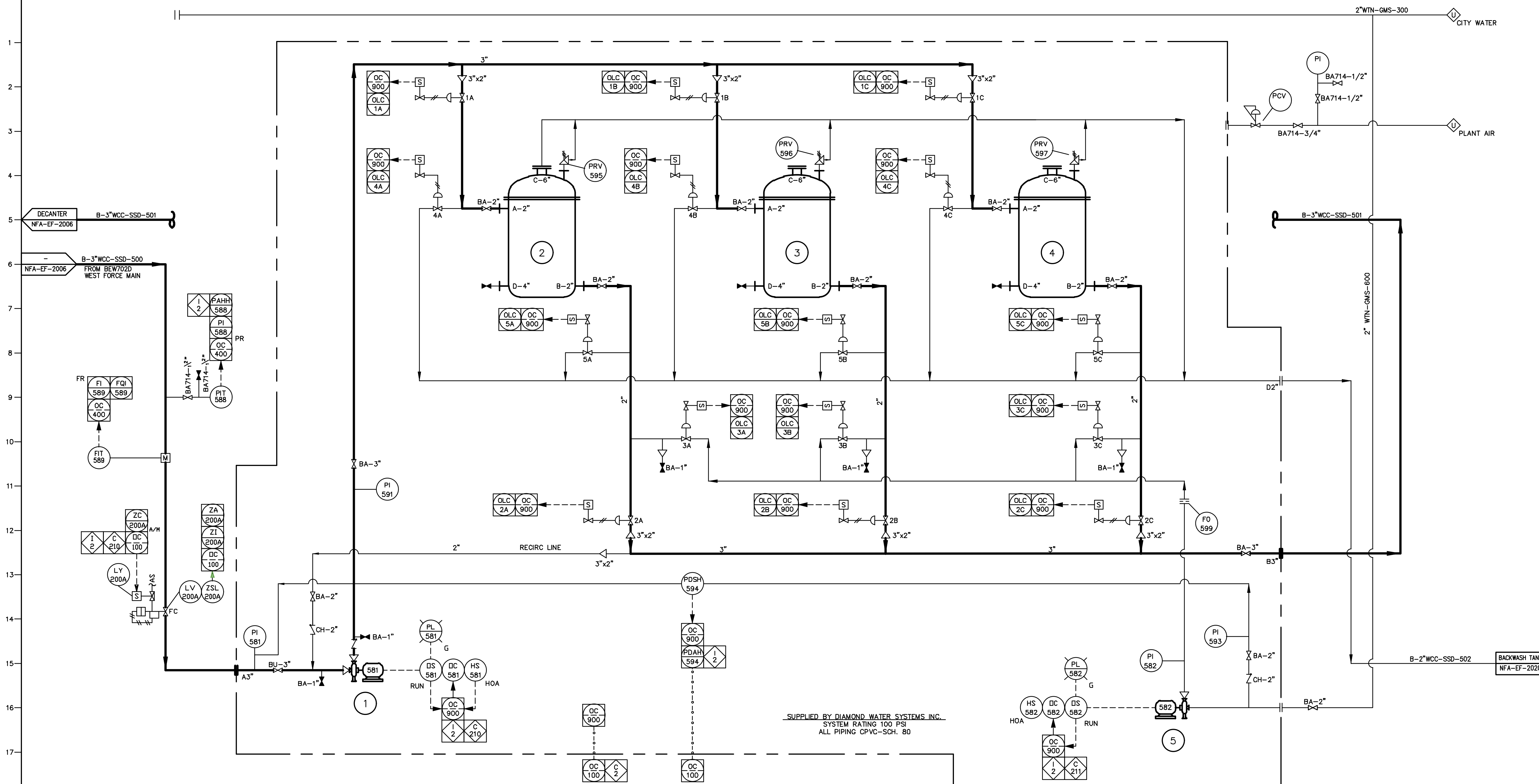
GLENN SPRINGS HOLDINGS, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
PLANT UTILITIES – NATURAL GAS

DRAWN | SCALE NONE | APPROVED | DRAWING NUMBER NFA-EF-2018 | REV 3
DATE | CHK'D | PROJ. NO 07478-00

07478-00(068)EF\NFA-EF-2018 JUN 02/2016

PLANT ID.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME		SAND FILTER FEED PUMP	SAND FILTER BED "A"	SAND FILTER BED "B"	SAND FILTER BED "C"	SAND FILTER BACKWASH PUMP																		
DESCRIPTION	MATERIAL	CI	304SS	304SS	304SS	CI																		
	SIZE	–	–	–	–	–																		
	CAPACITY	250 gpm @ 60FT	–	–	–	60 gpm @ 50FT																		
	TEMP/PRESS	–	100 PSI	100 PSI	100 PSI	–																		
	HP/V/RPM	5/4601/SP	–	–	–	2/4601/SP																		
	WEIGHT	–	–	–	–	–																		
	MANUFACTURE	GOULDS	DIAMOND	DIAMOND	DIAMOND	GOULDS																		
	MODEL	3656	–	–	–	3642																		
	VENDOR	DIAMOND	–	–	–	DIAMOND																		



4	06/02/16	MP	AS BUILT
3	9/10	J. EZAK	AS BUILT
2	4/09	JJ	AS BUILT
1	3/08	JJJ	ISSUED FOR CONSTRUCTION FLOW ZONE 1 DIVERSION
REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION

CONESTOGA-ROVERS & ASSOCIATES

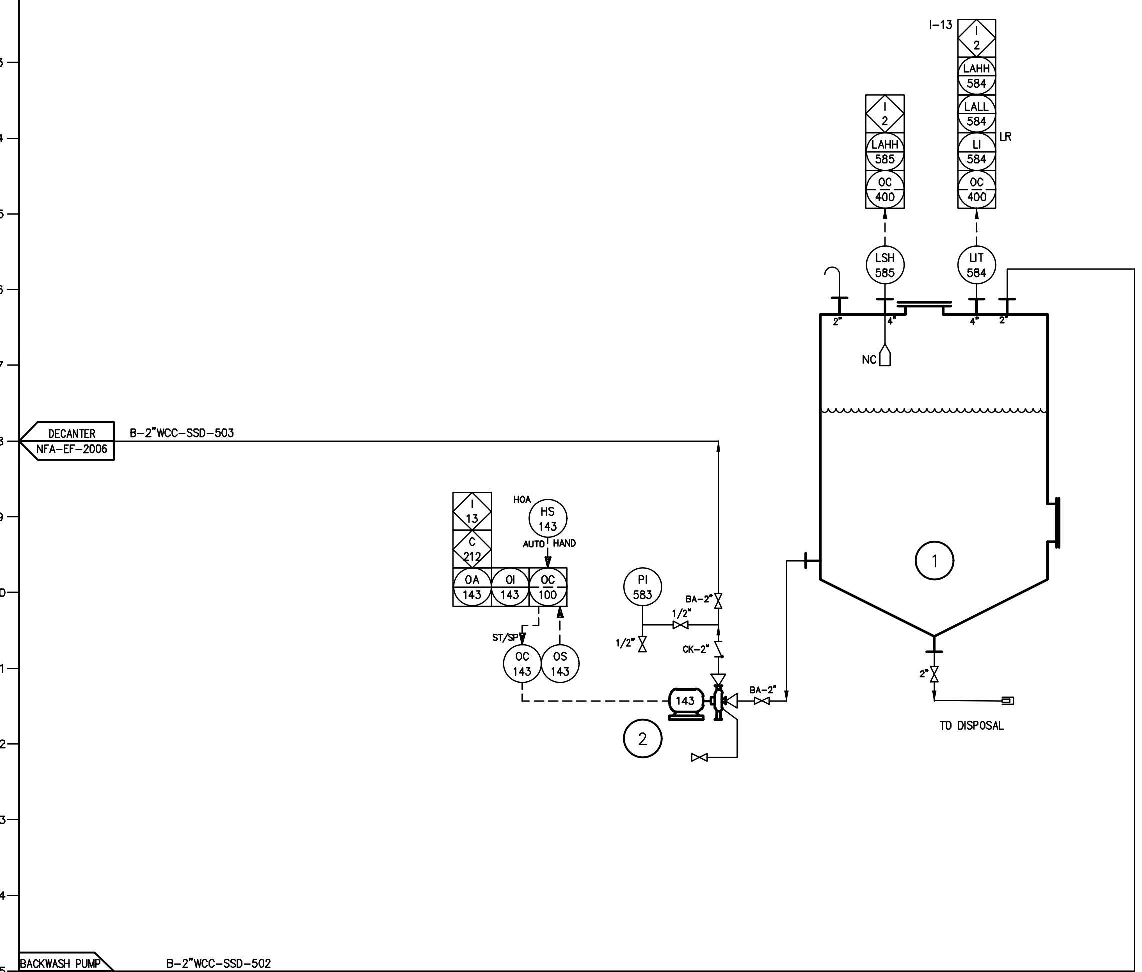
MILLER SPRINGS REMEDIATION MANAGEMENT, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
SAND FILTERS

DRAWN	SCALE NONE	APPROVED AS BUILT	DRAWING NUMBER NFA-EF-2019	REV 4
DATE	CHK'D	PROJ. NO 07478-00		

07478-00(068)EF\NFA-EF-2019 JUN 02/2016

PLANT ID.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME		BACKWASH TANK	BACKWASH TRANSFER PUMP																					
DESCRIPTION	MATERIAL	CS	CS																					
	SIZE	10'DIA. x 18'H	-																					
	CAPACITY	6,000 gal	65gpm @ 80FT TDH																					
	TEMP/PRESS	-	-																					
	HP/V/RPM	-	5/460/3600																					
	WEIGHT	-	-																					
	MANUFACTURE	-	GOULDS																					
	MODEL	-	-																					
	VENDOR	-	-																					



CONESTOGA-ROVERS & ASSOCIATES

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
3	9/10	J. EZAK	AS BUILT
2	4/09	JJ	AS BUILT
1	3/08	JJJ	ISSUED FOR CONSTRUCTION FLOW ZONE 1 DIVERSION

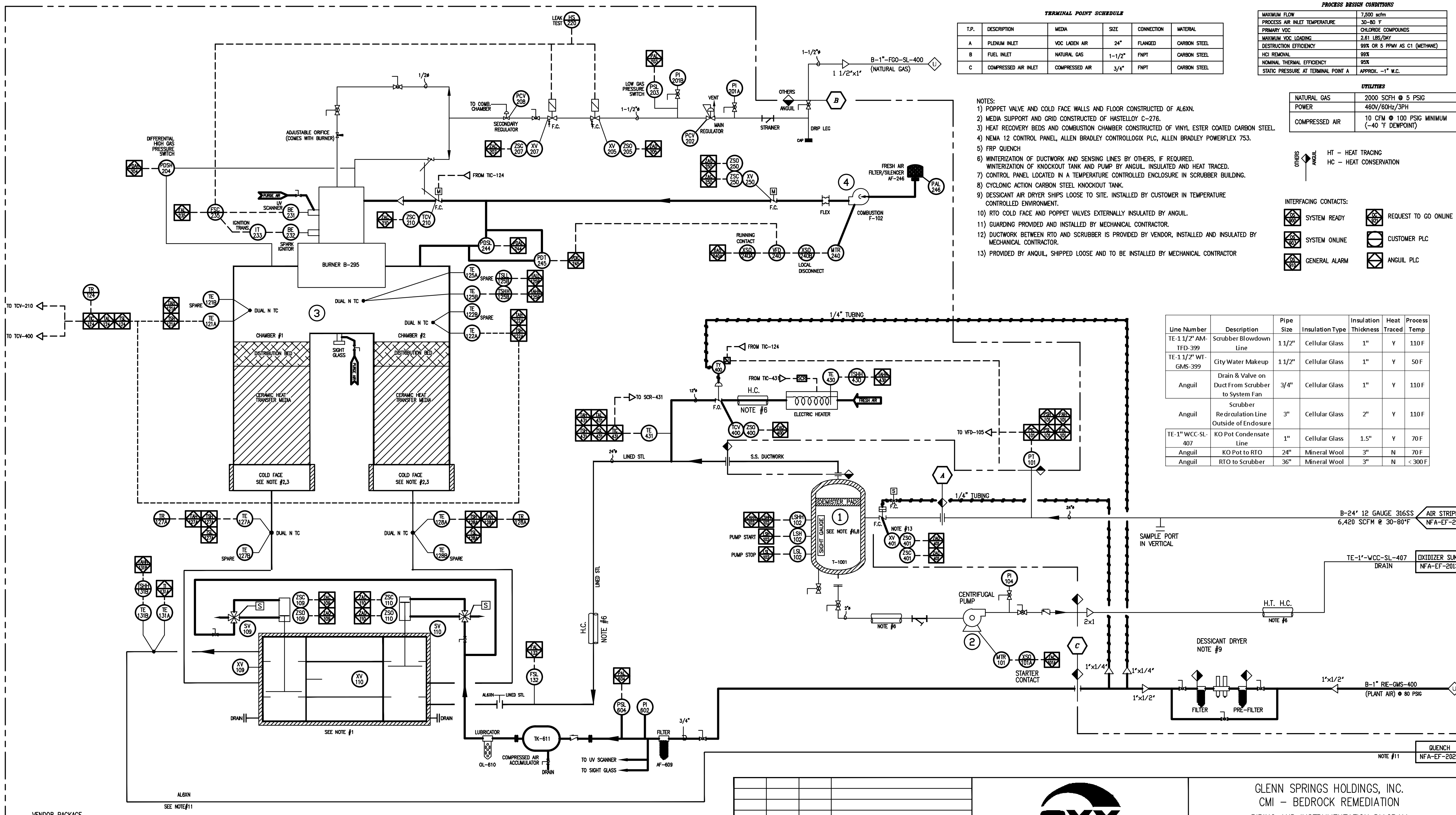
MILLER SPRINGS REMEDIATION MANAGEMENT, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
BACKWASH TANK

DRAWN	SCALE NONE	APPROVED	DRAWING NUMBER	REV
DATE	CHK'D	PROJ. NO 07478-00	NFA-EF-2020	3

07478-00(068)EF\NFA-EF-2020 JUN 02/2016

PLANT ID.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME		KNOCK-OUT POT	KNOCK-OUT POT CONDENSATE PUMP	REGENERATIVE THERMAL OXIDIZER	COMBUSTION AIR FAN																			
DESCRIPTION	MATERIAL	C.S.	316 STN STL	-	C.S.																			
	SIZE	60' ID x 96"	1x1 1/4x6	27FT x 17 FT	320 CFM																			
	CAPACITY	200 GAL	-	50,000 LBS	-																			
	TEMP/PRESS	-	-	-	-																			
	HP/V/RPM	-	.75HP	-	3/460/3600																			
	WEIGHT	-	-	-	-																			
	MANUFACTURE	ANGUIL ENVIR	GOULDS PUMP	ANGUIL ENVIR	TWIN CITY FANS																			
	MODEL	-	1ST1D5F4	RTO75	18N4,TBNA,CCW																			
	VENDOR	-	-	-	UBD DISC, ARR 4																			



TERMINAL POINT SCHEDULE

T.P.	DESCRIPTION	MEDIA	SIZE	CONNECTION	MATERIAL
A	PLENUM INLET	VOC LADEN AIR	24"	FLANGED	CARBON STEEL
B	FUEL INLET	NATURAL GAS	1-1/2"	FNPT	CARBON STEEL
C	COMPRESSED AIR INLET	COMPRESSED AIR	3/4"	FNPT	CARBON STEEL

PROCESS DESIGN CONDITIONS

MAXIMUM FLOW	7,500 scfm
PROCESS AIR INLET TEMPERATURE	30-80 °F
PRIMARY VOC	CHLORIDE COMPOUNDS
MAXIMUM VOC LOADING	2.61 LBS/DAY
DESTRUCTION EFFICIENCY	99% OR 5 PPMV AS C1 (METHANE)
HCl REMOVAL	99%
NOMINAL THERMAL EFFICIENCY	95%
STATIC PRESSURE AT TERMINAL POINT A	APPROX. -1" W.C.

UTILITIES

NATURAL GAS	2000 SCFH @ 5 PSIG
POWER	460V/60Hz/3PH
COMPRESSED AIR	10 CFM @ 100 PSIG MINIMUM (-40 °F DEWPOINT)

NOTES:
1) POPPET VALVE AND COLD FACE WALLS AND FLOOR CONSTRUCTED OF AL6XN.
2) MEDIA SUPPORT AND GRID CONSTRUCTED OF HASTELLOY C-276.
3) HEAT RECOVERY BEDS AND COMBUSTION CHAMBER CONSTRUCTED OF VINYL ESTER COATED CARBON STEEL.
4) NEMA 12 CONTROL PANEL, ALLEN BRADLEY CONTROLLOGIX PLC, ALLEN BRADLEY POWERFLEX 753.
5) FRP QUENCH
6) WINTERIZATION OF DUCTWORK AND SENSING LINES BY OTHERS, IF REQUIRED. WINTERIZATION OF KNOCKOUT TANK AND PUMP BY ANGUIL. INSULATED AND HEAT TRACED.
7) CONTROL PANEL LOCATED IN A TEMPERATURE CONTROLLED ENCLOSURE IN SCRUBBER BUILDING.
8) CYCLONIC ACTION CARBON STEEL KNOCKOUT TANK.
9) DESSICANT AIR DRYER SHIPS LOOSE TO SITE. INSTALLED BY CUSTOMER IN TEMPERATURE CONTROLLED ENVIRONMENT.
10) RTO COLD FACE AND POPPET VALVES EXTERNALLY INSULATED BY ANGUIL.
11) GUARDING PROVIDED AND INSTALLED BY MECHANICAL CONTRACTOR.
12) DUCTWORK BETWEEN RTO AND SCRUBBER IS PROVIDED BY VENDOR, INSTALLED AND INSULATED BY MECHANICAL CONTRACTOR.
13) PROVIDED BY ANQUIL, SHIPPED LOOSE AND TO BE INSTALLED BY MECHANICAL CONTRACTOR

OTHERS / ANGUIL
HT – HEAT TRACING
HC – HEAT CONSERVATION

INTERFACING CONTACTS:
SYSTEM READY
REQUEST TO GO ONLINE
SYSTEM ONLINE
CUSTOMER PLC
GENERAL ALARM
ANGUIL PLC

Line Number	Description	Pipe Size	Insulation Type	Insulation Thickness	Heat Traced	Process Temp
TE-1 1/2" AM-TFD-399	Scrubber Blowdown Line	1 1/2"	Cellular Glass	1"	Y	110 F
TE-1 1/2" WT-GMS-399	City Water Makeup	1 1/2"	Cellular Glass	1"	Y	50 F
Anguil	Drain & Valve on Duct From Scrubber to System Fan	3/4"	Cellular Glass	1"	Y	110 F
Anguil	Scrubber Recirculation Line Outside of Enclosure	3"	Cellular Glass	2"	Y	110 F
TE-1" WCC-SL-407	KO Pot Condensate Line	1"	Cellular Glass	1.5"	Y	70 F
Anguil	KO Pot to RTO	24"	Mineral Wool	3"	N	70 F
Anguil	RTO to Scrubber	36"	Mineral Wool	3"	N	< 300 F

CRA CONESTOGA-ROVERS & ASSOCIATES

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
2	06/02/16	MP	AS BUILT
1	01/16	JW	AS BUILT

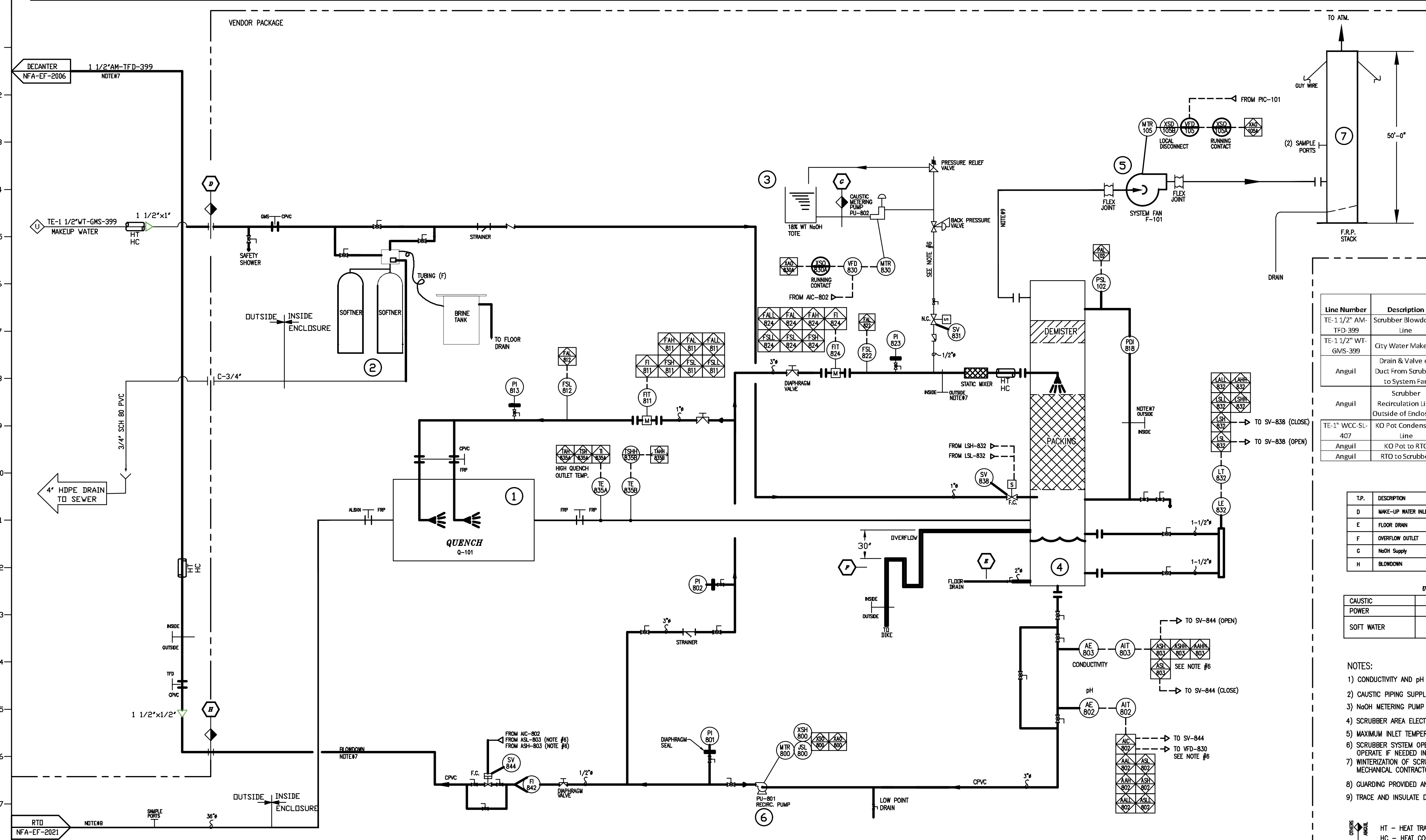
OXY

GLENN SPRINGS HOLDINGS, INC.
CMI – BEDROCK REMEDIATION
PIPING AND INSTRUMENTATION DIAGRAM
THERMAL OXIDIZER

DRAWN	SCALE	APPROVED	DRAWING NUMBER	REV
LVN	NONE		NFA-EF-2021	2
DATE 04/15	CHK'D	PROJ. NO 07478-00		

07478-00(068)EF\NFA-EF-2021 JUN 02/2016

PLANT ID.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NAME		QUENCH -	WATER SOFTENER SYSTEM	CAUSTIC ADDITION TANK & METERING PUMP (FUTURE)	PACKED BED COLUMN	SYSTEM FAN	RECIRCULATION PUMP	STACK																
DESCRIPTION	MATERIAL	-	-	-	FRP	FRP	-	FRP																
	SIZE	36' DIA x 4'-6'	-	-	54" ID x 20 FT	8668 CFM	2x1.5x6	24' DIA x 50 FT																
	CAPACITY	7500 SCFM	-	-	7500 SCFM	-	-	-																
	TEMP/PRESS	-	-	-	-	-	-	-																
	HP/V/RPM	-	-	-	-	75/460/1800	7.5 HP	-																
	WEIGHT	-	-	-	-	70 LBS	70 LBS	-																
	MANUFACTURE	ANGUIL	MARLO INC	-	ANGUIL	VERENTIS CORP	AWSIMAG PUMP	ANGUIL																
	MODEL	-	MATC-150-1	-	SPT-54-84	365T,CMMR-20,IV	KM2156-C04-AB-1	-																
	VENDOR	-	-	-	-	CCW,TAV,9H	-1-1-1-1-5-0	-																



INTERFACING CONTACTS:

- SYSTEM READY
- SYSTEM ONLINE
- GENERAL ALARM
- REQUEST TO GO ONLINE
- CUSTOMER PLC
- ANGUIL PLC

Line Number	Description	Pipe Size	Insulation Type	Insulation Thickness	Heat Traced	Process Temp
TE-1 1/2" AM-TFD-399	Scrubber Blowdown Line	1 1/2"	Cellular Glass	1"	Y	110 F
TE-1 1/2" WT-GMS-399	City Water Makeup	1 1/2"	Cellular Glass	1"	Y	50 F
Anguil	Drain & Valve on Duct From Scrubber to System Fan	3/4"	Cellular Glass	1"	Y	110 F
Anguil	Scrubber Recirculation Line Outside of Enclosure	3"	Cellular Glass	2"	Y	110 F
TE-1" WCC-SL-407	KO Pot Condensate Line	1"	Cellular Glass	1.5"	Y	70 F
Anguil	KO Pot to RTO	24"	Mineral Wool	3"	N	70 F
Anguil	RTO to Scrubber	36"	Mineral Wool	3"	N	< 300 F

TERMINAL POINT SCHEDULE

T.P.	DESCRIPTION	MEDIA	SIZE	CONNECTION	MATERIAL
D	MAKE-UP WATER INLET	SOFT WATER	1"	FLIP/SWE	CPVC
E	FLOOR DRAIN	SUMP SOLUTION	2"ø	FLIP/SWE	CPVC
F	OVERFLOW OUTLET	BLOWDOWN SOLUTION	2"ø	FLIP/SWE	CPVC
G	NaOH Supply	18% wt NaOH	1/2"	FLIP/SWE	CPVC
H	BLOWDOWN	BLOWDOWN SOLUTION	1/2"	FLIP/SWE	CPVC

UTILITIES

CAUSTIC	18% WT CAUSTIC
POWER	460V/60Hz/3PH
SOFT WATER	10 GPM @ 10 PSIG MINIMUM

NOTES:

1) CONDUCTIVITY AND pH SENSORS SHALL BE SUBMERGED IN SUMP LIQUID.
2) CAUSTIC PIPING SUPPLIED BY CUSTOMER SHALL BE OF SUITABLE CONSTRUCTION
3) NaOH METERING PUMP HAS MAXIMUM SUCTION LIFT CAPABILITIES OF 5 FT.
4) SCRUBBER AREA ELECTRICAL CLASSIFICATION NON-HAZARDOUS
5) MAXIMUM INLET TEMPERATURE TO QUENCH IS 300 DEGREE F.
6) SCRUBBER SYSTEM OPERATING WITHOUT CAUSTIC SYSTEM. PROVISIONS SUPPLIED TO OPERATE IF NEEDED IN FUTURE.
7) WINTERIZATION OF SCRUBBER PIPING OUTSIDE OF EQUIPMENT SHED BY MECHANICAL CONTRACTOR
8) GUARDING PROVIDED AND INSTALLED BY MECHANICAL CONTRACTOR
9) TRACE AND INSULATE DRAIN AND VALVE

OTHERS / ANGUIL

HT – HEAT TRACING
HC – HEAT CONSERVATION

CONESTOGA-ROVERS & ASSOCIATES

REV. NO.	REV. DATE	CHK'D BY	DESCRIPTION
2	06/02/16	MP	AS BUILT
1	01/16	JW	AS BUILT

GLENN SPRINGS HOLDINGS, INC.
CMI – BEDROCK REMEDIATION

PIPING AND INSTRUMENTATION DIAGRAM
SCRUBBER SYSTEM

DRAWN	LVN	SCALE	NONE	APPROVED		DRAWING NUMBER	REV
DATE	04/15	CHK'D		PROJ. NO	07478-00	NFA-EF-2022	2

07478-00(068)EF\NFA-EF-2022 JUN 02/2016

Appendix D
Interlock Summary Sheet

INTERLOCK SUMMARY FOR F-AREA AT OCC NIAGARA PLANT

INTERLOCK	DESCRIPTION	P&ID REF
01	Shutdown North Forcemain	NFA-EF-2002, 2003, 2004, 2005, 2006
02	Shutdown South Forcemain	NFA-EF-2003, 2005, 2006, 2019, 2020 and A-11-22118
04	Shutdown APL Transfer Pumps (M-113, M-124)	NFA-EF-2005, 2006, 2007, 2008, 2012, 2021
05	Stop Bleach Addition	NFA-EF-2005, 2006, 2007
06	Shutdown Air Stripper Blower (M-173)	NFA-EF-2008, 2021
07	Shutdown Carbon Feed Pumps (M-171 , M-172)	NFA-EF-2007, 2008
08	Close Oxidizer Process Inlet Valve	NFA-EF-2021
09	Shutdown Backwash Pump (M-132)	NFA-EF-2007, 2012
10	Shutdown Decanter Dike Sump Pump (M-134)	NFA-EF-2005
11	Shutdown Oxidizer Dike Sump Pump (M-164)	NFA-EF-2005, 2021
12	Shutdown Building Sump Pump (M-106)	NFA-EF-2005, 2007
14	Shutdown Wet Well 1 Pump (M-241LA)	A-11-22118
15	Shutdown Wet Well 2 Pumps (M-241RA, M-241RB)	A-11-22118
16	Shutdown MH-301 Pump (M-564)	NFA-EF-2002

Appendix E
Oxidizer Information

Section 2 | Process Description

The purpose of the ANGUIL oxidizer system is to destroy organic compound vapors from industrial processes prior to discharging them to the atmosphere. This destruction is accomplished by thermal oxidation.

This description is intended to familiarize the reader with the basic operation of the system from the standpoint of the control scheme as opposed to an analysis of chemical reactions or design parameters applied to mechanical aspects of the system.

Design Considerations

Thermal oxidation of hydrocarbons is a relatively straightforward process in concept. The air pollutants are raised to a temperature sufficient to oxidize (burn) them, converting the VOCs to carbon dioxide and water vapor. In practice, the actual operating thermal oxidizer's complexity results from design features incorporated to assure:

1. *Destruction Efficiency* - Compliant with applicable regulations. Destruction efficiency is indicated by the lower concentration of hydrocarbons in the cleansed air stream compared to the amount of hydrocarbons in the process stream entering the oxidizer.
2. *Fuel Efficiency*- Simple burning of the hydrocarbons without any recovery of heat from the system would consume large amounts of fuel to maintain the oxidation temperature. This unit has been designed with heat recovery to maximize fuel efficiency.

Destruction Efficiency

Destruction efficiency is achieved by maintaining two parameters. The first parameter is the required temperature. The hydrocarbons in the process stream must be raised to their oxidizing temperature. Temperature sensors and controls continuously monitor the temperature of the air in the oxidation chamber and modulate the fuel supply to the burner, increasing or decreasing it as needed to maintain a temperature sufficient to burn the pollutants, but not so hot as to physically damage the equipment.

The second parameter required for destruction efficiency is time. Burning (oxidation) is a chemical reaction. All chemical reactions take time, though to the casual observer some reactions, such as thermal oxidation, may appear to occur nearly instantaneously because this time is very short. The contaminated air stream must be held at a certain minimum temperature for a prescribed amount of time.

The function of the oxidation chamber of the oxidizer is to provide an area maintained at the required temperature across which the process air stream must traverse. Because it takes time for the air stream to pass through the oxidation chamber, the parameters of time and temperature are met.

The time required for proper destruction of the hydrocarbon contaminants, provided the necessary temperature is achieved, is referred to by designers and the regulatory agencies as "residence time". The Anguil thermal oxidizer is sized and designed based on airflow pressure and volume characteristics specific to the application.

When the thermal oxidizer is operated at or below its designed air flow rate, the process stream is held at the necessary temperature and takes sufficient time to pass through the oxidation chamber, resulting in the required destruction efficiency of VOCs to be met or exceeded.

If the volume of air per unit of time moved through the oxidizer exceeds the equipment design flow rate, the air may not be held at the oxidizing temperature for a sufficient amount of time to complete the hydrocarbon destruction. If the design flow rate is greatly exceeded, the burner may not be able to supply sufficient energy to raise the process air stream to the oxidizing temperature.

⚠ WARNING

For the above reasons, the stated design flow rate of the equipment should never be exceeded without first consulting Anguil Environmental Systems to determine the results. Proper VOC destruction may not be achieved, resulting in non-compliance with regulatory requirements and possible legal consequences.

Fuel Efficiency

Fuel efficiency is achieved by:

- *Providing for equipment turn-down.*

The oxidizer is designed to process, within certain limits, only the volume of air sent to it. When the process air volume is cut back, the oxidizer automatically reduces its gas firing rate and the speed of the main fan so that fuel is not wasted heating up a larger volume of air than is required. Also, when the equipment is first being heated prior to being placed into service, airflow volume is kept to a minimum so that the fuel burned is used to heat the equipment rather than a large stream of fresh air.

- *Conserving heat.*

The oxidizer consists of outer walls lined with high temperature insulation. This insulation's primary function is to conserve heat by containing most of the energy inside the oxidizer for VOC destruction, rather than allowing it to dissipate into the unit framework. Its secondary function is safety by protecting personnel and materials from the high temperatures within the oxidizer.

- *Heat recovered from the oxidation process.*

Much of the energy put into the process air stream to oxidize the VOCs , which results in the elevation of the stream's temperature, is still available after the hydrocarbons have burned. In addition, the VOCs themselves give off heat when oxidized, further elevating the air stream temperature. The process stream is hotter when exiting the oxidation chamber than when entering.

The oxidizer is equipped with two beds of ceramic packing which serve as heat sinks, scavenging much of the thermal energy from the process stream as it exits the oxidizer, cooling the exhaust stream and heating the packing.

The process stream enters the oxidizer through one bed of ceramic packing and exits through the other after the oxidation process is complete. When the ceramic packing in the exhaust bed becomes sufficiently hot as a result of heating by the oxidizer exhaust stream, the entering process stream is switched over to this heated bed. Passing through the heated bed, the incoming air stream's temperature is raised significantly. Therefore, only a small amount of additional heat must be supplied by the burner to raise the stream temperature to the oxidizing point with consequent savings in fuel consumption.

The process stream then passes through the oxidation chamber where the burning of the contaminants further raises the air temperature. It exits out the cooler ceramic packed bed, heating this bed up. Meanwhile, the bed through which the stream is entering is cooling because it is giving up its heat to the incoming process stream.

When the bed through which the exhaust is passing becomes sufficiently hot, the two beds again switch function, with the exit bed (now hot) becoming the entry bed and the entry bed (now cooled) becoming the exhaust bed.

Because the thermal energy of the system is being stored in a medium (the ceramic packing) and then subsequently released (regenerated) from this packing, this type of thermal oxidation is called “Regenerative Thermal Oxidation.”

General Process Description

During operation, the system fan pulls the process stream through the oxidizer, first through one bed of ceramic packing, continuing through the oxidation chamber, and finally out through the other bed of ceramic packing.

The VOC-laden air is heated as it passes through the entry ceramic bed and into the burner chamber where the burner, whose flame is supported by fresh air from a separate combustion fan, supplies additional heat as needed to elevate the air to the VOC oxidizing temperature.

The VOC-laden air then passes through the oxidization chamber where, maintained at a highly elevated temperature for a preset minimum amount of time, the VOCs are oxidized. An exothermic reaction takes place as heat is given off by this oxidation. The VOCs in the air stream are converted to carbon dioxide, HCl, and water vapor.

The hot, oxidized air then passes through the exit bed of ceramic packing, heating this bed as it exits. Finally, the oxidized air is passed through the scrubber system removing the HCl and exhausting it into the atmosphere.

After the entry bed cools sufficiently and the exit bed heats sufficiently, automatic valving is used to switch the direction of flow through the oxidizer, making the hot exit bed now the entry bed and the cooled entry bed now the exit bed.

Section 3 | Operational Overview

This section covers the general start-up, operation, and shutdown of the system. It is intended to explain to the reader in brief how the system operates, not how to operate the system. Information of interest to the operator is covered under the Operating Sequence (Section 5). However, any potential operator should read this section as well to understand the system.

START-UP

A number of conditions must be met in order for the system to be started. Fuel gas pressure must be within prescribed limits, the system fan must be running, and the fresh air inlet damper must be open. With these conditions satisfied, the following sequence occurs:

1. *Prove Combustion Airflow*

   The combustion air fan is started. A differential pressure switch must close to satisfy the controls that adequate pressure is being provided by the combustion blower to the burner. With this condition satisfied, start-up continues.

2. *Prove System Fan Airflow*

   The system air fan is started and the controls wait for flow switch to close to prove that the fan is providing its required air flow. Additionally, the controls monitor an excess negative pressure switch to assure that the negative pressure provided by the system fan is not so high that it may compromise the ductwork or oxidizer structural integrity. The system allows several seconds for airflow to be built up to prove one of the switches.

   Until any system inlet damper is opened, the controls hold the inlet dampers closed and hold the fresh air inlet open. The flow rate is at a minimum field adjustable value. This reduces air volume at start-up so that the fan is not burdened with a full flow start and an excessive amount of fuel is not used to heat the system. A higher airflow would necessitate more gas to heat the start-up air volume. With air proven and negative pressure within bounds, start-up continues.

3. *Burner Lighting*

   The controls enable the Flame Supervision Controller. After purging the combustion chamber for a prescribed time, the controller lights the burner pilot. With the pilot flame proven, the controls then open the main gas valves to feed fuel gas to the burner, completing the lighting sequence. The burner lighting is carried out in a prescribed order required by the National Fire Protection Association (NFPA). The controller monitors the flame, and will shut the burner down if at any time it fails to detect a flame. For more details, see the Control System Components (Section 5).

4. *System Heating*
   Upon opening of the main gas valves, a PID type loop controller assumes control of the firing rate control valve actuator, which modulates the combustion air and simultaneously, via mechanical linkage, the fuel gas flow to the burner, to achieve and maintain system operating temperature. The firing rate control uses the oxidation chamber temperature, monitored via a thermocouple sensor, as its process variable and provides a 4-20mA DC output to the firing rate actuator.

5. *System Ready Operating Temperature*
   The controls also monitor the oxidation chamber temperature and the two ceramic-packed chamber temperatures and close switches when the temperature in the chamber and the two ceramic-packed beds reach the proper oxidation temperature. When this "system ready" temperature is reached, the controls change the ready signal within the PLC to indicate the system is ready. The system ready temperature is defined as the temperature at which the VOCs will be oxidized in the chamber, assuming proper residence time is provided.

   When any system inlet damper is proven open via a position switch, the controls automatically drive the fresh air inlet damper closed. Once the inlet damper is proven open, the variable speed drive control is released from minimum speed to PID loop control. The system fan speed is allowed to module to maintain system inlet negative pressure as the system process inlet volume changes.

ON-LINE

Once any system inlet is opened and the oxidizer reaction chamber is at operating temperature, the oxidizer may be considered to be on-line. On-line, the varying parameters are system fan speed, firing rate valve position, and the repeated valve switching to reroute the process stream in one ceramic packed bed and out the other, and then reversal of this valving to alternate the inlet-outlet function of the two ceramic beds.

Once the system is on-line, if the oxidation chamber temperature drops below prescribed limits, the hard-wired contact limit string will open and the system will require a re-purge before the burners can be re-lit. The system fan speed will move to minimum, as at start-up, and the system would essentially be idling until the system ready temperature condition is again established.

While on-line, the controls continue to monitor the various system operational limits as at start-up. Loss of any of the system limits will result in system shutdown with alarm notification.

SHUTDOWN

Exclusive of safety shutdowns (see Set Points & Alarm Condition - Appendix B), normal system shutdown is a controlled shutdown process initiated by the push-button. When initiated, the shutdown process is as follows.

1. The fresh air inlet damper is opened and the system fan assumes its minimum speed.

2. The burner continues to operate at the set point temperature for two (2) minutes or more (adjusted at start-up by the Anguil technician). The purpose is to purge the oxidizer of any VOCs. At the end of this time period, the burner is automatically shut off.

3. The fans continue to run until a preset limit is reached within the oxidation chamber, between 800°F and 1000°F. The purpose is to provide a short cool down period so the high temperature air does not radiate heat back to the fans or burner, NOT to cool the unit down to ambient. The unit should cool down slowly and naturally, not through forced air provided by the fans. Force cooling is acceptable only if system entry is required for maintenance.

Section 4 | System Components

The components listed here are the functional blocks of the Anguil system. They represent hardware and associated controls and control concepts.

SYSTEM FAN

The system fan is located at the outlet to the scrubber. It induces a negative pressure on the ductwork to serve as the motive force to move air through the system with its associated drive mechanism and controls. Additionally, it is sized to provide suitable flow through the system under all design conditions. The amount of flow is controlled by a pressure loop control based upon the vacuum sensed in the inlet header.

NOTICE

It is important to read and understand the fan manufacturer's service and maintenance instructions provided in this manual.

Proper lubrication, belt tension, and preventative maintenance will help insure longer life for your fan. Refer to the maintenance and trouble shooting sections of the fan manufacturer's instructions for proper procedures.

Failure to follow correct maintenance instructions could void the fan manufacturers warranty.

COMBUSTION FAN

The combustion fan consists of a centrifugal blower, which is designed for lower air volume at high pressures. The fan provides air to the burner required for combustion.

VALVES/DAMPERS

FRESH AIR INLET DAMPER

The fresh air inlet damper and actuator are mounted on the inlet duct. The oxidizer must be started and heated up, using an air stream of fresh air only. Among the reasons for this requirement is that the oxidizer cannot destroy the VOCs until it reaches adequate temperatures, thus the process stream cannot be passed through the unit during heat-up. The fresh air inlet is maintained open as a default position, is always open during start-up, and is closed only if any process inlet is opened. Conversely, if at any time all process inlets are closed, the fresh air damper is again opened. In this way, a necessary movement of air is always assured through the oxidizer. The action of the fresh air damper is controlled automatically from the control panel.

SYSTEM INLET

The system inlet, located on the system process inlet ductwork, is opened to allow the process stream into the oxidizer. Conversely, it is closed to isolate the oxidizer from the process stream, as when the oxidizer is not on-line. The system inlet is maintained closed as a default position and are allowed to be opened only when the oxidizer is on-line (processing).

When an inlet is opened, the fresh air inlet closes.

The action of the system inlet valve is controlled automatically from the control panel. The dampers' opening is initiated by the operator closing a switch on the main control panel. If this switch is made, the controls then open the valve automatically, if the oxidizer is up to operating temperature and functioning properly.

INLET AND OUTLET DIVERTER VALVES

The oxidizer is equipped with an inlet and an outlet diverter valve. Each of the valves has a control solenoid valve. The inlet valve receives the process stream from the ductwork and directs this stream to one of the two ceramic heat recovery beds (See Heat Recovery below). The outlet valve receives the oxidizer exhaust stream from either ceramic bed and exhausts that stream to the exhaust stack.

The state of each valve's controlling solenoid valve determines the direction of the process stream. In one state, the process stream is directed into one heat recovery bed (Bed A) while the exhaust stream is directed to the outlet valve out of the other heat recovery bed (Bed B). This has the effect of cooling the inlet bed as the inlet stream scavenges heat from that bed, and of heating the outlet bed as the hot exhaust passes through it.

The valves change state based on time. After a short period of time, Bed A has become too cool to provide much heat to the inlet stream, while Bed B has become quite hot. The solenoid valves switch the porting of the inlet and outlet valves to direct the process stream into the now hot bed and out of the now cooled bed.

The hot bed (Bed B) now gives up its heat to the inlet stream, while the colder bed (Bed A) is becoming heated by the exhaust stream. After the same time period has again elapsed, the valves switch back to their original state.

This back-and-forth switching between beds, making each bed serve time as the inlet and outlet, conserves large amounts of heat, providing nominal heat exchange efficiencies of up to 99%.

FIRING RATE VALVE

The burner controls include a modulating firing rate valve that governs the amount of air and fuel to the burner based on the signal from a temperature control loop within the PLC to control the system temperature.

EXCESS NEGATIVE PRESSURE SWITCH

The system excessive negative pressure switch alerts the controls to a high negative pressure, or vacuum, impressed on the plenum, upstream ductwork, scrubber, and oxidizer by the system fan. It causes the controls to shut down the system fan, the motive force providing the vacuum, should such a condition occur so that ductwork integrity is not compromised.

HEAT RECOVERY

To maximize energy efficiency and utilize the energy content of the organic vapors, a heat exchanger is used to preheat the incoming process air stream. Employment of a heat exchanger reduces total system operating costs.

The heat recovery consists of two chambers filled with ceramic packing. The oxidizer inlet and exhaust pass through these chambers.

These two chambers alternate functions with each other. One is the inlet to the oxidation chamber while the other is the outlet. Then, through the movement of valving, the process stream path is reversed with the inlet chamber becoming the outlet, passing the exhaust stream to the exhaust stack, and the outlet now functioning as the inlet, conducting the process stream into the oxidizer.

The incoming air passes through the ceramic packing of the inlet chamber. As the hot exhaust passes through the ceramic packing of the exit chamber, the ceramic absorbs the heat of the exhaust stream.

When the two ceramic-filled chambers switch function, the inlet stream now passes through the ceramic which was just previously heated by the exhaust stream. Meanwhile, the ceramic packing, which had just previously served as the inlet bed, is now absorbing heat from the oxidizer exhaust.
After a short period, the chambers again switch function. Thus, the inlet stream is always passing through a bed of ceramic recently heated by the oxidizer exhaust stream.

This preheating of the inlet stream saves a significant amount in fuel consumption to operate the oxidizer. This form of heat exchange is referred to as regenerative heating because the available heat is being stored and later released from a storage medium (the ceramic packing).

HEAT RECOVERY CHAMBERS

The heat recovery chambers hold the ceramic packing described above. The heat recovery chambers are constructed entirely of 7GA thick vinyl ester interior coated carbon steel plate and are lined with high-density ceramic fiber insulation with varying thickness depending on the heat requirement at the specific depth within the chamber.

OXIDATION CHAMBER

The oxidation chamber is constructed entirely of 7GA thick vinyl ester coated carbon steel plate and is lined with eight inches of high temperature ceramic fiber insulation.

BURNER AND IGNITION

The oxidizer is equipped with a nozzle-mixing type burner. The burner capacity and fuel requirements are listed on the Specification Sheet in this manual (Section 1-5).

The burner and associated controls combust a fuel-air mixture to provide the initial driving heat to the system. The burner and ignition controls are designed to various code requirements and include specialized supervisory devices and instrumentation required for safety. The controls include a modulating firing rate valve and temperature loop controller to modulate the volume of fuel going to the burner.

FUEL TRAIN

The fuel train consists of the piping, valving, and safety switches, which conduct fuel gas into the burner. It is built to applicable FM standards and includes:

- Pressure regulators to reduce pressure from supply pressure down to draft range pressures usable within the combustion chamber
- Gas shut-off valves on the main gas line to conduct fuel to the burners or isolate fuel from the burners
- Safety switches to assure that gas pressure remains within safe limits

Individual fuel train components are discussed in more detail in the Control Components section (Section 4) of the manual.

VARIABLE SPEED DRIVE

A variable speed drive modulates the speed of the system fan in response to a pressure control set point that maintains a constant pressure in the ductwork.

As the drive increases the fan speed, the system fan induces more vacuum on the ductwork. As the fan speed is decreased, less vacuum is induced on the ductwork by the system fan.

The combustion air fan is also controlled by a VFD to ensure proper air/fuel ratio during burner operation.

CONTROLS

The main control panel contains the essential control components of the system that carry out the primary actuation of all operating devices on the oxidizer, including signaling motor starting and stopping, moving and modulating damper positions, monitoring temperatures, and taking action accordingly. More detail regarding these components is available in the Control Components section (Section 4). The main control panel also houses the control transformer, the combustion blower VFD, the flame safety circuitry for the oxidizer, and the variable speed drive (VFD) for the system fan.

Section 5 | Control System Components

The control system is comprised of many components. For a complete list, see the system process and instrumentation diagram, electrical schematics, and control panel layout drawings. However, several components are of special interest with regard to understanding of the system control, maintenance, and operation. These are covered here separately.

Fuel Train

The fuel train consists of the piping, valving, and safety switches that conduct fuel gas into the burner and is built to applicable FM standards. It is comprised of the following components:

Main Gas Regulator

The main gas regulator reduces the gas pressure from supply pressure and maintains it at a lowered value outlet of the regulator for control and metering to the burner.

Secondary Gas Regulator

The secondary gas regulator is back-loaded to the combustion chamber so that the gas flow is consistent even with changing pressures in the combustion chamber.

Low Gas Pressure Switch

The low gas pressure switch is a safety device that shuts down the burner if the gas pressure downstream of the main regulator is below a preset value.

High Gas Pressure Switch

The high gas pressure switch is a safety device that shuts down the burner if the gas pressure downstream of the main regulator exceeds a preset value.

Main Shut-Off Valves

The burner fuel train contains a set of two (2) blocking safety shut off valves with limit switches. These valves are used to block the fuel from entering the RTO. The flame safety controller controls the operation of these valves.

Air Firing Rate Valve (TCV-210)

The air firing rate valve modulates the combustion airflow and pressure delivered to the burner based upon a signal from the inlet temperature controller.

Gas Flow Meter

The gas flow meter provides natural gas flow rate measurement information to the burner to increase maximize fuel efficiency.

Gas Firing Rate Valve

The gas firing rate valve modulates the natural gas flow and pressure delivered to the burner based upon a signal from the inlet temperature controller.

Flame Supervision Control

The burner system is controlled by an electronic flame safeguard controller in compliance with NFPA regulations. The controller controls lighting and shutoff of the burner and monitors the flame emanating from the burner.

The flame controller controls the entire lighting sequence of the burner and monitors the flame strength during the entire burning cycle. The flame strength is monitored via a device called an ultraviolet scanner (UV scanner), which observes ultraviolet radiation from the flame.

The burner includes a minimum fire bypass around the gas firing rate valve. Therefore, the burner lights when the main fuel safety shutoff valves are opened.

NOTICE

> The use of the flame supervision controller on this application is mandated by regulation and of extreme importance in safe operation of the unit. It should never be removed from the control circuit nor should any attempt be made to light the burner bypassing the controller.

The flame controller provides the following flame control sequence:

1. A pre-purge time.

2. Trial for ignition of the burner flame for ten (10) seconds. The gas valves are opened and the ignition transformer is energized to create an arc at the spark igniter.

3. After the flame is proven, as indicated by the burner's UV scanner, the flame controller opens the main gas valves and releases the burner to automatic temperature control.

4. If at any time during the burner cycle, the flame strength falls below preset and unalterable limits, the flame controller immediately closes the main gas valves, extinguishing the flame.

5. If at any time during the burner cycle, any of the defined flame limits are tripped (virtually any oxidizer alarm condition), the start signal to the flame controller is opened. This de-energizes the flame controller, which in turn closes the gas valves, extinguishing the flame.

Fresh Air and Process Stream Control

The system is provided with dampers and damper actuators, which serve to control and direct fresh air and system process inlet streams.

The inlet damper is closes anytime the oxidizer is not on-line. This includes the condition in which the oxidizer is simply shut down, anytime the oxidizer is experiencing an alarm condition, and while the oxidizer is heating up prior to going on-line.

The system inlet damper and driving actuator (one for each process line) conduct the process stream into the oxidizer.

Placing the oxidizer on-line, thus opening the system inlet damper, is semi-automatic, requiring the operator to throw a switch. The actual opening of the damper is automatic via its motorized actuator. The damper remains closed regardless of switch position if the oxidizer is locked out from being on-line. This includes the condition in which the oxidizer is simply shut down, anytime the oxidizer is experiencing an alarm condition, and while the oxidizer is heating up prior to going on-line.

The fresh air valve remains open until the oxidizer is placed on-line. Prior to the oxidizer burner being placed on-line, the fresh air valve must prove open via a position switch in order for the controls to allow lighting of the burner. The assures that only fresh air passes through the oxidizer until it is up to operating temperature and can oxidize the VOCs in the process stream.

Flow Control

The system accommodates varying process flow rates, processing only the volume of air sent to it from the VOC stream source. This is achieved by maintaining a constant negative pressure in the system inlet assembly. As more air is sent to the inlet from the process, the pressure transmitter adjusts by increasing the speed of the system fan.

Pressure Controller & Transmitter
A pressure sensor connected to taps on the system inlet assembly senses the pressure and, via an internal transducer and electronic amplification circuitry, produces a 4-20mA signal proportional to the plenum pressure.

A loop controller in the PLC receives the pressure transmitter 4-20mA signal, executes the control algorithm, and transmits a 4-20mA control output to the final control device to drive the duct pressure back to its set point.

Variable Speed Drive
The system fan variable speed drive controls the flow rate by modulating the system fan speed. As the static pressure transmitter output signal changes (increases or decreases), the fan speed modulates (speeds up or slows down).

While the unit is heating up on fresh air, the air flow rate is held to a low value to bring the oxidizer up to operating temperature at a controlled rate. The pressure control loop is not active during system heat-up.

The combustion air fan is also controlled by a VFD to ensure proper air/fuel ratio during burner operation.

Firing Rate Control Valves
The firing rate valves are modulating valves which vary the amount of fuel supplied to the burner to control the temperature to which the combustion chamber is heated. They are controlled by the temperature control loop, explained below in the Temperature Control section. They modulate in response to a 4-20mA signal.

Combustion Air Valve
A combustion air valve is also provided to control the introduction of fresh air and fuel to the burner. The positioning of this valve is related to the fuel firing rate valve so that the burner air and gas ratio is held in a proper balance. The control signal operates a single actuator which, via mechanical linkage, opens or closes both the combustion air and fuel gas inlets. The combustion air and fuel gas inlets are held in proper ratio by mechanical balance of the relative positions of the fuel and air valves via the gas proportioning valve.
The temperature control loop is released to module, however, only after the main flame of the burner is lit. Prior to burner lighting, the controls hold the firing rate valve closed.

Temperature Control

Temperature control is one of the most critical functions of an oxidizer. The driving force for the functioning of an oxidizer is heat. With relatively high operating temperatures, care must be taken to carefully control these temperatures to prevent damage to components.

With temperature as critical as it is to the system, the issue of temperature control is lengthy here. In addition, the various elements of temperature control applied in the oxidizer are dealt with separately under this section for clarity.

Temperature control encompasses the monitoring and acting on temperatures of the air stream in the oxidation chamber and in the dilution air ductwork. These temperatures are used to:

- Control the heat up of the oxidation chamber to VOC oxidation temperature.
- Maintain the oxidation chamber temperature while on-line.
- Detect when oxidation temperature has been reached in order to determine when to introduce the process stream into the oxidizer.
- Alarm a high oxidation chamber temperature condition and shut off the burner in order to protect the system from over temperature.
- Alarm a low inlet temperature condition to ensure adequate preheat of the process gasses prior to entering the RTO.

The devices used to sense the air stream temperature at the oxidization chamber and below the media beds, also known as the cold face, are thermocouples.

The thermocouple assemblies consist of thermocouple junctions and wire protected within the oxidizer by sheathing, with the thermocouple leads terminated outside the oxidizer in standard industrial-type thermocouple heads.

The thermocouples produce a small electrical potential, in the range of 300 millivolts (mV) non-linearly proportional to the temperature. This small voltage signal is fed to the receiving devices on the main control panel.

Two thermocouples are housed in a single sheath toward one end of the oxidation chamber and an identical thermocouple pair is also located toward the other end of the chamber. Thus, there is a total of four thermocouples sensing the oxidation chamber temperature contained in two housings, one located at each end of the oxidation chamber (TE121A/B, TE122A/B). Two thermocouples contained in such a single housing are called dual thermocouples.

One each of the dual thermocouples located at opposite ends of the oxidation chamber are wired to the PLC for temperature control of the oxidation chamber via the temperature control loop. The other thermocouple sensor is a spare.

One separate dual thermocouple (TE125A/B) is used for a special high temperature alarm switch called the high temperature limit controller, which shuts the oxidizer down in the event of over-temperature. An additional temperature switch is used for detecting when the oxidation chamber is up to operating temperature.

Two additional dual thermocouples (TE127A/B, TE128A/B) are located in the media bed cold face.

One additional dual thermocouple is located on the poppet valve outlet (TE131A/B).

Two single element thermocouples are located near the fresh air heater. One high temperature K-style single thermocouple is located in the electric heater (TE430) while the other N-style single thermocouple is located in the ductwork (TE431).

The controls sense the thermocouple millivolt signal and translate it into a temperature which can be viewed by the operator on the control display. The two temperature control devices are called out individually later in this section on CONTROLS, but their function in overall temperature control is dealt with below.

1. *Control heat-up to oxidizing temperature.*

The VOCs will not be adequately destroyed unless the oxidation chamber is at the proper temperature for the VOCs being treated. The primary function of the controls during the heat-up stage is to heat the oxidation chamber and surrounding insulation of the oxidizer to operating temperature.

This is distinguished from the temperature control during operation, in which the oxidizer is up to operating temperature and the primary intent is to heat the process air stream up to this temperature.

Though the intent during heat-up is to heat up the ceramic beds and metal rather than air, it is a stream of fresh air which is used as the medium to transport this heat. The process variable controlled is the temperature of the air exiting the burner chamber. The final control device is the firing rate valve, which modulates the amount of fuel and air supplied to the burner.

The controller uses a PID algorithm to determine control output to the final control device. The controller's output is a 4-20mA signal to the firing rate valve actuator.

Once the main gas shut-off valves are opened, the controller signal is released to modulate the firing rate valve to establish and maintain operating temperature.

2. *Maintain oxidizing temperature while on-line.*

Once the oxidizer is on-line, the unit is already up to oxidizing temperature. The primary function of the temperature control at this point is to heat the process air stream entering the unit to the oxidation temperature. The process air stream is partially heated by the heat given off through oxidation of the VOCs in the oxidation chamber, which is transferred to the incoming air stream via the heat recovery media. The burner supplies the additional heat needed.

Since the amount of heat released by oxidation varies with the amount of VOCs in the air stream, and since this VOC concentration typically varies in industrial processes, the amount of preheating available from the media is variable. Thus, the amount of heat supplied by the fuel train system must also vary. The temperature control continuously monitors the temperature sensed in the oxidation chamber and modulates the firing rate valve to vary the gas supplied to maintain the temperature set point.

3. *Detect when the oxidation temperature has been reached.*

The oxidizer temperature must be at the minimum operating point relative to the air stream's residence time in the chamber to destroy the VOCs at the level required by the user. This minimum operating point is defined by the chamber temperatures being at prescribed set points for a prescribed time period. When the PLC receives the signal that these parameters are met, it will allow the process stream into the oxidizer.

Prior to reaching this temperature such as during start-up, the VOCs are kept out of the air stream and the oxidizer passes only fresh air. After the oxidizer reaches the “ready temperature,” the PLC allows the process inlet damper to open.

4. *Alarm a high chamber temperature condition.*

If the control loop is mis-tuned, or the firing rate actuator malfunctions, or the control set point is established at too high a value resulting in a chamber temperature potentially high enough to cause damage, a high chamber temperature condition will result. Additionally, since added heat is given off by the oxidation reaction, an overly high VOC loading could result in oxidation chamber over-temperature even with loop tuning and control devices operating properly. In order to prevent this, the PLC is programmed to alarm at high alarm temperature. This alarm automatically disables the burner and places the system in alarm.
Additionally, a second device called the high temperature limit controller is incorporated as a redundant temperature safety switch. This control includes a normally closed switch, which

opens when a high temperature set point is exceeded. This switch opening immediately disables the burner and places the oxidizer in alarm status.

High Temperature Limit Control

As mentioned above, the oxidizer is equipped with a temperature limit control device. This high temperature limit controller is FM approved specifically for such duty.

The power to the flame safety controller is hardwired through normally closed contacts on the high limit control such that should a temperature exceeding the high limit controller set point exist in the oxidation chamber, the limit controller goes into lockout and opens the contacts. This immediately shuts off fuel to the burner.

Being hardwired directly into the burner circuit, unlike the other high temperature alarm in the PLC, this safety function does not depend on the programmable controller software to turn off the fuel to the burner.

It is a failsafe device in that failure of the controller or failure of the temperature sensing thermocouple results in the opening of the limit contacts and consequent shutting off the burner blocking valve as though a high temperature were reached.

If the high temperature limit controller trips, the device remains in the lockout condition until manually reset by the operator. It will not reset if the high temperature condition still exists.

NOTICE

The use of the high temperature limit controller on this application is of extreme importance in safe operation of the unit. It should never be removed from the control circuit. The thermocouple feeding its input must never be shared with any other device, nor should its limit set point be raised without first consulting Anguil Environmental Systems.

Chart Recorder

The control panel is equipped with a digital chart recorder, which charts numerous RTO variables. Combustion chamber temperature is normally a required record-able temperature to satisfy local authorities.

The recorder is equipped with flash card memory and is field adjustable. The charting of the oxidation chamber temperature is useful in monitoring and trouble-shooting oxidizer performance.

Programmable Logic Controller

See electrical schematics for controller and I/O details.

The PLC receives analog and discrete inputs from the various system transmitters and outputs discrete and analog signals to devices controlled. The program logic controls the overall system operation. All timing and alarm detection and annunciation control reside in the PLC. A digital display, used to annunciate alarm conditions, is driven and controlled by the PLC.

Digital Display

A digital display and touchscreen is provided, which annunciates alarm conditions, provides some on-line start-up instructions, and via the touchscreen, allows the operator to view a limited number of program timer set points.

Appendix F
Scrubber System Information

Section 2 | System Description

The purpose of the scrubber system is to further destroy caustic chemicals, such as hydrochloric acid, from the industrial processes prior to discharging them to the atmosphere.

This description is intended to familiarize the reader with the basic operation of the system from the standpoint of the control scheme as opposed to an analysis of chemical reactions or design parameters applied to mechanical aspects of the system.

DESIGN CONSIDERATIONS

The HCl Quench/Absorber unit consists of a quench tower and a scrubber tower (the words absorber and scrubber will be used interchangeably throughout this manual) sharing a common sump. Hot, HCl-laden air enters through an inlet at the top of the FRP quench section. A hastelloy teflon nozzle provides a high-pressure spray into the quench tower. The mixing of the hot air and spray in the tower also lowers the air temperature through the mechanism of evaporative cooling.

The air passes over the sump water and into the absorber tower inlet. The air temperature should now be approximately 107°F. The HCl fumes are removed in this stage and the scrubbed air exits through the outlet.

THEORY OF OPERATION

As the name implies, there are essentially two processes occurring in the Quench/Absorber unit. Although there is a small absorption effect in the quench stage and some cooling in the scrubber stage, the two processes will be treated as separate.

QUENCHING

The temperature of the air stream entering the Quench/Absorber unit must be lowered in order to:

- Prevent the fiberglass unit from being over-heated
- Allow the air stream to be effectively scrubbed

The temperature reduction is achieved by the mechanism of the evaporative cooling. In this process, latent heat in the air stream is used to evaporate a quenching spray with an accompanying temperature reduction in the air.

The minimum achievable temperature due to evaporative cooling is the wet bulb temperature of the air stream. Knowing the air inlet volume and temperature, one can refer to the Psychrometric Chart to find the wet bulb temperature and other factors, such as the humid volume of the air at the inlet temperature, the humid volume at the outlet (wet bulb) temperature, and the specific humidity of the air. These factors are used to calculate the water usage necessary for complete evaporation of the quench spray.

The most important factors of the quench mechanism are quantity and size of the water droplets in the quenching spray. The droplets must have a large ratio of surface area to volume, so they must be of a small average diameter.

WET SCRUBBING

Fugitive emissions are collected in a wet scrubber by one or more of the following three principles of collection:

1. *Inertial Impaction*
   The fugitive emission having a mass sufficient to cross air stream boundaries in a torturous path and impact on the packing media.
2. *Direct Interception*
   The fugitive emission does not necessarily cross air stream boundaries, but simply touches the media and becomes absorbent solution.
3. *Brownian Movement*
   The fugitive emission having insufficient mass to be affected by the above has substantial movement imparted to it by the collision with air molecules. This active displacement causes the fugitive gas to pass into and become part of the liquid molecule.

The basic purpose of the scrubber packing is to offer a torturous path to the fugitive emission to effect operation of one or more of the above mentioned collection principles. The packing is irrigated to wash away the now entrained gas. The packing provides the physical/chemical interface for entraining the gas.

NEUTRALIZATION

In a wet scrubber, the irrigating solution is usually maintained at a specific pH. In this case, there is an optional caustic injection used for scrubbing HCl and maintaining a pH greater than 7. The scrubber will operate as an acidic scrubber initially running around a pH of 2. The pH will be controlled using a continuous blow-down.

After neutralization using the caustic option, NaC1 or table salt is formed. This salt is removed from the circulating solution and discharged to the sewer. Excessive build up of salt will cause precipitation in the scrubber. A high conductivity alarm is provided to indicate that salt build up is excessive.

The salt content is controlled by adding fresh water to the scrubber sump. This will produce an overflow of scrubber water to the sewer.

Section 3 | System Installation and Operation

This section covers the general start-up, operation, and shut-down of the scrubber system and how it works in concert with the ANGUIL RTO unit. Information of interest to the operator is covered under the Operating Sequence (Section 5). However, any potential operator should read this section as well to understand the scrubber system.

START-UP AND OPERATION

1. Connect soft water at the pressure required from the operation parameters to the make up water manifold piping.

⚠CAUTION

Care should be taken not to run the recirculation pump dry or damage could result.

2. Connect a grounded power source of the proper voltage and phase. Check recirculation pump motor for proper rotation.

NOTICE

It is important to read and understand the *recirculation pump and caustic metering pump* manufacturer's instructions provided in this manual.

Proper maintenance will help insure longer life for the recirculation pump. Refer to the servicing assembly/ disassembly sections of the recirculation pump manufacturer's instructions for proper procedures.

Failure to follow correct maintenance instructions will void the recirculation pump manufacturer's warranty.

3. Connect the sump blow-down line to the export piping

⚠CAUTION

> The oxidizer must shutdown upon scrubber shutdown. High temperature vapor from the oxidizer will severely damage the scrubber if quench water is not circulating.

4. Prime the caustic metering pump. This may be accomplished by plugging the pump into a 115V un-switched receptacle and putting the "Auto/Off/On" switch on the face of the pump to the "On" position. Place the suction wand into the chemical and allow to pump until air is out of the suction line.

⚠DANGER

> Caustic solution is a **HAZARDOUS** chemical. Use protective clothing when working in a caustic area.

5. Provide the caustic metering pump with a 115V power cord. Plug the 4-20 mA signal cable from the pH controller into the appropriate jack on the front of the metering pump. Set the stroke to about 80%. Set the "Auto/Off/On" switch on the face of the pump to "Auto" position.

⚠WARNING

> Based on field experience, it is recommended that a 25% NaOH solution be used.
>
> Always use distilled water when mixing your own solution. Solution mixing should take place at temperature conditions >20°C and making certain that adequate mixing is achieved.
>
> Use of 50% NaOH solution or improper mixing procedure may result in precipitation of solids and subsequent fouling of the pump, recirculation piping and nozzles.

6. Ascertain that there is the proper level of water in the sump. All valves on the pump discharge piping must be open. Power is applied to the unit by turning the control panel door disconnect to the "On" position.
7. pH probe(s) are supplied with the unit. The pH sensor(s) have been calibrated in the factory but require recalibration once installed. Follow the manufacturer's guidelines to perform a two (2) point calibration.
8. Observe the keypad controller display. When the message "System Ready" appears, the unit may be started. Press the "Pump Start" key to start the unit. If there are no shutdown conditions, begin adjusting valves to get the proper flows as listed in the "Operational Parameters" section.
9. Turn the "Caustic Metering Pump" switch to the "Auto" position.

SHUT-DOWN

To turn the unit off, press the "Stop Recirc Pump" key on the keypad controller. DO NOT TURN PUMP OFF WHILE OXIDIZER IS ON. Although this will shut off the oxidizer, causing a temperature drop in the air stream entering the Quench/Absorber unit, repeated short-term exposure to high temperature air may damage the unit and/or melt the absorber packing.

⚠ WARNING

It is important to read and understand the caustic metering pump manufacturer's instructions provided in this manual.

Proper maintenance will help insure longer life for the caustic metering pump. Refer to the maintenance and trouble-shooting sections of the caustic metering pump manufacturer's instructions for proper procedures.

Failure to follow correct maintenance instructions will void the caustic metering pump manufacturer's warranty.

Section 4 | Preventive Maintenance

It is known that over time, dissolved solids (precipitates) drop out of the solution and deposit on the wetted surface(s) of the gas acid scrubber. Once a thick enough layer has formed, a noticeable film can be seen on the internal surfaces of the flow meters and level gauge. The scrubber could be damaged if this situation were allowed to proceed.

SCRUBBER AND WASH PROCEDURE (CAUSTIC OPTION)

A procedure for acid washing follows:

1. Make sure the system is on-line, operating properly and producing HCL.

2. Adjust the simulated pH value to pH 5. Please refer to the pH controller manufacturer's manual for instructions.

3. The time required for an acid wash is dependent on the amount of deposited solids there are. Therefore you will need to hold the pH at 5 until the flow meters and the level gauge are clear again.

4. Manually flush the dissolved solids by using the make-up waters solenoid by-pass valve. Flush at least one volume of the scrubber sump.

5. Once the system has been acid washed, you will need to restore the pH controller to normal operating mode. Please refer to the pH controller manufacturer's manual for instructions.

Section 5 | Troubleshooting

RECOMMENDED TROUBLESHOOTING PROCEDURES

1. **High pH alarm**

   a. Possible Cause
   pH analyzer/controller is in need of calibration.

   Action
   Recalibrate. Refer to pH probe vendor literature.

   b. Possible Cause
   Set point (Lo Out Value) too high on pH analyzer/controller.

   Action
   Refer to pH analyzer operating instruction. Scroll through pH analyzer settings.

   c. Possible Cause
   Stroke setting too high on caustic metering pump.

   Action
   Decrease stroke setting on metering pump.

   d. Possible Cause
   pH probe dirty.

   Action
   Check sensor "slope" by scrolling through pH analyzer functions. A slope below 80% indicates probe needs cleaning or replacement.

2. **Consistently high pH**

   a. Possible Cause
   pH analyzer in need of calibration.

   Action
   Recalibrate.

   b. Possible Cause
   HC1 loading levels lower than anticipated.

Action
Decrease "Lo Out Value" set point. This value represents a 4 mA analog output from the pH analyzer to the caustic metering pump. At 4 mA pumping should cease.

c. Possible Cause
pH probe dirty.

Action
Check sensor "slope" by scrolling through pH analyzer functions. A slope below 80% indicates probe needs cleaning or replacement.

3. Low pH Alarm

a. Possible Cause
Insufficient caustic delivery.

Action
Check caustic supply. If a sufficient amount of caustic is present, check metering pump prime. Refer to metering pump operations manual for instructions on priming. Check stroke setting on metering pump. Increase, if necessary, until caustic delivery is adequate to maintain proper pH.

Note that while the pH controller controls the pumping stroke rate, the pump stroke volume (of fluid per stroke) is adjustable at the pump.

b. Possible Cause
Erroneous pH tracking.

Action
Increase "Hi Out Value" set point. This value represents a 20 mA output from the pH analyzer to the caustic metering pump. At 20 mA pump rate should be at maximum.

4. Low Absorber Flow Alarm

a. Possible Cause
Damage to pump impeller.

Action
Remove pump and inspect.

b. Possible Cause

Flow restriction.

Action
Adjust diaphragm valve for branch of piping in line with flow meter. Check spray nozzles for plugging.

5. **Low Quench Flow Alarm**

a. Possible Cause
Damage to pump impeller.

Action
Remove pump and inspect.

b. Possible Cause
Flow restriction.

Action
Adjust diaphragm valve for branch of piping in line with flow meter. Check spray nozzles for plugging.

6. **High Temperature Shutdown**

a. Possible Cause
Insufficient quenching.

Action
Check eductor quench nozzles for plugging. Check flow to nozzles.

b. Possible Cause
Temperature controller.

Action
Check set point of temperature limit controller. Set point should be 150°F. Check configuration of controller.

c. Possible Cause
High oxidizer outlet temperature.

Action
Check heat exchanger efficiency or burner firing rate turndown.

d. Possible Cause
Thermocouple connection.

Action
If the controller consistently reads 1616 °F, this indicates the thermocouple has become disconnected either at the thermocouple, at the controller, or has been broken somewhere in between.

This controller is configured for what is referred to as an "upscale burnout". This is a fail-safe configuration in which the controller assumes a maximum temperature condition and acts accordingly if the thermocouple input is not sensed (open circuit). Check thermocouple wire continuity. Re-secure terminal connections. If wire is broken, replace.

7. High Conductivity Alarm or Shutdown

a. Possible Cause
System not exporting at proper set point.

Action
Check set point for dump valve opening (Conductivity Analyzer Relay B "Set PT A"). Adjust, as necessary, to keep up with generation of sodium chloride.

If set point for dump valve opening is decreased, the "High Conductivity Alarm" set point value, Relay A, must also be decreased. Although the conductivity values corresponding to the alarm and blowdown valve opening are factory set, accurate values are unique to each application and must be arrived at through observing operation of the unit. Monitor dump valve open time as a trouble shooting aid.

b. Possible Cause
System not exporting at sufficient rate.

Action
Check the export flow manual valve when the dump valve is open. If necessary, increase flow rate by opening valve.

c. Possible Cause
Conductivity analyzer out of calibration.

Action
Check the analyzer calibration. Refer to conductivity analyzer manual for information.

8. Low Level Shutdown

a. Possible Cause

Level control system not responding to decreasing sump level.

Action

Check level control system for proper operation. Make certain ground probe electrical connection is secure. Check level control calibration.

b. Possible Cause

Blowdown valve remaining open.

Action

Check blowdown solenoid valve to assure closure when valve is de-energized. Also check conductivity analyzer calibration and blowdown setting to verify that conductivity analyzer is not calling constantly for blowdown. Make certain the bypass valve around the dump solenoid valve is closed.

c. Possible Cause

Make-up water pressure not available or inadequate.

Action

Check to assure that adequate pressure is available at the make-up connection.

d. Possible Cause

Make-up water solenoid valve not opening or flow restricted.

Action

Check operation of the make-up water solenoid valve. Make certain valve opens when energized. Check valve and associated piping for any obstructions to flow.

9. High Level Alarm

a. Possible Cause

Make-up water valve remaining open.

Action

Check level control system set points and calibration. Make certain electrical connection to ground probe is secure. Check make-up water solenoid to make certain valve closes fully when de-energized.

10. High pressure drop indicated by magnehelic gauge.

a. Possible Cause

Packing in scrubber tower is fouled.

Action

Remove and clean packing. The pressure drop across the scrubber unit should be less than 2" w.c. If packing is fouled by precipitate, it may be dissolved with an acid wash. Contact Global Technologies.

b. Possible Cause

Problem with gauge.

Action

Check tubing connections to gauge. Make sure tubing is not clogged or restricted. Verify that gauge is functioning properly.

Appendix G
Operating Sequence & Setpoints and Alarm Conditions (Anguil)

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
1.	Turn on high voltage power.	Switch the disconnect on the main control panel to the ON position.	Control panel is powered. Panel devices execute self-test routines.	
2.	Turn on and enable control power. Operator Display Message: "Control Power OFF. Turn On Control Power."	Assure that no emergency stops are pushed in. Press the CONTROL RESET pushbutton.	The CONTROL POWER ON indication light will illuminate.	Any time the main disconnect for the control panel is shut-off or an emergency stop is pressed, control power is removed. Control power must then be reset by pressing the CONTROL POWER RESET pushbutton.
3.	System Reset. Operator Display Message: "Press Fault Reset to Enable System."	Press system reset pushbutton on the Human Machine Interface (HMI) or activate the remote start signal (DI940).	After reset, system start button is enabled. System is ready for start-up.	Anytime system is powered up, emergency stop button is depressed (control power OFF) or the system goes through a shutdown sequence, the PLC will latch a system shutdown bit. This bit MUST be reset before further operation is allowed.

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Rev A: BM 1/26/16 – Added pH Alarm
Rev B: BM 2/12/16 – As Commissioned
Rev C: BM 4/22/16 – As Noted

Rev D: BM 6/1/16 – As Noted

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31 pages

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
4.	Scrubber Make-Up Water Control. SV838 LSH832 LSL832	None. Automatic.	The make up water solenoid (SV838) is controlled by the water level sensor and is active whenever control power is on.	Refer to the Alarm Section of this sequence for High and Low water level alarming.
4.	Start system. Operator Display Message: "Press Start Button to Start System."	Press Start pushbutton on the Human Machine Interface (HMI).	The system will go through an auto-start-up sequence that starts fans, checks safeties and monitors pressures.	
6.	Start Scrubber Circulation Pump. MTR800	None. Automatic.	If the water level is above the low low water level alarm, the system will start the circulation pump.	The system will then wait for a motor starter running contact from the circulation pump motor starter. The scrubber water level is controlled by the level detector and the make-up water solenoid. Please refer to Setpoints and Alarm Conditions section of this sequence for a full explanation.

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
7.	Circulation Flow Proving. FSL811 FSL812 FSL822 FSL824 Operator Display Message: "Circ Pump On. Proving Flow. Combustion Blower Will Start Auto-matically."	None. Automatic.	With the circulation pump running, the flow proving switches will close on sufficient flow. Flow is also monitored by the PLC using FI824 and FI811.	Allow 3-5 seconds for flow to be proven. The circulation flow is monitored by the PLC. The PLC will alarm if the flow is not maintained or not made in the allotted amount of time. Please refer to the Setpoints and Alarm Conditions section of this sequence for a complete explanation.
8.	Knockout Pot Level Control. LSH102 LSL101 MTR101	None. Automatic.	When the knockout pot level reaches the LSH102 setpoint, the knockout pot drain pump will run until the LSL102 level setpoint is reached.	

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
9.	Conductivity Dilution Control. ASH803 ASL803 SV844	None. Automatic.	The PLC monitors the conductivity of the water in the scrubber. If the conductivity of the water reaches a field adjustable setpoint, the controller will initiate a blowdown cycle by opening the blowdown solenoid (SV844).	When a blowdown cycle is initiated, the blowdown solenoid is held open for a minimum of five (5) minutes and the conductivity has come back down below setpoint.
10. **Rev B**	pH Control. (Intended for future use if necessary) AIC802 SV831 HS802	Automatic control of the caustic pump is enabled any time the circulation pump is running. _Note_: When pH control is not utilized, the blowdown valve (SV844) is allowed to open for five minutes whenever the pH drops below the ASL802 setpoint.	The PLC will monitor to assure that the circulation pump is running before it enables the caustic pump. Normally closed caustic blocking solenoid valve (SV831) on the caustic metering pump discharge is opened. The PLC adjusts the pumping rate of the caustic metering pump to control the pH within a field adjustable setpoint range.	There is a separate PID loop in the PLC to control the caustic metering pump. Refer to the Warning Alarm Section of this sequence for High and Low pH alarming.

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
11. **Rev B**	Check Scrubber Interlocks. LSLL832 LSHH832 FSL812 FSL822 FSL824-(offline only) TSHH835B TAH835A FSL811	None. Automatic.	Scrubber safeties that MUST be made before the start-up sequence of the oxidizer is enabled: a. Water level must be within safe limits (i.e. between LSLL832 & LSHH832). b. Circulation pump must be on and flow to the quench and scrubber towers must be above the minimum setting of the flow switches. c. Temperature of the scrubber must be within safe limits.	All these conditions MUST be met before the burner may be lit. Please refer to the setpoint and alarm section of this sequence for specific alarm information.

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
12.	Start Combustion Fan. Operator Display Message: "Combustion Fan Started. Proving Airflow." MTR240	None. Automatic.	The PLC will close the run contact on the VFD for the combustion fan.	System waits for feedback signal from VFD indicating that the VFD is running.
13.	Combustion Airflow Proving. PDSL244	None. Automatic.	Shortly after the fan is started, the combustion air-proving switch closes.	The system allows several seconds for airflow to be built up to prove each of the switches. If the switch does not prove closed within the allotted time or if the switch was closed and unexpectedly opens, the operator is alerted to this condition via the HMI.

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
14.	Start system Fan. Operator Display Message: "System Fan Started. Proving Airflow." MTR105	None. Automatic.	After the combustion fan is started and airflow is proven, the PLC will close the run contact on the VFD for the system fan.	System waits for feedback signal from VFD indicating that the VFD is running.
15.	System Airflow Proving. FSL132	None. Automatic.	Shortly after the system fan is started, the system flow switch closes to prove airflow. The system flow switch assures that the system is operating within normal flow requirements.	The system allows several seconds for airflow to be built up to prove the switch. If the switch does not prove closed within the allotted time or if the switch was closed and unexpectedly opens, the operator is alerted to this condition via the HMI. Please refer to alarm conditions and explanations of this sequence.

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
16.	Oxidizer Poppet Valve Switching. XV109 XV110	None. Automatic.	The oxidizer poppet valves start cycling. The cycle time is adjustable through the HMI, within limits.	Before the poppet valves start cycling they are held in a bottled up position to hold in the system heat. When the poppet valves stop cycling, or the system fan is shut-off, they return to the bottled up position. Poppet valves continue to cycle whenever the system fan is on. Once the poppet valves start cycling, their positions are monitored by the PLC.
17.	Fresh Air Heating Loop. TCV400 TIC431	None. Automatic.	Whenever the system fan is running and the fresh air damper is opened to add dilution air the PLC will modulate the fresh air electric heater output to attain a fresh air temperature value of the process stream temperature setpoint. During system warm up the heater control will also be active.	When this heated fresh air mixes with the process stream, it should keep the process stream from condensing.

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
18.	System pre-purge requirements check. PSL203 PDSH204 TSHH125B TSHH131B XSO240A PDSL244 XSO105A FSL132 ZSC207 ZSO400 ZSC401	None. Automatic.	With the system and combustion fans on and proving switches closed, the controls check to assure that: a. Gas pressure is within acceptable limits. b. All high temperature limit controllers read safe temperature conditions. c. The gas train blocking valves and firing rate actuator are closed. d. The process inlet damper(s), are closed and fresh air damper is open.	If any of the required conditions are not satisfied, system purge is prevented. The operator is alerted to which condition is not met via the message display.

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
19.	System Purge. Operator Display Message: "System Purging. Please Wait."	None. Automatic.	The system and combustion fan are run for a predetermined amount of time. This time is determined by the volume of the oxidizer.	Air is passed through the combustion area for a preset, non-adjustable, time period. Purge time is set for TBD seconds.
20.	Burner Enable/ Disable Push-button. Operator Display Message: "Burner Not Enabled. Press Burner Enable Button."	Operator presses the "burner enable" button if the burner is not enabled. Burner can be enabled or disabled before this step. After a shutdown or if control power is shut off the burner will default to the ***enabled*** state.	At any time, while the system is running and the burner is on the operator can press the burner disable pushbutton to disable and shut-off the burner.	If the burner disable pushbutton is pressed, the system will hold without lighting the burners. The system and combustion fans will continue to run and the message display will alert the operator to this condition. If the burner disable pushbutton is pressed, while the burner is lit, the burner will be shut-off and system will hold with fans running and alert the operator to this condition. When the system is started the burner is automatically enabled.

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
21.	Burner lighting. Operator Display Message: "Burner Enabled. Main Flame Not Yet Established." XV205 XV207 IT233 BE231 TCV210	None. Automatic.	The burner controller circuit is enabled. The burner control carries out the following steps: a. Main fuel valves are opened. b. Burner ignition spark. c. Burner flame established. d. The burner firing rate actuator is released to modulate. *Note*: Prior to opening of main fuel valves, the firing rate valve is opened to a pre-light position.	 Fuel introduced to the burner. The spark igniter attempts to light the fuel. The ignition spark is turned off. The flame controller assures the flame stability. System will enter a ramp sequence until setpoint is reached.

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
22.	System heating. Operator Display Message: "Burner ON. Heating to Operating Temperature." TIC124	None. Automatic.	The firing rate valves modulate to drive and hold the combustion chamber temperature to field adjustable setpoint. System will ramp to setpoint at twelve degrees (12°F) per minute.	Heat energy moves through the oxidizer and surrounding metal, gradually elevating the oxidizer temperature. Loop control and tuning is via two separate PID loops in the PLC and is accessed through the HMI. The combustion air pressure setpoint is a fixed value based off the fixed gas pressure. The combustion fan VFD will modulate the fan speed to maintain the field adjustable setpoint. Because the gas and air pressures upstream of the firing rate valves are held constant, the mechanically linked gas and air valves modulate from 0-100% together to maintain the correct air-fuel ratio. *Note*: The combustion air valve is mechanically fixed to allow a minimum airflow at low fire.

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
23.	Oxidizer ready. Operator Display Message: "RTO at Operating Temperature. System Ready in xxx Second." DO900	None. Automatic.	The oxidizer chamber temperature reaches the field adjustable system operating "ready" setpoint. The controls close normally open ready relay contacts (DO900) within the control panel to indicate the system is ready. These contacts are available for owner's use to indicate that the system is ready, to enable other necessary ancillary equipment.	Oxidizer ready temperature must be maintained in the oxidizer chamber continuously for several minutes before the controls acknowledge the oxidizer is ready. System heat-up rate is twelve degrees (12°F) per minute. System heat up period is generally 90 to 120 minutes. When the oxidizer is ready, the HMI notifies the operator and the system ready contacts (DO900), in the control panel, change states.

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
24.	Place system online. Operator Display Message: "System Online." DI921 XV401	The oxidizer waits for the request to connect signal from the process line (DI921). When the signal is received and the inlet(s) is enabled from the HMI, the associated process inlet damper(s) is opened to the oxidizer. The inlet(s) may also be disabled from the HMI. In order for an inlet to open it MUST be enabled from the HMI and receive the customer handshake signal. *Note*: The inlet(s) is enabled by default when control power is turned on.	When one of the process inlet damper switches indicates to the oxidizer controls that a process inlet damper is open, the fresh air damper is released to modulate. The controls place the oxidizer in the "online" configuration.	The oxidizer assumes its "online" status only if one of the process inlet dampers are open and the oxidizer is at the "ready" operating temperature.

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
25.	System Fan Speed Modulation. PIC101 VFD105	None. Automatic.	A pressure transmitter located in the process inlet ductwork senses static pressure of the process line. The pressure loop controller maintains the pressure setpoint by controlling the fresh air damper position and system fan speed.	The control loop accommodates, within limits, varying process flow to the oxidizer.
26.	Poppet Valve Short Cycle.	None. Automatic.	The system monitors the cold face temperatures and will short cycle the poppet valves to avoid a high temperature condition. This function cannot be disabled and is active whenever the system fan is running. This function is meant to protect the equipment.	The poppet valves will cycle at regular intervals except when the temperatures reach a predetermined high level.

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
27.	Taking system offline. DI921 XV401	If the request to connect signal (DI921) is removed or the inlet(s) is disabled through the HMI, the system is taken offline after an adjustable time period.	When the process inlet damper is no longer enabled the fresh air damper is opened. The feedback signal from the process inlet controls to the oxidizer controls must indicate the process inlets are no longer open. The fan speed pressure loop control becomes inactive and fan speed is reduced to a minimum setting. The oxidizer temperature control continues operating normally.	The oxidizer may be taken offline and again placed online as often as necessary by the operator or process line. Every time the system is taken offline it will assume the idle (fresh air inlet open) mode.

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
28. **Rev B**	System shut down. Operator Display Message: "System Shutdown. Cooling to Shutdown Temperature." DO900	Press the system STOP push-button on the HMI.	The oxidizer enters into the shutdown routine: a. The contact (DO900) that indicates the system is ready for the process stream opens. b. If the system was online, it is taken offline, and the fresh air damper is returned to the fully open position. c. If the burner is on when the STOP button is pressed it is then shut off.	The HMI indicates shutdown and burner and blower running status during shutdown procedure. *Note*: If the STOP button is pressed before the oxidizer start-up has been completed, specifically before the burner has yet been lit (and the system is below system shutdown temperature), then there is no need for a cool-down period. If the STOP button is pressed and the burner is not on, the combustion and system fans stop immediately if the system temperature is below the system shutdown temperature. *Note*: At any time during the shutdown sequence, the system can be restarted by pressing the system start button.

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
28.	System shut down. *(Continued)* Operator Display Message: "System Shutdown. Cooling to Shutdown Temperature."		d. With the burner off, the controls maintain all fans on for an oxidizer cool down which continues until the oxidizer temperature cools to a system cool down temperature setpoint (adjustable through the HMI). e. When this cooling period elapses, and shutdown temperature is reached the combustion and system fans shut off. When the system fan shuts off the poppet valves return to their fully extended positions.	 *Note*: The system temperature is monitored and fans will not shut off until shutdown temperature is reached.

I. Operating Sequence

	Step	Operator Action	Effects	Remarks
29.	System shutdown completion. Operator Display Message: "Please Wait to Re-Start System."	None. Automatic.	The scrubber pump continues to run until shutdown by the operator. System shutdown bit is latched. Further system operation is prevented until RESET push-button is pressed. Operation is returned to Step 3 of system operation.	Anytime the system is powered up, emergency stop button is depressed (control power OFF) or the system goes through a shutdown sequence, the PLC will latch a system shutdown bit. This bit MUST be reset before further operation is allowed.
30.	Leak Test. Operator Display Message: "System In Leak Test Mode." HS220 XV205 XV207	Operator places the system in leak test mode with the main fuel selector switch on the main control panel.	The operator performs an NFPA approved leak test.	If the system is running when one of the leak test selector switches is switched to "Leak Test" from "Run", the system is shutdown immediately.

II. Setpoints and Alarm Conditions

Process Setpoint or Alarm Condition	Value or Trip Condition	Explanation
Key:		**Warning Alarm**: The alarm horn and alarm light are activated. The system takes no other action. **Offline Alarm**: The alarm horn and alarm light are activated. If any of the system inlets are open, they are closed and the ready signal (DO900) is de-energized. The alarm signal (DO910) is energized. The system takes no other action. **Shutdown Alarm**: The alarm horn and alarm light are activated. The ready signal (DO900) is de-energized and the system enters the shutdown sequence. See Step 28 in the Operating Sequence section of this document. **Hard Shutdown Alarm**: The alarm horn and alarm light are activated. All PLC controlled devices are shutdown. This is similar to pressing an E-Stop pushbutton. Fault reset must be pressed before system restart. **Setpoint**: The value that is to be entered in the HMI, set in a controller or the value that a physical switch must be scaled/set to. **Alarm Condition Operator Response:** 1. Press Alarm Silence. 2. Note the alarm condition displayed in the alarm banner. 3. Close the alarm banner. 4. Diagnose and correct the alarm condition. 5. Press the Fault Reset button. 6. Re-start the system.

II. Setpoints and Alarm Conditions

Process Setpoint or Alarm Condition	Value or Trip Condition	Explanation
Total Poppet Time **Setpoint**	Setpoint = 6 min	This is the total time for one complete cycle of the poppet valves (extending and retracting of both XV109 and XV110). This setpoint is accessed through the HMI. This setpoint is automatically adjusted by the poppet valve cycle time extension feature, in the PLC, when the system is online and the chamber temperature rises above setpoint or shortened in the condition of a high cold face temperature.
Pressure Setpoint **Setpoint**	-1.0" w.c. PIC101	When the system is online the system VFD will modulate to maintain this pressure setpoint. This setpoint is accessed through the HMI.
System Low Pressure Alarm PAL101 **Warning Alarm**	Setpoint = -7.0" w.c. PSL101	The pressure control loop for the system VFD is active and the process pressure has not attained acceptable limits. After a sixty (60) second delay, an alarm is asserted.
System High Pressure Alarm PAH101 **Warning Alarm**	Setpoint = 0.0" w.c. PSH101	The pressure control loop for the system VFD is active and the process pressure has not attained acceptable limits. After a sixty (60) second delay, an alarm is asserted.
Knockout Pot Drain Pump Alarm XAO101A **Hard Shutdown Alarm**	XSO101A	The knockout pot drain pump was given the run signal from the PLC and the motor starter contact did not close in the allotted amount of time or the motor was running with the contact closed and the contact unexpectedly opened.
High High Knockout Pot Level LAHH102 **Shutdown Alarm** **Rev B**	Setpoint= 16” LSHH102	The knockout pot level has risen above the high high level switch setpoint.

II. Setpoints and Alarm Conditions

Process Setpoint or Alarm Condition	Value or Trip Condition	Explanation
Excess Negative Pressure Alarm PAL102 **Hard Shutdown Alarm**	Setpoint = -25.0" w.c. PSL102	The negative pressure at the inlet plenum has risen above the setting on the excess negative pressure switch.
System VFD Alarm XAO105A **Hard Shutdown Alarm**	XSO105A	The system VFD was given the run signal from the PLC and the VFD running contact did not close in the allotted amount of time or the VFD was running with the contact closed and the contact unexpectedly opened.
Poppet Valve Extend/Retract Positioning Alarm ZAO109 ZAC109 ZAO110 ZAC110 **Offline Alarm**	ZSO109 ZSC109 ZSO110 ZSC110	Each poppet valve is individually monitored for position while the system fan is running. If a valve or a set of valves fails to make position, the operator is alerted as to which poppet valve did not make position and what position it did not make.
High Chamber Temperature Alarm TAH121A TAH122A **Hard Shutdown Alarm**	Setpoint = 1900°F TSH121A TSH122A	The oxidizer chamber temperature has risen above the setpoint in the PLC. This setpoint is adjustable through HMI. This setpoint should only be adjusted by qualified service personal.
Chamber Temperature Setpoint **Setpoint**	1650°F TIC124	The firing rate actuator will modulate to maintain this temperature setpoint. This setpoint is accessed through the HMI.
Shutdown Temperature **Setpoint**	800°F TIC124	The system will cool down to this temperature setpoint when a normal shutdown routine is run.

II. Setpoints and Alarm Conditions

Process Setpoint or Alarm Condition	Value or Trip Condition	Explanation
System Ready Temperature **Setpoint**	Setpoint = TIC124.SP - 25°F TSL124	When the system reaches this temperature a ten (10) minute timer is started. When the ten (10) minute timer is complete the system is considered "Ready".
System Ready Temperature Lost Alarm TAL124 **Warning Alarm** **Rev D**	Setpoint = TIC124.SP - 75°F TSL124	Once the system has attained ready temperature (and is not in a shutdown sequence) the chamber temperature is monitored and if it ever falls below setpoint (75°F), this alarm is asserted.
High Chamber Limit Temperature Alarm TAHH125B **Hard Shutdown Alarm**	Setpoint = 1900°F TSHH125B	The oxidizer temperature on TE125B has risen above the setpoint in the high limit controller. Temperature high limit controllers are required safety devices and should NEVER be bypassed.
Chamber Above Purge Temperature **Setpoint** **Rev C**	1550°F TSLL125B	The chamber must remain above this temperature while the system is online. If the chamber falls below this temperature the limit string will open and the system will require a re-purge before the burners can be re-lit.
Cold Face #1 or Cold Face #2 High Temperature Alarm TAH127A TAH128A **Hard Shutdown Alarm** **Rev B**	Setpoint = 725°F TSH127A TSH128A	The thermocouple that monitors the cold face temperature of each chamber is compared to the setpoint for Cold Face High Temperature. If the temperature is ever at or above this setpoint the system is shutdown. The setpoint is adjustable through the HMI.

II. Setpoints and Alarm Conditions

Process Setpoint or Alarm Condition	Value or Trip Condition	Explanation
RTO Outlet High Limit Temperature Alarm TAHH131B **Hard Shutdown Alarm** **Rev B**	Setpoint = 725°F TSHH131B	The RTO outlet temperature on TE131B has risen above the setpoint in the high limit controller. Temperature high limit controllers are required safety devices and should NEVER be bypassed.
System Low Air Flow Alarm FAL132 **Hard Shutdown Alarm** **Rev B**	Setpoint = 2500 SCFM FSL132	The system fan is running and the low flow switch has not closed in the allotted time or the switch was closed and unexpectedly opens.
Low Gas Pressure Alarm PAL203 **Hard Shutdown Alarm**	Setpoint = 6.0" w.c. PSL203	The gas pressure has fallen below the setpoint on the gas pressure switch. This setpoint is adjustable on the switch itself. These pressure switches are required safety devices and should NEVER be bypassed.
High Gas Pressure Alarm PDAH204 **Hard Shutdown Alarm**	Setpoint = 5.0" w.c. PDSH204	The gas pressure has risen above the setpoint on the gas pressure switch. This setpoint is adjustable on the switch itself. These pressure switches are required safety devices and should NEVER be bypassed.
Main Gas Valve Position Alarm ZAO205 **Hard Shutdown Alarm**	ZSO205	Once the burner is enabled, this alarm will be asserted if XV205 does not prove open within a specified time period or if it is proven open while the burner is not enabled.
Main Gas Valve Position Alarm ZAC207 **Hard Shutdown Alarm**	ZSC207	This valve MUST be proven closed to purge the oxidizer system.
Gas Low Fire	ZSC210	This valve MUST be proven closed to purge

II. Setpoints and Alarm Conditions

Process Setpoint or Alarm Condition	Value or Trip Condition	Explanation
Position Alarm ZAC210 **Warning Alarm**		the oxidizer system.
Burner Flame Supervisor Alarm FAL235 **Shutdown Alarm**	FSC235	The flame safety relay has faulted. Flame safety relay information is displayed on the LEDs inside the flame relay head unit, located near the burner. Refer to Table 1 for fault details. The flame safety relay is a required safety device and should NEVER be bypassed.

Table 1 - Flame Relay LED Indicator Description

LED Status		Condition	Flame Relay Status	*Shutter Position	
				Open	Close
Green	Off	No Flame Detected	Off		
	Once Per Second	Marginal Flame Signal	On		
	Rapid Flash	Normal Flame Signal	On		
	Steady On	High Flame Signal	On		
Red	Off	Normal	On		
	Flash	Self-Check Failure (Observe Shutter Position)*	Off	Shutter Failure	UV Tube Failure
	On	Microprocessor Error	Off		

Combustion Motor Alarm XAO240A **Hard Shutdown Alarm**	XSO240A	The combustion motor starter was given the run signal by the PLC and the motor starter running contact to the PLC did not close in the allotted amount of time or the motor starter was on and the overload tripped and shut-off the starter.

II. Setpoints and Alarm Conditions

Process Setpoint or Alarm Condition	Value or Trip Condition	Explanation
Combustion Air Flow Switch Alarm PDAL244 **Hard Shutdown Alarm**	Setpoint = 4.0" w.c. PDSL244	The combustion fan is running and the differential pressure switch from the fan to the combustion chamber has not proven or the switch had been closed and unexpectedly opened.
Combustion Air Pressure Setpoint **Setpoint**	22.0" w.c. PDIC245	This is the differential pressure between the combustion chamber and combustion air ductwork. The combustion air VFD will modulate to maintain this pressure setpoint. This setpoint is accessed through the HMI.
Fresh Air Damper Positioning Alarm ZAO400 **Shutdown Alarm**	ZSO400	The fresh air damper is required to be open for purge and when the system is offline to supply air to the system fan. If the damper is not proved open in these conditions this alarm is asserted.
Inlet Damper Positioning Alarms ZAC401 ZAO401 **Warning Alarm**	ZSC401 ZSO401	The position switches did not indicate the damper is in the correct position.
Fresh Air Heater Element High Limit Temperature Alarm TAHH430 **Off-line Alarm**	Set Point = 1000°F TSHH430	The fresh air temperature on TE430 has risen above the set point in the high limit controller. Temperature high limit controllers are required safety devices and should NEVER be bypassed.
Fresh Air Temperature **Setpoint**	120°F TIC431	When the system is on-line this is the temperature that the heater will modulate to try to maintain. This set point is accessed through the HMI.

II. Setpoints and Alarm Conditions

Process Setpoint or Alarm Condition	Value or Trip Condition	Explanation
Fresh Air Low Temperature Alarm TAL431 **Warning Alarm**	Setpoint = 80°F TSL431	The oxidizer system is running on-line and the dilution air temperature, as measured by TE431, has fallen below the set point for this alarm.
Dilution Air High Temperature Alarm TAH431 **Warning Alarm**	Setpoint = 150°F TSH431	The oxidizer system is running on-line and the Dilution air temperature, as measured by TE431, has risen above the set point for this alarm.
Loss of Plant Supplied Air Alarm PAL604 **Hard Shutdown Alarm**	Setpoint = 70 psig PSL604	The pressure switch that monitors plant-supplied air has tripped, indicating loss of plant air. The system uses the air in the accumulator tanks to drive the dampers to the bottled up position.
Circulation Pump Motor Alarm XAO800 **Hard Shutdown Alarm**	XSH800 JSL800	The circulation pump motor starter was given the run signal by the PLC and the motor starter running contact to the PLC did not close in the allotted amount of time or the motor starter was on and the overload tripped and shut-off the starter. Or the motor is running but operating at a load below minimum.
PH Control Setpoint (intended for future use if necessary) **Setpoint**	Setpoint = 8 pH AIC802	When the circulation pump is running the pH PID loop in the PLC is active and will control the caustic metering pumps to maintain this pH level.
High pH Alarm AAH802 **Warning Alarm**	Setpoint = 10 pH ASH802	If the circulation pump is running and the pH in the scrubber has risen to this level for more than ten (10) minutes, this alarm is asserted.

II. Setpoints and Alarm Conditions

Process Setpoint or Alarm Condition	Value or Trip Condition	Explanation
Low pH Alarm AAL802 **Warning Alarm**	Setpoint= 4 pH ASL802	If the circulation pump is running and the pH in the scrubber has fallen to this level for more than ten (10) minutes, this alarm is asserted.
Low Low pH Alarm AALL802 **Hard Shutdown Alarm**	Setpoint= 1.1 pH ASLL802	If the circulation pump is running and the pH in the scrubber has fallen to this level, this alarm is asserted.
High Conductivity Alarm AAHH803 **Warning Alarm**	Setpoint = 80 mS ASHH803	If the circulation pump is running and the conductivity has reached this setpoint, this alarm is asserted.
Conductivity, Start Blowdown Setpoint **Setpoint**	50 mS ASH803	When the conductivity in the scrubber reaches this setpoint, the blowdown solenoid (SV844) is held open for five (5) minutes or the conductivity has come back down below the stop blowdown setpoint (ASL803).
Conductivity, Stop Blowdown Setpoint **Setpoint**	40 mS ASL803	During a blowdown cycle, the conductivity will fall to this setpoint at which time the blowdown solenoid will close.
Quench Low Flow Alarm FAL811 **Warning Alarm** **Rev B**	Setpoint = 5 gpm FSL811	The enabled circulation pump has been started and flow was not proven in the allotted amount of time or flow was made and is unexpectedly lost, a warning alarm is asserted.
Quench High Flow Alarm FAH811 **Warning Alarm** **Rev B**	Setpoint = 13 gpm FSH811	The circulation pump has been started and the required flow has not been made in the allotted amount of time or flow had been made and it rose above the setpoint for the analog signal while the unit was running.

II. Setpoints and Alarm Conditions

Process Setpoint or Alarm Condition	Value or Trip Condition	Explanation
Quench Low Low Flow Alarm FALL811 **Hard Shutdown Alarm** **Rev D**	Setpoint = 3 gpm FSLL811	The circulation pump has been started and the required flow has not been made in the allotted amount of time or flow had been made and it fell below the setpoint for the analog signal while the unit was running.
Quench Low Flow Alarm FAL812 **Hard Shutdown Alarm** **Rev B**	Setpoint = 3 gpm FSL812	The circulation pump has been started and the required flow has not been made in the allotted amount of time or flow had been made and it falls below to open the switch while the unit is running.
Scrubber Low Flow Alarm FAL822 **Hard Shutdown Alarm** **Rev B**	Setpoint = 30 gpm FSL822	The circulation pump has been started and the required flow has not been made in the allotted amount of time or flow had been made and it falls below to open the switch while the unit is running.
Scrubber Low Flow Alarm FAL824 **Warning Alarm** **Rev D**	Setpoint = 95 gpm FSL824	The enabled circulation pump has been started and flow was not proven in the allotted amount of time or flow was made and is unexpectedly lost, a warning alarm is asserted.
Scrubber Low Flow Alarm FALL824 **Hard Shutdown Alarm** **Rev D**	Setpoint = 90 gpm FSLL824	The enabled circulation pump has been started and flow was not proven in the allotted amount of time or flow was made and is unexpectedly lost, a warning alarm is asserted.
Scrubber High Flow Alarm FAH824 **Warning Alarm** **Rev B**	Setpoint = 100 gpm FSH824	The circulation pump has been started and the required flow has not been made in the allotted amount of time or flow had been made and it rose above the setpoint for the analog signal while the unit was running.

II. Setpoints and Alarm Conditions

Process Setpoint or Alarm Condition	Value or Trip Condition	Explanation
Caustic Metering Pump Running Alarm XAO830A **Warning Alarm**	XSO830A	The metering pump VFD was given the run signal from the PLC and the VFD running contact did not close in the allotted amount of time or the VFD was running with the contact closed and the contact unexpectedly opened.
Scrubber High Water Level Alarm LAHH832 **Hard Shutdown Alarm** **Rev B**	Setpoint = 36" Above Bottom of Sump LSHH832	The water level in the scrubber has risen and the over flow piping may be plugged. Please inspect the over flow piping.
Scrubber Low Low Water Level Alarm LALL832 **Hard Shutdown Alarm** **Rev B**	Setpoint = 16" Above Bottom of Sump LSLL832	The water level in the scrubber has fallen to a level that could cause damage to the circulation pump. Please check the makeup water supply.
Scrubber Add Water Level **Setpoint** **Rev B**	Setpoint = 18" Above Bottom of Sump LSL832	The water level in the scrubber has fallen to a level that turns on the soft water supply solenoid (SV838).
Scrubber Stop Add Water Level **Setpoint** **Rev B**	Setpoint = 21" Above Bottom of Sump LSH832	The water level in the scrubber has risen to a level that turns off the soft water supply solenoid (SV838) after an add water cycle has started.
High Quench Outlet Temperature Alarm TAH835A **Hard Shutdown Alarm**	Setpoint = 150°F TSH835A	The temperature of the quench outlet has risen to an unsafe level and the unit is shutdown to protect the packing material in the scrubber. The scrubber pump is restarted if shut down. Running the scrubber pump while this alarm is active will protect the packing material.

II. Setpoints and Alarm Conditions

Process Setpoint or Alarm Condition	Value or Trip Condition	Explanation
High Quench Outlet Limit Temperature Alarm TAHH835B **Hard Shutdown Alarm**	Setpoint = 150°F TSHH835B	The quench outlet temperature on TE835B has risen above the setpoint in the high limit controller. The scrubber pump is restarted if shut down. Running the scrubber pump while this alarm is active will protect the packing material. Temperature high limit controllers are required safety devices and should NEVER be bypassed.

Appendix H
Startup, Shutdown, Malfunction Plan

Startup, Shutdown, and Malfunction Plan
F-Area Groundwater Treatment System Oxidizer and Scrubber
January 25, 2016

The purpose of this startup, shutdown, and malfunction plan (SSMP) is to present the procedures to be followed should emissions occur outside of those allowed by Title V Permit 9-2911-00112/00234 (Permit) during startup, shutdown, or malfunction of the F-Area groundwater treatment system oxidizer and scrubber. Emissions from this treatment system (Emission Unit F-00001) are regulated under the Permit for emission control F0202 (oxidizer) and F0203 (scrubber). The Permit has specific operating limits for the emission unit as follows:

- Oxidizer temperature – minimum of 1550 degrees Fahrenheit (F)
- Scrubber liquor pH – greater than or equal to 1.1
- Scrubber liquor flow rate – greater than 90 gallons per minute (gpm)

Details of the SSMP are presented below.

Oxidizer Temperature

The system has been designed to operate at a temperature of 1650 degrees F. A low temperature alarm will occur at 1600 degrees F and an interlock (low-low temperature) will shutdown process air at 1550 degrees F.

During startup, the following will be implemented:

- Temperature probe will be checked to make sure it is on and a signal is being sent
- Once the oxidizer reaches temperature (1650 degrees F), process air will be allowed to enter the oxidizer
- The temperature will be monitored by the operator for a period of time once process air is flowing to make sure it does not fluctuate
- If the temperature probe fails, the system will automatically shut down process air
- If a temperature below 1600 and/or 1550 degrees F is observed (indicating an instrument malfunction), the operator will immediately shut down process air via the emergency procedures presented in the Operational Procedures Manual

During shutdown, the following will be implemented:

- Process air to the oxidizer will cease
- Operator will check to make sure groundwater flow to the air stripper has ceased, the blower has shut down, and valve on the duct between the air stripper and the oxidizer has closed
- If this has not occurred (indicating a malfunction), the operator will manually shut down groundwater feed to the air stripper via the emergency procedures presented in the Operational Procedures Manual

Scrubber Liquor pH

The scrubber has been designed to operate above a pH of 1.5. A low pH alarm will occur at a pH of 1.5 and an interlock (low-low pH) will shutdown the process at a pH of less than 1.1.

During startup, the following will be implemented:

- pH probe will be checked to make sure it is on and a signal is being sent
- The pH reading will be monitored by the operator for a period of time once process air is flowing
- If the pH probe fails, the system will automatically shut down process air
- If a pH below 1.5 is observed and no alarm is signaled or the interlock does not trip at a pH of 1.1 (indicating an instrument malfunction), the operator will immediately shut down process air via the emergency procedures presented in the Operational Procedures Manual

During shutdown, the following will be implemented:

- Process air to the oxidizer will cease
- Operator will check to make sure groundwater flow to the air stripper has ceased, the blower has shut down, and the valve on the duct between the air stripper and the oxidizer has closed
- If this has not occurred (indicating a malfunction), the operator will manually shut down groundwater feed to the air stripper via the emergency procedures presented in the Operational Procedures Manual

Scrubber Liquor Flow

The scrubber has been designed to operate at a flow above of 95 gpm. A low flow alarm will occur at a flow of 95 gpm and an interlock (low-low flow) will activate to shutdown the process at a flow of 90 gpm. The flow through the scrubber is controlled by a flow switch. To add redundancy, a flow meter was added to monitor the actual flow. Should the flow meter malfunction (no signal or bad quality signal), an alarm will occur and the interlock will be tripped.

During startup, the following will be implemented:

- Flow meter will be checked to make sure it is on and a signal is being sent
- The flow rate will be monitored by the operator for a period of time once process air is flowing to
- If the temperature probe fails, the system will automatically shut down process air
- If a flow below 95 gpm is observed and no alarm is signaled or the interlock does not trip at a flow rate of 90 gpm (indicating an instrument malfunction), the operator will immediately shut down process air via the emergency procedures presented in the Operational Procedures Manual

During shutdown, the following will be implemented:

- Process air to the oxidizer will cease
- Operator will check to make sure groundwater flow to the air stripper has ceased, the blower has shut down, and the valve on the duct between the air stripper and the oxidizer has closed

- If this has not occurred (indicating a malfunction), the operator will manually shut down groundwater feed to the air stripper via the emergency procedures presented in the Operational Procedures Manual

RECORDING AND REPORTING

Any malfunction that that occurs will be reported on a 24 hours per day basis using the attached EIIR form. The shift supervisor or the GSH supervisor will fill out the EIIR with respect to the malfunction, distribute, and post at the main gate. Actions to prevent recurrence of the event will be listed on the form. This will be done on the shift basis as it occurs. This event will normally not be considered a deviation if this SSMP is followed.

OxyChem.

OSHA STAR WORKSITE

EIIR Report

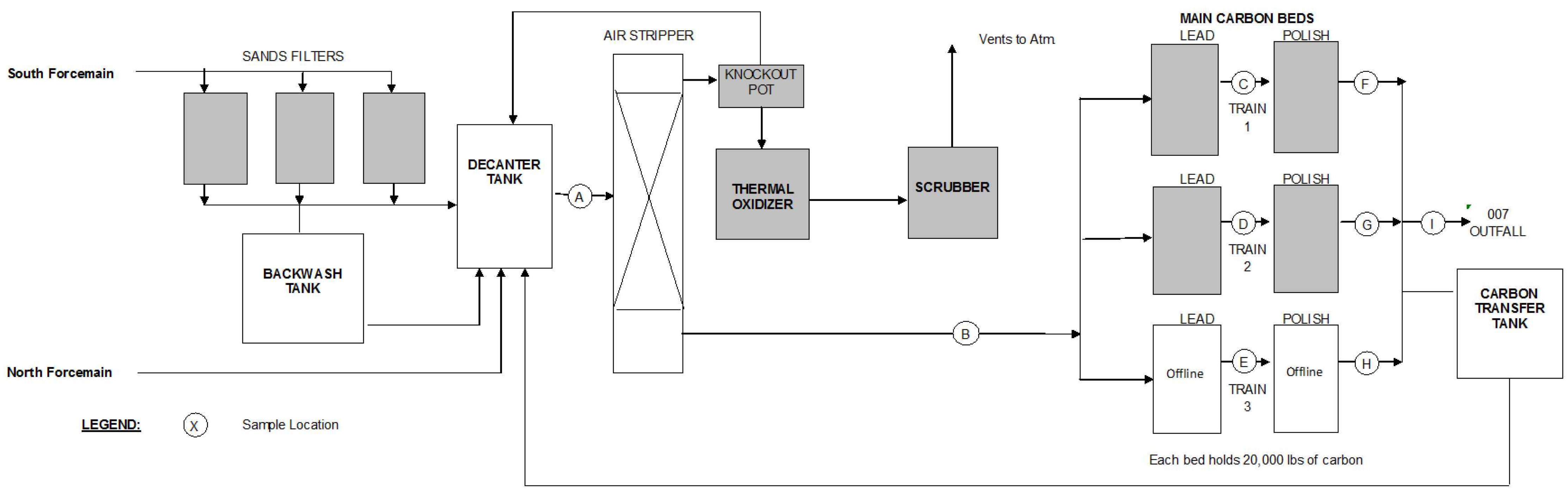
Link to RQ Listing →RQ table

Department:	Area:
Date:	Reported by:
Start Time:	End Time:
Material Released:	Estimated Quantity Released :

Items 1-10 to be completed by the Supervisor and posted /emailed to EIIR list.

1. Was the EIIR associated with:
   - startup or shutdown of a process ☐ Yes ☐ No
   - was the shutdown ☐ Planned ☐ Emergency
   - equipment malfunction ☐ Yes ☐ No
2. Was there any offsite impact? ☐ Yes ☐ No
3. Released to: ☐Air ☐Dike ☐Pavement ☐Sanitary Sewer ☐Outfall ☐Ground
4. R.Q. of material:
5. If released to a dike or pavement was the material completely contained: ☐Yes ☐ No
   (***DID NOT enter the environment***)
6. Was the spill or area cleaned up and decontaminated? ☐ Yes ☐ No ☐ N/A
7. Description of incident:
8. Immediate Action taken to mitigate the incident:
9. What action will be taken before placing equipment back into service?
10. What was the initial cause determination of the EIIR or emission?

Appendix I
Process Sampling Schematic



Permit (1) - 2/Month Compound and Daily Max
TSS (avg/max) - 280/720 lb/day

Permit (2) - Monthly Compound and Daily Max
MCTs, PCBTFs, DCBTFs, C-56, Monochlorobenzenes, Trichlorobenzenes, TCE, PCE, Toluene, Sum of BHCs, Bromodichloromethane, Chloroform, 1,1-DCE, t-1,2-DCE, Vinyl Chloride, Benzene, CCl4, 1,2-DCA, 1,1-DCA, Ethylbenzene - 0.15 lb/day
Dichlorobenzenes - 0.46 lb/day
Phenolics, total - 0.6 lb/day

Permit (3) - Quarterly Compound and Daily Max
Dioxins/Furans - 0.00012 lb/day

Permit (4) - Semiannual Compound and Action Level
Antimony, Bis (2-ethylhexyl)phthalate - 0.43 lb/day
Chromium, silver, Di-(n-butyl)-phthalate, 2,4-Dinitrotoluene, Naphthalene, 2,4-Dichlorophenol, Hexachlorobenzenes, Hexachlorobutadiene - 0.15 lb/day
Pyrene, 2,6-Dinitrotoluene, Fluoranthene, Hexachloroethane, Indeno-(1,2,3-cd)-pyrene, Phenanthrene, Benzo(a)pyrene, 3,4-Benzofluoranthene, Benzo(ghi)perylene, Benzo(k)fluoranthene, Bis-(2-chloroethoxy)-methanes, Chrysene, Dibenzo(a,h)anthracene - 0.07 lb/day

2/Weekly		I - Effluent-007	Grab	Env.Ctrl.	Q&E		pH		Permit - 6 to 9
Weekly	(Tuesday)	I - Effluent-007	Grab	F-Area	Q&E	48-hr	VOC	601 +VC, MCT	Process Information
2/Month		I - Effluent-007	24-hr Comp	Env.Ctrl.	Q&E	Std	TSS		Permit (1)
Monthly	(2nd Tues.)								
		A - Air Stripper Feed	Grab	F-Area	Q&E	48-hr	VOC	601 +VC, MCT	Process Information
		A - Air Stripper Feed	Grab	F-Area	GSH Contract Lab	48-hr	Phenol(distilled)		Process Information
		B - Carbon Bed Feed	Grab	F-Area	Q&E	48-hr	VOC	601 +VC, MCT	Process Information
		C - Inter Carbon Bed	Grab	F-Area	Q&E	48-hr	VOC	601 +VC, MCT	Process Information - TCE>7ppb or >5ppb twice, check air stripper
		C - Inter Carbon Bed	Grab	F-Area	GSH Contract Lab	48-hr	Phenol(distilled)		Process Information - If greater than 5 ppb notify operations
		D - Inter Carbon Bed	Grab	F-Area	Q&E	48-hr	VOC	601 +VC, MCT	Process Information - TCE>7ppb or >5ppb twice, check air stripper
		D - Inter Carbon Bed	Grab	F-Area	GSH Contract Lab	48-hr	Phenol(distilled)	601 +VC, MCT	Process Information - If greater than 5 ppb notify operations
		I - Effluent-007	Grab	F-Area	GSH Contract Lab	48-hr	Phenol(distilled)		Process Information - If greater than 5 ppb notify operations
		I - Effluent-007	24-hr Comp	Env.Ctrl.	Q&E	Std	See Permit (2)		Permit (2)
Quarterly		I - Effluent-007	24-hr Comp	Env.Ctrl.	Q&E	Std	Dioxins, Furans		Permit (3)
Quarterly	coincide w/ Monthly	A - Air Stripper Feed	Grab	F-Area	GSH Contract Lab	Std	SVOC	625 PPL,C66	Process Information
		C - Inter Carbon Bed	Grab	F-Area	GSH Contract Lab	Std	SVOC	625 PPL,C66	Process Information - Consistent breakthrough, change carbon
		D - Inter Carbon Bed	Grab	F-Area	GSH Contract Lab	Std	SVOC	625 PPL,C66	Process Information - Consistent breakthrough, change carbon
		B - Carbon Bed Feed	Grab	F-Area	GSH Contract Lab	Std	SVOC	625 PPL,C66	Process Information
		I - Effluent-007	Grab	F-Area	GSH Contract Lab	Std	SVOC	625 PPL,C66	Process Information
Semiannual		I - Effluent-007	24-hr Comp	Env.Ctrl.	Q&E	Std	See Permit (4)		Permit (4)
Carbon Change		F, G, +/or H - Train Effluent	Grab	F-Area	Q&E	48-hr	VOC	601 +VC, MCT	>ND, check valving, carbon bed

Email results to
Joel Spring - Process Sampling Results
John Pentilchuk - Process Sampling Results
Jim Czapla - Permit Sampling Results

Note 1: Lab to call operations if anything shows up in the effluent (I) on any permitted parameter >ND
Note 2: Operations will track results weekly to see if changes to the stripper or carbon system must be made
Note 3: Look above for the permt limits. For example, many parameters are set at 0.15 lbs /day. If the flow is 500 gpm, conc of 25 ppb is at the permit max.

Q&E - OxyChem Niagara Plant in-house laboratory

figure I.1

PROCESS SAMPLING SCHEMATIC
F-AREA GROUNDWATER REMEDIATION SYSTEM
BUFFALO AVENUE PLANT
OCCIDENTAL CHEMICAL CORPORATION
GLENN SPRINGS HOLDINGS, INC.
Niagara Falls, New York

GHD

www.ghd.com