ARCADIS

Appendix A

Basis of Design

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MEMO

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Date:
February 13, 2013

ARCADIS Project No.:
B0031174

Subject:
Dewey Loeffel Landfill Superfund Site
Nassau, New York
Treatment System
Basis of Design

This memorandum presents the basis of design for the proposed treatment system at the Dewey Loeffel Landfill Superfund Site located in the Town of Nassau, Rensselaer County, New York (site). Presented herein are the following items:

- Treatment System Overview;
- Basis of Design Information;
- Major Equipment Specifications;
- Contract Drawings; and
- Operation, Maintenance and Monitoring (OM&M) Requirements.

TREATMENT SYSTEM OVERVIEW

Process Description

In 2009 and 2010 the New York State Department of Environmental Conservation (NYSDEC) seasonally operated three extraction wells located south of the Dewey Loeffel Landfill (landfill) for about seven months each year. These wells were also operated by NYSDEC for a shorter time period in 2008. In 2011, NYSDEC operated the three extraction wells for four months until the United States Environmental Protection Agency (USEPA) took over operations for the last two months of the year. Pursuant to the Administrative Settlement Agreement and Order on Consent for a Removal Action (CERCLA Index No. 02-2012-2005) (Consent Order) executed by USEPA, General Electric Company (GE), and SI Group, Inc. (SI Group), GE and SI Group (referred to herein as Respondents) assumed responsibility from USEPA for continued operation of the groundwater extraction and landfill leachate collection system. This transition from USEPA occurred on August 1, 2012, and the first transportation of leachate and extracted groundwater by Respondents occurred on August 2, 2012. The extracted groundwater is currently collected in two frac tanks and, along with leachate from the landfill, is trucked to a permitted treatment and disposal facility.

The purpose of the treatment system is to eliminate the need for the continued, year-round trucking of extracted groundwater and leachate from the site. The treatment system will also facilitate the extraction of additional groundwater (from eight extraction wells, including five new extraction wells in addition to the three existing extraction wells). The treatment system is primarily designed to address volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) in the extracted groundwater and landfill leachate prior to discharge to surface water (i.e., the Valatie Kill). The system is not specifically designed to treat metals, but some amount of metals treatment is expected to occur as dissolved metals are taken up by the biomass and removed from the system with the biological sludge. Groundwater will be extracted from eight wells using electric submersible well pumps. The extracted groundwater will be pumped through double-contained high density polyethylene (HDPE) piping from each well to a common double-contained HDPE header line, which will extend to the treatment system. Landfill leachate will also be pumped from the landfill leachate collection tank to the treatment system. The treatment system will be housed within a 40-feet by 80-feet pre-engineered metal building which will be constructed to the west of the landfill on property owned by Rensselaer County. The treatment system will include the following major components:

- One equalization tank for leachate;
- One equalization tank for groundwater and leachate combined;
- One aerobic fixed-film bioreactor primarily to destroy benzene, toluene, ethylbenzene, and xylenes (BTEX), vinyl chloride, and acetone;
- One clarifier settling tank to remove residual solids/biological carryover from the bioreactor;
- Bag filtration system to remove remaining solids carryover from the clarifier;

- One induced draft low-profile air stripper system to address remaining or residual strippable VOCs;

- Two liquid-phase granular activated carbon (GAC) adsorption units installed in series to address SVOCs, residual adsorbable VOCs, and low concentrations of polychlorinated biphenyls (PCBs);

- Three vapor-phase GAC vessels to address primarily VOCs (with the exception of vinyl chloride and methylene chloride) from the air stripper exhaust stream;

- Two vapor-phase potassium permanganate impregnated zeolite (PPZ) vessels for the destruction of vinyl chloride and methylene chloride from the air stripper exhaust prior to discharge;

- One backwash water supply tank required for backwashing GAC and/or air stripper cleaning, etc.; and

- Programmable logic controller (PLC)–based control system.

Extracted groundwater will be pumped from the extraction wells to an equalization tank located in the treatment building. Landfill leachate will be first pumped from the leachate collection tank at the landfill to a leachate equalization tank in the treatment building, and will then be pumped into the main equalization tank. Groundwater and landfill leachate will then be pumped from the main equalization tank to an aerobic fixed-film bioreactor tank. The bioreactor will consist of a submerged fixed-film growth media within a reactor tank, incorporating aeration and biological treatment. The bioreactor system will be designed primarily to destroy BTEX, vinyl chloride, and acetone, and is also expected to address other chlorinated VOCs and SVOCs to some extent. Inside of the bioreactor, biomass will attach to the growth media, with aerators and chemical feed systems to provide sufficient oxygen and nutrients for sustaining adequate biomass within the reactor. In the course of the biological process, biomass will slough off the growth media and exit the reactor tank. Effluent from the reactor tank, which will include this biomass and other solids that carryover from the bioreactor, will flow to a clarifier. Settled solids collected at the bottom of the clarifier will be periodically withdrawn for dewatering and off-site transportation and disposal.

The clarifier settling tank will overflow to a pump station tank, which will be equipped with transfer pumps to subsequent treatment processes and a recycle pump. A recycle stream will be directed back to the influent tank in order to maintain a consistent flow rate through the bioreactor/clarifier as well as provide additional bio-treatment to enhance removal of contaminants. Water will then be pumped through a bag filtration system (two bag filter units installed in parallel) for removal of suspended solids prior to being directed to an induced draft low-profile air stripper to address remaining or residual strippable VOCs. Vapor exhaust from the air stripper and the vented air from the bioreactor will pass through three vapor-phase GAC units for adsorption of VOCs followed by two vessels containing PPZ for destruction of methylene chloride and vinyl chloride remaining in the vapor stream. Treated effluent from the air stripper will be either recycled back to the equalization tank based on tank level to maintain a continuous flow rate across the bioreactor, clarifier and air stripper, or directed through two liquid-phase GAC units in series to address SVOCs, residual adsorbable VOCs, and low concentrations of PCBs. Treated effluent will then flow to a backwash water storage tank. In order to maintain an adequate supply of treated water for backwashing purposes, all effluent will be directed through this tank. Treated effluent will be pumped for discharge to the Valatie Kill.

Equipment Layout

The treatment system will be located in a 40-feet by 80-feet by 18-feet tall pre-engineered metal building constructed on a concrete slab with a 6-inch containment curb at the building perimeter. Secondary containment within the treatment building is approximately 8,400 gallons, which is greater than 110% of the capacity of the largest tank specified. Building floor space will be allocated for waste drum storage and spare parts/equipment storage. The GAC and PPZ vessels along with the waste drum storage will be located near a 12-feet wide roll-up door on the east side of the treatment building to facilitate easy access for media change-out and waste removal.

The treatment building will also include a 10-feet by 16-feet (interior dimensions) control room to house the motor control center (MCC), PLC, human-machine interface (HMI) panel, and other electrical and control equipment. The control room is not part of the secondary containment area.

Instrumentation and Controls

The treatment system will be equipped with adequate instrumentation necessary for monitoring of key parameters. The function of major instrumentation is summarized below and described in further detail on Contract Drawings P2, P3, P4, and P5 provided in Appendix C of the Design Report/Implementation Plan (DR/IP).

- The extraction wells will be equipped with local pump control panels to control pump operation, flow meters to monitor extraction well flow, and level switches. All extraction well pump instrumentation will be in communication with and interlocked with the treatment system main control panel via buried control wiring. A similar configuration will be provided at the leachate collection tank at the landfill;

- The leachate tank in the treatment building will be equipped with level controls and switches to monitor for high or low level conditions and to control pump and actuated valve operation;

- The main equalization tank will be equipped with level controls and switches to monitor for high or low level conditions and to control pump and actuated valve operation;

- The fixed-film bioreactor feed line will be equipped with a flow meter to control feed pump operation and monitor flow conditions to the bioreactor;

- The fixed-film bioreactor will be equipped with instrumentation to monitor pH, dissolved oxygen, and temperature, along with a level switch to monitor for a high level condition;

- The clarifier will be equipped with a level switch to monitor for a high level condition;

- The clarifier pump station will be equipped with level controls and switches to monitor for high or low level conditions and to control pump operation;

- The air stripper feed line will be equipped with a pressure transmitter to monitor line pressure upstream of the bag filtration system and a flow meter to monitor flow conditions to the air stripper;

- The air stripper will be equipped with level transmitters and switches, pressure transmitters and switches, air flow meter, and temperature transmitter to detect critical alarm conditions associated with the air stripper system;

- The liquid-phase GAC system feed line will be equipped with a flow meter to monitor flow conditions and a pressure transmitter to monitor line pressure upstream of the GAC system; and

- Flow and pH meters will be mounted at the discharge line in the building for flow and effluent quality monitoring prior to discharge to surface water.

The instrumentation and process equipment located in the building and at the extraction wells will be hard-wired to a PLC mounted inside the building. The PLC will perform the following functions:

- Monitor various system parameters such as groundwater and air flow rates, tank levels, air stripper air inlet temperature, air stripper sump pressure, effluent pH, building temperature, bioreactor pH, bioreactor dissolved oxygen, and bioreactor temperature;

- Directly control equipment operations including actuated valves, pumps, and the air stripper;

- Initiate alarms and/or equipment shutdowns as detailed in the interlocks and control logic provided on Contract Drawings P5 in Appendix C of the DR/IP; and

- Notify operating personnel of alarm and/or shutdown conditions as appropriate via wireless telemetry.

A panel-mounted HMI will allow operators to connect to the PLC and will graphically display the status of the treatment system as well as log data and alarms. From the HMI, the operator will be able to operate equipment (i.e., turn on/off pumps, etc.), and change control and alarm set points. The PLC will also be provided with a wireless modem that will allow an off-site operator to remotely monitor the treatment system.

BASIS OF DESIGN

This section presents the basis of design for the proposed treatment system including flow rate, influent design concentrations, effluent limitations, air dispersion modeling results, anticipated performance of unit treatment processes, anticipated media usage, and utility requirements. The influent design concentrations and effluent limitations are provided in Table 1. Mass balances at flow rates of 5, 10, 15, 20, and 25 gallons per minute (gpm) are provided in Table 2.

Flow

The assumed total groundwater extraction and landfill leachate collection rate is expected to be between approximately 8 and 15 gpm. This anticipated total groundwater extraction and landfill leachate collection rate is based on an anticipated groundwater extraction rate of approximately 1 to 2 gpm per well from the three existing extraction wells and the five additional wells (total of eight extraction wells) and 0.75 gpm from the landfill leachate collection system. However, the design of the treatment system is based on an average flow rate of 15 gpm and a maximum flow rate of 25 gpm. Comparatively, the three existing wells operated by NYSDEC, USEPA and now the Respondents have extracted groundwater at an average combined flow rate of about 3 to 4 gpm for seven months in 2009 and 2010, six months in 2011, and twelve months in 2012.[1]

[1] In 2009, 2010, and 2011, based on data provided by NYSDEC and USEPA regarding the volume of landfill leachate and extracted groundwater transported off-site, NYSDEC, USEPA and the Respondents extracted 846,836 gallons, 1,075,381 gallons, 759,197 gallons, and 1,829,113 gallons of groundwater, respectively, from the three existing extraction wells during the periods of operation each year. Using these volumes, the effective annual groundwater extraction rates were 1.6 gpm in 2009, 2.1 gpm in 2010, 1.4 gpm in 2011, and 3.5 gpm in 2012. However, groundwater extraction only occurred for about seven months in 2009 and 2010, and six months in 2011. Therefore, during the periods of operation, the extraction rate was about 3 to 4 gpm for the three wells combined, which is comparable to the full year of operation in 2012. Extraction well EW-2 accounted for about 50 to 60 percent of the flow with the remainder about evenly split between EW-1 and EW-3. NYSDEC only extracted 206,511 gallon of groundwater in 2008, and over a shorter period than in the three subsequent years, so that flow data was not used during the design process.

The expected landfill leachate collection rate is approximately 0.75 gpm on a year-round basis, or 400,000 gallons per year. This is based on NYSDEC's collection rate that averaged about 368,000 gallons per year for the 15 years between 1997 and 2011 (with USEPA performing the landfill leachate collection in late 2011). In 2012, the leachate collection rate was about 0.5 gpm, or about 264,226 gallons per year, which may be related to dry weather conditions.

Influent Design Concentrations

Groundwater sampling and analysis from the existing three extraction wells and landfill leachate have shown concentrations of BTEX, chlorinated VOCs, and some SVOCs in excess of the effluent limitations. A summary of the sampling and analysis performed prior to the Consent Order was provided in Appendix B of the Preliminary Design Plan (PDP) conditionally approved by USEPA. The influent design concentrations were developed using the analytical data gathered prior to the Consent Order, the analytical data provided in the Preliminary Design Data Report (PDDR) submitted to USEPA, and additional extraction well sampling results from December 2012 submitted to USEPA in the December 2012 Monthly Progress Report. The influent design concentrations for groundwater and landfill leachate were calculated by first averaging the concentrations for each parameter at each of the three extraction wells and the leachate collection tank. A flow-weighted concentration for each parameter was then calculated. Because extraction well EW-2 has about twice the flow, EW-2 concentrations were weighted two times the concentrations of each of the other two extraction wells (EW-1 and EW-3) and the landfill leachate. The resultant influent design concentrations are provided in Table 1.

Effluent Limitations

The treatment system is being designed to remove constituents of concern from the extracted groundwater and landfill leachate before discharge to the Valatie Kill. Effluent limitations for individual constituents are also included in Table 1. USEPA provided Respondents with revised discharge limitations and monitoring requirements from NYSDEC on February 6, 2013.[2]

Air Dispersion Modeling Results

Anticipated VOC and SVOC concentrations in the air stripper exhaust and all vented tanks were modeled to evaluate the need for vapor treatment based on current NYSDEC air quality regulations. Based on the influent design concentrations and design average flow rate (i.e., 15 gpm), vapor-

[2] In the substantive requirements provided by USEPA from NYSDEC, the discharge to the unnamed tributary to the Valatie Kill is referred to as Outfall 001 and the discharge to the Valatie Kill is referred to as Outfall 002. The effluent limitations on Table 1 are the discharge limitations and monitoring requirements for discharge to the Valatie Kill.

phase treatment will be necessary and has been incorporated into the design. Vented air from the bioreactor and the air stripper exhaust will both be treated through three vapor-phase GAC vessels installed in series on the air stripper blower outlet. The GAC vessels will address VOCs with the exception of methylene chloride and vinyl chloride. Two vapor-phase PPZ vessels will be installed in series with the GAC vessels for methylene chloride and vinyl chloride destruction. The following five tanks and air stripper unit that could potentially contain VOC and SVOC emissions were included in the modeling:

- T-100 – Leachate Tank;
- T-200 – Equalization Tank;
- T-300 – Fixed-Film Bioreactor;
- T-400 – Clarifier;
- T-410 – Clarifier Pump Station; and
- AS-500 – Low-Profile Air Stripper

Additional information regarding the dispersion modeling used to calculate air emissions was provided in the PDP conditionally approved by USEPA. As shown on Table 3, which is an updated version of the table provided in Appendix E of the PDP, the air emissions from the proposed treatment system are much lower than the applicable annual guideline concentrations (AGCs) and short-term guideline concentrations (SGCs).

Anticipated Bioreactor Performance

As stated above, the aerobic fixed-film bioreactor is designed primarily to destroy BTEX and acetone, but it will also address chlorinated VOCs and SVOCs to some extent. The design was based on observed operational performance from existing ARCADIS-operated biological treatment systems, discussions with equipment suppliers, results of a two-phase bench-scale treatability test provided in the PDDR, and results from a third pilot-scale treatability test completed at the site in January 2013. The results of the third test are discussed in the Phase III Treatability Test Report provided as Attachment A to this basis of design. In order to develop the mass balances provided in Table 2, the anticipated removal rates through the bioreactor for various constituents are as follows:

- Acetone and other ketones such as 2-butanone and 4-methyl-2-pentanone 98 to 99%
- BTEX and vinyl chloride 92 to 99%
- Phenols (non-chlorinated) 80 to 95%
- Other chlorinated VOCs 70 to 90%

For the purposes of developing the mass balances, the lower removal rates were used and these removal rates were not varied for flow rates between 5 and 25 gpm.

Anticipated Low-Profile Air Stripper Performance

The air stripper is being designed to address VOCs listed in Table 1 leaving the bioreactor, with the exception of acetone and other ketones, to below 1 microgram per liter (µg/L). Acetone, other ketones, and SVOCs (except chlorinated benzenes) are not anticipated to be removed by the air stripper.

Anticipated Liquid-Phase Carbon Usage

Based on the influent design concentrations provided in Table 1, an assumed average groundwater extraction and landfill leachate flow rate of 15 gpm, and the lower end of the anticipated constituent removal efficiency ranges by equipment upstream of the liquid-phase GAC units identified above, the annual liquid-phase carbon usage is estimated to be approximately 6,000 pounds per year (three change-outs of the lead GAC unit per year). Carbon usage rates have been estimated based on isotherms provided by Tigg.

Anticipated Vapor-Phase Media Usage

Based on the influent design concentrations provided in Table 1, an assumed average groundwater extraction and landfill leachate flow rate of 15 gpm, and the lower end of the anticipated constituent removal efficiency ranges by equipment upstream of the low-profile air stripper identified above, the annual vapor-phase carbon usage is estimated to be approximately 5,000 pounds per year (one or two change-outs of the lead GAC unit per year) to treat VOCs, except as noted below, to non-detect levels. Carbon usage rates are based on the assumption that methylene chloride and vinyl chloride will not be effectively removed by the GAC. The annual vapor-phase PPZ usage is estimated to be approximately 1,000 pounds per year (one change-out of the lead PPZ unit every three to four years) for the destruction of methylene chloride and vinyl chloride. While the liquid and vapor-phase GAC units were sized based on anticipated carbon usage, the vapor-phase PPZ units were also sized based on the required contact time needed for destruction of methylene chloride and vinyl chloride. Usage rates for both vapor-phase media have been estimated based on isotherms provided by Tigg.

Utility Requirements

Single-phase power is available from National Grid near the landfill. As identified on Contract Drawing E2, a new 480 volt transformer is required to supply a 400 amp service to the treatment building. In order to power the well pumps and treatment equipment (centrifugal pumps and blowers) located in the treatment building, step-down transformers will be installed to provide 240 volt single-phase service. National Grid has easements in place to install the necessary utility poles and transformer for this project, and this will be performed by National Grid prior to or during construction of the treatment system.

No natural gas, compressed air, or potable water is anticipated to be required. Sanitary facilities will consist of a portable restroom located outside the treatment system (but within the fencing that will surround the treatment system).

MAJOR EQUIPMENT SPECIFICATIONS

This section presents a description of the equipment that will be utilized in the treatment system. The specifications of the major system equipment are provided below. An equipment schedule that includes instrumentation is provided in Table 4.

Extraction Well Pumps (P-101 to P-108)

Quantity:	8
Type:	Submersible well pump
Manufacturer:	Grundfos or equivalent
Model:	10Redi-Flo3-260 or equivalent
Capacity:	5 gpm at 340 feet total dynamic head (TDH)
Electrical:	1 horsepower (hp), 230 volt, single phase

Leachate Collection Tank Pump (P-001) (located at the landfill)

Quantity:	1
Type:	Submersible well pump
Manufacturer:	Grundfos or equivalent
Model:	XGOWS0712BF or equivalent
Capacity:	20 gpm at 35 feet TDH
Electrical:	1/2 hp, 230 volt, single phase

Leachate Tank (T-100) (located within the treatment building)

Quantity:	1
Type:	Flat bottom vertical tank with domed top
Manufacturer:	Snyder Industries or equivalent
Model:	1800000N or equivalent
Capacity:	550 gallons
Material of Construction:	HDPE

Leachate Feed Pump (P-100) (located at Leachate Tank T-100)

Quantity:	1
Manufacturer:	LMI or equivalent
Model:	SD8387P or equivalent
Capacity:	115 GPH at 75 pounds per square inch (psi)
Electrical:	60 Hertz (Hz), 230 volt, single phase

Equalization Tank (T-200)

Quantity:	1
Type:	Flat bottom vertical tank with domed top
Manufacturer:	Snyder Industries or equivalent
Model:	1780200N or equivalent
Capacity:	1,900 gallons
Material of Construction:	HDPE

Bioreactor Feed Pumps (P-200A/B)

Quantity:	1
Type:	Closed coupled centrifugal
Manufacturer:	Goulds or equivalent
Model:	2ST2C4K4 or equivalent
Capacity:	25 gpm at 33 feet TDH
Electrical:	1/2 hp, 240 volt, three phase, 1750 revolutions per minute (rpm)

Fixed-Film Bioreactor (T-300)

Quantity:	1
Dimensions:	10 feet diameter with 12 feet side water height
Continuous Design Flow Rate:	15 gpm
Maximum Design Flow Rate:	25 gpm
Design BOD (5 day) Loading:	20 pounds per day
Media Volume:	450 cubic feet of polypropylene packing
Material of Construction:	Epoxy-coated carbon steel

Bioreactor Blower (B-300)

Quantity:	1
Type:	Positive displacement
Manufacturer:	Dresser Industries or equivalent
Model:	URI-22 or equivalent
Capacity:	36 cubic feet per minute (cfm) at 10 psi
Electrical:	5 hp, 240 volt, single phase

Bioreactor Chemical Feed Pumps (P-300 and P-301)

Quantity:	2
Type:	Electronic metering pump
Manufacturer:	Pulsatron or equivalent
Model:	LE03 or equivalent
Capacity:	0.50 GPH at 150 psi
Electrical:	5 hp, 230 volt, single phase, 1750 rpm

Clarifier (T-400)

Quantity:	1
Type:	Sloped bottom with integrally molded drain outlet and domed top
Dimensions:	10 feet diameter by 8 feet, 7 inches high
Capacity:	4,000 gallons
Continuous Design Flow Rate:	15 gpm
Maximum Design Flow Rate:	25 gpm
Design Influent Solids:	100 milligrams per liter (mg/L)
Estimated Sludge Production:	75 gallons per day (3% solids)
Material of Construction:	HDPE

Sludge Pump (P-400)

Quantity:	1
Type:	Progressive cavity
Manufacturer:	Moyno or equivalent
Model:	33152 or equivalent
Capacity:	1.7 gpm at 30 psi
Electrical:	5 hp, 230 volt, single phase, 1750 rpm

Pressure Filter Unit (PF-400 and PF-410A/B)

Quantity:	3
Manufacturer:	Rosedale
Model:	8-30
Capacity:	25 gpm
Materials of Construction:	Stainless steel

Clarifier Pump Station Tank (T-410)

Quantity:	1
Type:	Flat bottom with domed top
Manufacturer:	Snyder Industries or equivalent
Model:	8060000N
Capacity:	550 gallons
Materials of Construction:	HDPE

Air Stripper Feed and Discharge Pumps (P-410A/B and P-500A/B)

Quantity:	1
Type:	Closed coupled centrifugal
Manufacturer:	Goulds or equivalent
Model:	1ST1D4E4 or equivalent
Capacity:	25 gpm at 58 feet TDH
Electrical:	3/4 hp, 240 volt, three phase, 3500 rpm

Air Stripper Inlet Duct Heater

Manufacturer:	Indeeco or equivalent
Model:	QUZ or equivalent
Capacity:	10 kW (kilowatt)

Recycle Pump (P-420)

Quantity:	1
Type:	Closed coupled centrifugal
Manufacturer:	Goulds or equivalent
Model:	1ST2C4A4 or equivalent
Capacity:	15 gpm at 33 feet TDH
Electrical:	1/2 hp, 240 volt, single phase, 1750 rpm

Low-Profile Air Stripper (AS-500)

Quantity:	1
Manufacturer:	NEEP Systems or equivalent
Model:	ShallowTray Model 2600 or equivalent
Maximum Design Flow Rate:	25 gpm
Number of Trays:	5
Materials of Construction:	304L Stainless Steel

Air Stripper Blower (B-500)

Quantity:	1
Manufacturer:	New York Blower or equivalent
Model:	2606A or equivalent
Flow Rate:	600 cfm at 52 inches water column
Electrical:	10 hp, 240 volt, single phase

Vapor-Phase Carbon Vessels (GAC-501 to GAC-503)

Quantity:	3
Manufacturer:	Tigg or equivalent
Model:	N-4000-PDB or equivalent
Design Flow Rate:	600 cfm
Media Capacity:	4,000 pounds of vapor-phase GAC
Materials of Construction:	Epoxy-coated carbon steel

Vapor-Phase PPZ Vessels (PPZ-504 and PPZ-505)

Quantity:	2
Manufacturer:	Siemens or equivalent
Model:	FB-2000 or equivalent
Design Flow Rate:	600 cfm
Media Capacity:	3,500 pounds of PPZ
Materials of Construction:	Epoxy-coated carbon steel

Liquid-Phase Carbon Vessels (GAC-601 and GAC-602)

Quantity:	2
Manufacturer:	Siemens or equivalent
Model:	PV-2000 or equivalent
Maximum Design Flow Rate:	25 gpm
Media Capacity:	2,000 pounds of liquid-phase GAC
Materials of Construction:	Epoxy-coated carbon steel

Backwash Tank (T-800)

Quantity:	1
Type:	Flat bottom with domed top
Manufacturer:	Snyder Industries or equivalent
Model:	1831000N
Capacity:	2,000 gallons
Materials of Construction:	HDPE

Backwash Pump (P-800)

Quantity:	1
Type:	Closed coupled centrifugal
Manufacturer:	Goulds or equivalent
Model:	2ST1E4E4 or equivalent
Capacity:	50 gpm at 58 feet TDH
Electrical:	1-1/2 hp, 240 volt, single phase, 3500 rpm

Process Wash Vessel Feed Pump (P-810)

Quantity:	1
Type:	Closed coupled centrifugal
Manufacturer:	Davey or equivalent
Model:	HS12-40HT1 or equivalent
Capacity:	12 gpm at 40 psi
Electrical:	120 volt, single phase, 0.9 kW

Backwash Supply Tank Discharge Pumps (P-820A/B)

Quantity:	1
Type:	Closed coupled centrifugal
Manufacturer:	Goulds or equivalent
Model:	1ST1D4E4 or equivalent
Capacity:	25 gpm at 58 feet TDH
Electrical:	3/4 hp, 240 volt, three phase, 3500 rpm

Process Sump Pump (P-900)

Quantity:	1
Type:	Submersible sump pump
Manufacturer:	Goulds or equivalent
Model:	WE0312M or equivalent
Capacity:	10 gpm at 16 feet TDH
Electrical:	1/3 hp, 230 volt, single phase, 1750 rpm

Process Wash Vessel

Manufacturer:	Eagle Group or equivalent
Model:	314-16-1-18-R or equivalent
Materials of Construction:	304 Stainless Steel

CONTRACT DRAWINGS

The Contract Drawings for this project are separately bound in Appendix C of the DR/IP.

OM&M REQUIREMENTS

The OM&M Plan is provided in Appendix I of the DR/IP and includes the following information:

- Procedures for regular operation, maintenance and monitoring of the systems, including, but not limited to, inspection and maintenance checklists and schedules for inspection and maintenance activities;

- Plans for general maintenance of access roads, the fence surrounding the landfill, extraction wells and treatment building area, structures including the treatment building and any other enclosures which house parts of the groundwater extraction and landfill leachate collection systems, and snow removal and grass cutting as necessary to access all components of the groundwater extraction and landfill leachate collection systems;

- A plan for providing security measures to be taken to keep unauthorized personnel from entering restricted work areas;

- A schedule for operation of the groundwater extraction, landfill leachate collection and treatment systems; and

- Plans and a schedule for monitoring of the treatment system in accordance with the revised Quality Assurance Project Plan (QAPP), that will be submitted to USEPA after the DR/IP, as well as a schedule for submission of the results to USEPA and/or other parties to be determined by USEPA.

ARCADIS

Tables

TABLE 1
DEWEY LOEFFEL LANDFILL SUPERFUND SITE
NASSAU, NEW YORK
INFLUENT DESIGN CONCENTRATIONS AND EFFLUENT LIMITATIONS

Parameter	Influent Design Concentrations	Effluent Limitations (Discharge to the Valatie Kill)
VOC (µg/L)		
Acetone	810	280
Benzene	9,800	5
2-Butanone	330	280
Chlorobenzene	1,900	10
Chloroethane	15	10
Chloroform	740	50
Chloromethane	60	10
Total Dichlorobenzenes	50	27
1,1-Dichloroethane	120	10
1,2-Dichloroethane	450	10
1,1-Dichloroethene	40	10
cis-1,2-Dichloroethene	2,400	10
trans-1,2-Dichloroethene	55	10
Ethylbenzene	210	5
Isopropylbenzene	<14	14
Methylene Chloride	3,600	10
4-Methyl-2-Pentanone	<140	140
1,1,2,2-Tetrachloroethane	<50	50
Tetrachloroethene	120	5.4
Toluene	7,800	5
1,2,4-Trichlorobenzene	300	10
1,1,1-Trichloroethane	90	10
1,1,2-Trichloroethane	<10	10
Trichloroethylene	17,000	10
Trichlorofluoromethane	<10	10
Vinyl Chloride	570	10
Total Xylenes	870	15
SVOC (µg/L)		
Bis(2-Ethylhexyl)phthalate	5	5
2-Chlorophenol	5	Monitor
2,4-Dimethylphenol	85	10
2-Methylphenol	90	10
3- & 4-Methylphenol	310	10
Pentachlorophenol	10	Monitor
Phenol	270	10

Notes:
1. µg/L = Micrograms per liter
2. VOCs = Volatile organic compounds
3. SVOCs = Semi-volatile organic compounds
4. Influent concentrations based on data from existing extraction wells EW-101, EW-102 and EW-103, and landfill leachate.
5. The United States Environmental Protection Agency provided Respondents with revised effluent limitations and monitoring requirements from New York State Department of Environmental Conservation on February 6, 2013. Effluent limitations are based on daily maximum limits except for Tetrachloroethene, which is a monthly average limit. Total Xylenes effluent limitation is based on the sum of o-, m-, and p- isomers. Total Dichlorobenzenes effluent limitation is based on the sum of o-, m-, and p- isomers. The 3 & 4-Methylphenol effluent limitation is based on the sum of 3 and 4-Methylphenol, which often coelute. Effluent limitations are also included for total (sum of detected) chlorinated phenols (5.4 µg/L) and total (sum of detected) unchlorinated phenols (27 µg/L).

TABLE 2
DEWEY LOEFFEL LANDFILL SUPERFUND SITE
NASSAU, NEW YORK
MASS BALANCE

Mass Balance @ 5 gpm

Parameter	Design Influent		Bioreator Removal	Bioreactor Discharge		Air Stripper Discharge		Vapor-Phase GAC Loading	Potassium Permanganate Loading	Liquid-Phase GAC Loading	Liquid-Phase GAC Discharge	
	µg/L	lb/day	%	µg/L	lb/day	µg/L	lb/day	lb/day	lb/day	lb/day	µg/L	lb/day
VOC												
Acetone	810	0.049	98%	16	0.001	16	0.001	0.000	0.000	0.000	16	0.001
Benzene	9,800	0.589	92%	784	0.047	<1	0.000	0.047	0.000	0.000	<1	0.000
2-Butanone	330	0.020	98%	7	0.000	7	0.000	0.000	0.000	0.000	7	0.000
Chlorobenzene	1,900	0.114	70%	570	0.034	<1	0.000	0.034	0.000	0.000	<1	0.000
Chloroethane	15	0.001	70%	5	0.000	<1	0.000	0.000	0.000	0.000	<1	0.000
Chloroform	740	0.044	70%	222	0.013	<1	0.000	0.013	0.000	0.000	<1	0.000
Chloromethane	60	0.004	70%	18	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
Total Dichlorobenzenes	50	0.003	70%	15	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
1,1-Dichloroethane	120	0.007	70%	36	0.002	<1	0.000	0.002	0.000	0.000	<1	0.000
1,2-Dichloroethane	450	0.027	70%	135	0.008	<1	0.000	0.008	0.000	0.000	<1	0.000
1,1-Dichloroethene	40	0.002	70%	12	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
cis-1,2-Dichloroethene	2,400	0.144	70%	720	0.043	<1	0.000	0.043	0.000	0.000	<1	0.000
trans-1,2-Dichloroethene	55	0.003	70%	17	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
Ethylbenzene	210	0.013	92%	17	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
Isopropylbenzene	14	0.001	70%	4	0.000	<1	0.000	0.000	0.000	0.000	<1	0.000
Methylene Chloride	3,600	0.216	70%	1,080	0.065	<1	0.000	0.000	0.065	0.000	<1	0.000
4-Methyl-2-Pentanone	140	0.008	98%	3	0.000	<1	0.000	0.000	0.000	0.000	<1	0.000
1,1,2,2-Tetrachloroethane	50	0.003	70%	15	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
Tetrachloroethene	120	0.007	70%	36	0.002	<1	0.000	0.002	0.000	0.000	<1	0.000
Toluene	7,800	0.469	92%	624	0.037	<1	0.000	0.037	0.000	0.000	<1	0.000
1,2,4-Trichlorobenzene	300	0.018	70%	90	0.005	<1	0.000	0.005	0.000	0.000	<1	0.000
1,1,1-Trichloroethane	90	0.005	70%	27	0.002	<1	0.000	0.002	0.000	0.000	<1	0.000
1,1,2-Trichloroethane	5	0.000	70%	2	0.000	<1	0.000	0.000	0.000	0.000	<1	0.000
Trichloroethene	17,000	1.021	70%	5,100	0.306	<1	0.000	0.306	0.000	0.000	<1	0.000
Trichlorofluoromethane	5	0.000	70%	2	0.000	<1	0.000	0.000	0.000	0.000	<1	0.000
Vinyl Chloride	570	0.034	92%	46	0.003	<1	0.000	0.000	0.003	0.000	<1	0.000
Total Xylenes	870	0.052	92%	70	0.004	<1	0.000	0.004	0.000	0.000	<1	0.000
SVOC												
Bis(2-Ethylhexyl)phthalate	8	0.000	80%	2	0.000	2	0.000	0.000	0.000	0.000	<1	0.000
2-Chlorophenol	5	0.000	80%	1	0.000	1	0.000	0.000	0.000	0.000	<1	0.000
2,4-Dimethylphenol	85	0.005	80%	17	0.001	17	0.001	0.000	0.000	0.001	<1	0.000
2-Methylphenol	90	0.005	80%	18	0.001	18	0.001	0.000	0.000	0.001	<1	0.000
4-Methylphenol	310	0.019	80%	62	0.004	62	0.004	0.000	0.000	0.004	<1	0.000
Pentachlorophenol	10	0.001	80%	2	0.000	2	0.000	0.000	0.000	0.000	<1	0.000
Phenol	270	0.016	80%	54	0.003	54	0.003	0.000	0.000	0.003	<1	0.000

Conversions:

lbs/day = (gpm)(1,440 gpd/ 1 gpm)(3.7853 liters/ 1 gal)(µg/liter)(1 lb/ 453,592,370 µg)

1 gpm = 1,440 gpd
1 gal = 3.7853 liters
1 lb = 453,592,370 micrograms

TABLE 2
DEWEY LOEFFEL LANDFILL SUPERFUND SITE
NASSAU, NEW YORK
MASS BALANCE

Mass Balance @ 10 gpm

Parameter	Design Influent		Bioreator Removal	Bioreactor Discharge		Air Stripper Discharge		Vapor-Phase GAC Loading	Potassium Permanganate Loading	Liquid-Phase GAC Loading	Liquid-Phase GAC Discharge	
	µg/L	lb/day	%	µg/L	lb/day	µg/L	lb/day	lb/day	lb/day	lb/day	µg/L	lb/day
VOC												
Acetone	810	0.097	98%	16	0.002	16	0.002	0.000	0.000	0.000	16	0.002
Benzene	9,800	1.178	92%	784	0.094	<1	0.000	0.094	0.000	0.000	<1	0.000
2-Butanone	330	0.040	98%	7	0.001	7	0.001	0.000	0.000	0.000	7	0.001
Chlorobenzene	1,900	0.228	70%	570	0.068	<1	0.000	0.068	0.000	0.000	<1	0.000
Chloroethane	15	0.002	70%	5	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
Chloroform	740	0.089	70%	222	0.027	<1	0.000	0.027	0.000	0.000	<1	0.000
Chloromethane	60	0.007	70%	18	0.002	<1	0.000	0.002	0.000	0.000	<1	0.000
Total Dichlorobenzenes	50	0.006	70%	15	0.002	<1	0.000	0.002	0.000	0.000	<1	0.000
1,1-Dichloroethane	120	0.014	70%	36	0.004	<1	0.000	0.004	0.000	0.000	<1	0.000
1,2-Dichloroethane	450	0.054	70%	135	0.016	<1	0.000	0.016	0.000	0.000	<1	0.000
1,1-Dichloroethene	40	0.005	70%	12	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
cis-1,2-Dichloroethene	2,400	0.288	70%	720	0.087	<1	0.000	0.087	0.000	0.000	<1	0.000
trans-1,2-Dichloroethene	55	0.007	70%	17	0.002	<1	0.000	0.002	0.000	0.000	<1	0.000
Ethylbenzene	210	0.025	92%	17	0.002	<1	0.000	0.002	0.000	0.000	<1	0.000
Isopropylbenzene	14	0.002	70%	4	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
Methylene Chloride	3,600	0.433	70%	1,080	0.130	<1	0.000	0.000	0.130	0.000	<1	0.000
4-Methyl-2-Pentanone	140	0.017	98%	3	0.000	<1	0.000	0.000	0.000	0.000	<1	0.000
1,1,2,2-Tetrachloroethane	50	0.006	70%	15	0.002	<1	0.000	0.002	0.000	0.000	<1	0.000
Tetrachloroethene	120	0.014	70%	36	0.004	<1	0.000	0.004	0.000	0.000	<1	0.000
Toluene	7,800	0.937	92%	624	0.075	<1	0.000	0.075	0.000	0.000	<1	0.000
1,2,4-Trichlorobenzene	300	0.036	70%	90	0.011	<1	0.000	0.011	0.000	0.000	<1	0.000
1,1,1-Trichloroethane	90	0.011	70%	27	0.003	<1	0.000	0.003	0.000	0.000	<1	0.000
1,1,2-Trichloroethane	5	0.001	70%	2	0.000	<1	0.000	0.000	0.000	0.000	<1	0.000
Trichloroethene	17,000	2.043	70%	5,100	0.613	<1	0.000	0.613	0.000	0.000	<1	0.000
Trichlorofluoromethane	5	0.001	70%	2	0.000	<1	0.000	0.000	0.000	0.000	<1	0.000
Vinyl Chloride	570	0.068	92%	46	0.005	<1	0.000	0.000	0.005	0.000	<1	0.000
Total Xylenes	870	0.105	92%	70	0.008	<1	0.000	0.008	0.000	0.000	<1	0.000
SVOC												
Bis(2-Ethylhexyl)phthalate	8	0.001	80%	2	0.000	2	0.000	0.000	0.000	0.000	<1	0.000
2-Chlorophenol	5	0.001	80%	1	0.000	1	0.000	0.000	0.000	0.000	<1	0.000
2,4-Dimethylphenol	85	0.010	80%	17	0.002	17	0.002	0.000	0.000	0.002	<1	0.000
2-Methylphenol	90	0.011	80%	18	0.002	18	0.002	0.000	0.000	0.002	<1	0.000
4-Methylphenol	310	0.037	80%	62	0.007	62	0.007	0.000	0.000	0.007	<1	0.000
Pentachlorophenol	10	0.001	80%	2	0.000	2	0.000	0.000	0.000	0.000	<1	0.000
Phenol	270	0.032	80%	54	0.006	54	0.006	0.000	0.000	0.006	<1	0.000

Conversions:

lbs/day = (gpm)(1,440 gpd/ 1 gpm)(3.7853 liters/ 1 gal)(µg/liter)(1 lb/ 453,592,370 µg)

1 gpm = 1,440 gpd
1 gal = 3.7853 liters
1 lb = 453,592,370 micrograms

TABLE 2
DEWEY LOEFFEL LANDFILL SUPERFUND SITE
NASSAU, NEW YORK
MASS BALANCE

Mass Balance @ 15 gpm

Parameter	Design Influent		Bioreator Removal	Bioreactor Discharge		Air Stripper Discharge		Vapor-Phase GAC Loading	Potassium Permanganate Loading	Liquid-Phase GAC Loading	Liquid-Phase GAC Discharge	
	µg/L	lb/day	%	µg/L	lb/day	µg/L	lb/day	lb/day	lb/day	lb/day	µg/L	lb/day
VOC												
Acetone	810	0.146	98%	16	0.003	16	0.003	0.000	0.000	0.000	16	0.003
Benzene	9,800	1.767	92%	784	0.141	<1	0.000	0.141	0.000	0.000	<1	0.000
2-Butanone	330	0.059	98%	7	0.001	7	0.001	0.000	0.000	0.000	7	0.001
Chlorobenzene	1,900	0.342	70%	570	0.103	<1	0.000	0.103	0.000	0.000	<1	0.000
Chloroethane	15	0.003	70%	5	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
Chloroform	740	0.133	70%	222	0.040	<1	0.000	0.040	0.000	0.000	<1	0.000
Chloromethane	60	0.011	70%	18	0.003	<1	0.000	0.003	0.000	0.000	<1	0.000
Total Dichlorobenzenes	50	0.009	70%	15	0.003	<1	0.000	0.003	0.000	0.000	<1	0.000
1,1-Dichloroethane	120	0.022	70%	36	0.006	<1	0.000	0.006	0.000	0.000	<1	0.000
1,2-Dichloroethane	450	0.081	70%	135	0.024	<1	0.000	0.024	0.000	0.000	<1	0.000
1,1-Dichloroethene	40	0.007	70%	12	0.002	<1	0.000	0.002	0.000	0.000	<1	0.000
cis-1,2-Dichloroethene	2,400	0.433	70%	720	0.130	<1	0.000	0.130	0.000	0.000	<1	0.000
trans-1,2-Dichloroethene	55	0.010	70%	17	0.003	<1	0.000	0.003	0.000	0.000	<1	0.000
Ethylbenzene	210	0.038	92%	17	0.003	<1	0.000	0.003	0.000	0.000	<1	0.000
Isopropylbenzene	14	0.003	70%	4	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
Methylene Chloride	3,600	0.649	70%	1,080	0.195	<1	0.000	0.000	0.195	0.000	<1	0.000
4-Methyl-2-Pentanone	140	0.025	98%	3	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
1,1,2,2-Tetrachloroethane	50	0.009	70%	15	0.003	<1	0.000	0.003	0.000	0.000	<1	0.000
Tetrachloroethene	120	0.022	70%	36	0.006	<1	0.000	0.006	0.000	0.000	<1	0.000
Toluene	7,800	1.406	92%	624	0.112	<1	0.000	0.112	0.000	0.000	<1	0.000
1,2,4-Trichlorobenzene	300	0.054	70%	90	0.016	<1	0.000	0.016	0.000	0.000	<1	0.000
1,1,1-Trichloroethane	90	0.016	70%	27	0.005	<1	0.000	0.005	0.000	0.000	<1	0.000
1,1,2-Trichloroethane	5	0.001	70%	2	0.000	<1	0.000	0.000	0.000	0.000	<1	0.000
Trichloroethene	17,000	3.064	70%	5,100	0.919	<1	0.000	0.919	0.000	0.000	<1	0.000
Trichlorofluoromethane	5	0.001	70%	2	0.000	<1	0.000	0.000	0.000	0.000	<1	0.000
Vinyl Chloride	570	0.103	92%	46	0.008	<1	0.000	0.000	0.008	0.000	<1	0.000
Total Xylenes	870	0.157	92%	70	0.013	<1	0.000	0.013	0.000	0.000	<1	0.000
SVOC												
Bis(2-Ethylhexyl)phthalate	8	0.001	80%	2	0.000	2	0.000	0.000	0.000	0.000	<1	0.000
2-Chlorophenol	5	0.001	80%	1	0.000	1	0.000	0.000	0.000	0.000	<1	0.000
2,4-Dimethylphenol	85	0.015	80%	17	0.003	17	0.003	0.000	0.000	0.003	<1	0.000
2-Methylphenol	90	0.016	80%	18	0.003	18	0.003	0.000	0.000	0.003	<1	0.000
4-Methylphenol	310	0.056	80%	62	0.011	62	0.011	0.000	0.000	0.011	<1	0.000
Pentachlorophenol	10	0.002	80%	2	0.000	2	0.000	0.000	0.000	0.000	<1	0.000
Phenol	270	0.049	80%	54	0.010	54	0.010	0.000	0.000	0.010	<1	0.000

Conversions:

lbs/day = (gpm)(1,440 gpd/ 1 gpm)(3.7853 liters/ 1 gal)(µg/liter)(1 lb/ 453,592,370 µg)

1 gpm =	1,440	gpd
1 gal =	3.7853	liters
1 lb =	453,592,370	micrograms

TABLE 2
DEWEY LOEFFEL LANDFILL SUPERFUND SITE
NASSAU, NEW YORK
MASS BALANCE

Mass Balance @ 20 gpm

Parameter	Design Influent		Bioreator Removal	Bioreactor Discharge		Air Stripper Discharge		Vapor-Phase GAC Loading	Potassium Permanganate Loading	Liquid-Phase GAC Loading	Liquid-Phase GAC Discharge	
	µg/L	lb/day	%	µg/L	lb/day	µg/L	lb/day	lb/day	lb/day	lb/day	µg/L	lb/day
VOC												
Acetone	810	0.195	98%	16	0.004	16	0.004	0.000	0.000	0.000	16	0.004
Benzene	9,800	2.355	92%	784	0.188	<1	0.000	0.188	0.000	0.000	<1	0.000
2-Butanone	330	0.079	98%	7	0.002	7	0.002	0.000	0.000	0.000	7	0.002
Chlorobenzene	1,900	0.457	70%	570	0.137	<1	0.000	0.137	0.000	0.000	<1	0.000
Chloroethane	15	0.004	70%	5	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
Chloroform	740	0.178	70%	222	0.053	<1	0.000	0.053	0.000	0.000	<1	0.000
Chloromethane	60	0.014	70%	18	0.004	<1	0.000	0.004	0.000	0.000	<1	0.000
Total Dichlorobenzenes	50	0.012	70%	15	0.004	<1	0.000	0.004	0.000	0.000	<1	0.000
1,1-Dichloroethane	120	0.029	70%	36	0.009	<1	0.000	0.009	0.000	0.000	<1	0.000
1,2-Dichloroethane	450	0.108	70%	135	0.032	<1	0.000	0.032	0.000	0.000	<1	0.000
1,1-Dichloroethene	40	0.010	70%	12	0.003	<1	0.000	0.003	0.000	0.000	<1	0.000
cis-1,2-Dichloroethene	2,400	0.577	70%	720	0.173	<1	0.000	0.173	0.000	0.000	<1	0.000
trans-1,2-Dichloroethene	55	0.013	70%	17	0.004	<1	0.000	0.004	0.000	0.000	<1	0.000
Ethylbenzene	210	0.050	92%	17	0.004	<1	0.000	0.004	0.000	0.000	<1	0.000
Isopropylbenzene	14	0.003	70%	4	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
Methylene Chloride	3,600	0.865	70%	1,080	0.260	<1	0.000	0.000	0.260	0.000	<1	0.000
4-Methyl-2-Pentanone	140	0.034	98%	3	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
1,1,2,2-Tetrachloroethane	50	0.012	70%	15	0.004	<1	0.000	0.004	0.000	0.000	<1	0.000
Tetrachloroethene	120	0.029	70%	36	0.009	<1	0.000	0.009	0.000	0.000	<1	0.000
Toluene	7,800	1.875	92%	624	0.150	<1	0.000	0.150	0.000	0.000	<1	0.000
1,2,4-Trichlorobenzene	300	0.072	70%	90	0.022	<1	0.000	0.022	0.000	0.000	<1	0.000
1,1,1-Trichloroethane	90	0.022	70%	27	0.006	<1	0.000	0.006	0.000	0.000	<1	0.000
1,1,2-Trichloroethane	5	0.001	70%	2	0.000	<1	0.000	0.000	0.000	0.000	<1	0.000
Trichloroethene	17,000	4.086	70%	5,100	1.226	<1	0.000	1.226	0.000	0.000	<1	0.000
Trichlorofluoromethane	5	0.001	70%	2	0.000	<1	0.000	0.000	0.000	0.000	<1	0.000
Vinyl Chloride	570	0.137	92%	46	0.011	<1	0.000	0.000	0.011	0.000	<1	0.000
Total Xylenes	870	0.209	92%	70	0.017	<1	0.000	0.017	0.000	0.000	<1	0.000
SVOC												
Bis(2-Ethylhexyl)phthalate	8	0.002	80%	2	0.000	2	0.000	0.000	0.000	0.000	<1	0.000
2-Chlorophenol	5	0.001	80%	1	0.000	1	0.000	0.000	0.000	0.000	<1	0.000
2,4-Dimethylphenol	85	0.020	80%	17	0.004	17	0.004	0.000	0.000	0.004	<1	0.000
2-Methylphenol	90	0.022	80%	18	0.004	18	0.004	0.000	0.000	0.004	<1	0.000
4-Methylphenol	310	0.075	80%	62	0.015	62	0.015	0.000	0.000	0.015	<1	0.000
Pentachlorophenol	10	0.002	80%	2	0.000	2	0.000	0.000	0.000	0.000	<1	0.000
Phenol	270	0.065	80%	54	0.013	54	0.013	0.000	0.000	0.013	<1	0.000

Conversions:
lbs/day = (gpm)(1,440 gpd/ 1 gpm)(3.7853 liters/ 1 gal)(µg/liter)(1 lb/ 453,592,370 µg)

1 gpm = 1,440 gpd
1 gal = 3.7853 liters
1 lb = 453,592,370 micrograms

TABLE 2
DEWEY LOEFFEL LANDFILL SUPERFUND SITE
NASSAU, NEW YORK
MASS BALANCE

Mass Balance @ 25 gpm

Parameter	Design Influent		Bioreator Removal	Bioreactor Discharge		Air Stripper Discharge		Vapor-Phase GAC Loading	Potassium Permanganate Loading	Liquid-Phase GAC Loading	Liquid-Phase GAC Discharge	
	µg/L	lb/day	%	µg/L	lb/day	µg/L	lb/day	lb/day	lb/day	lb/day	µg/L	lb/day
VOC												
Acetone	810	0.243	98%	16	0.005	16	0.005	0.000	0.000	0.000	16	0.005
Benzene	9,800	2.944	92%	784	0.236	<1	0.000	0.235	0.000	0.000	<1	0.000
2-Butanone	330	0.099	98%	7	0.002	7	0.002	0.000	0.000	0.000	7	0.002
Chlorobenzene	1,900	0.571	70%	570	0.171	<1	0.000	0.171	0.000	0.000	<1	0.000
Chloroethane	15	0.005	70%	5	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
Chloroform	740	0.222	70%	222	0.067	<1	0.000	0.066	0.000	0.000	<1	0.000
Chloromethane	60	0.018	70%	18	0.005	<1	0.000	0.005	0.000	0.000	<1	0.000
Total Dichlorobenzenes	50	0.015	70%	15	0.005	<1	0.000	0.004	0.000	0.000	<1	0.000
1,1-Dichloroethane	120	0.036	70%	36	0.011	<1	0.000	0.011	0.000	0.000	<1	0.000
1,2-Dichloroethane	450	0.135	70%	135	0.041	<1	0.000	0.040	0.000	0.000	<1	0.000
1,1-Dichloroethene	40	0.012	70%	12	0.004	<1	0.000	0.003	0.000	0.000	<1	0.000
cis-1,2-Dichloroethene	2,400	0.721	70%	720	0.216	<1	0.000	0.216	0.000	0.000	<1	0.000
trans-1,2-Dichloroethene	55	0.017	70%	17	0.005	<1	0.000	0.005	0.000	0.000	<1	0.000
Ethylbenzene	210	0.063	92%	17	0.005	<1	0.000	0.005	0.000	0.000	<1	0.000
Isopropylbenzene	14	0.004	70%	4	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
Methylene Chloride	3,600	1.082	70%	1,080	0.324	<1	0.000	0.000	0.324	0.000	<1	0.000
4-Methyl-2-Pentanone	140	0.042	98%	3	0.001	<1	0.000	0.001	0.000	0.000	<1	0.000
1,1,2,2-Tetrachloroethane	50	0.015	70%	15	0.005	<1	0.000	0.005	0.000	0.000	<1	0.000
Tetrachloroethene	120	0.036	70%	36	0.011	<1	0.000	0.011	0.000	0.000	<1	0.000
Toluene	7,800	2.343	92%	624	0.187	<1	0.000	0.187	0.000	0.000	<1	0.000
1,2,4-Trichlorobenzene	300	0.090	70%	90	0.027	<1	0.000	0.027	0.000	0.000	<1	0.000
1,1,1-Trichloroethane	90	0.027	70%	27	0.008	<1	0.000	0.008	0.000	0.000	<1	0.000
1,1,2-Trichloroethane	5	0.002	70%	2	0.000	<1	0.000	0.000	0.000	0.000	<1	0.000
Trichloroethene	17,000	5.107	70%	5,100	1.532	<1	0.000	1.532	0.000	0.000	<1	0.000
Trichlorofluoromethane	5	0.002	70%	2	0.000	<1	0.000	0.000	0.000	0.000	<1	0.000
Vinyl Chloride	570	0.171	92%	46	0.014	<1	0.000	0.000	0.014	0.000	<1	0.000
Total Xylenes	870	0.261	92%	70	0.021	<1	0.000	0.021	0.000	0.000	<1	0.000
SVOC												
Bis(2-Ethylhexyl)phthalate	8	0.002	80%	2	0.000	2	0.000	0.000	0.000	0.000	<1	0.000
2-Chlorophenol	5	0.002	80%	1	0.000	1	0.000	0.000	0.000	0.000	<1	0.000
2,4-Dimethylphenol	85	0.026	80%	17	0.005	17	0.005	0.000	0.000	0.005	<1	0.000
2-Methylphenol	90	0.027	80%	18	0.005	18	0.005	0.000	0.000	0.005	<1	0.000
4-Methylphenol	310	0.093	80%	62	0.019	62	0.019	0.000	0.000	0.019	<1	0.000
Pentachlorophenol	10	0.003	80%	2	0.001	2	0.001	0.000	0.000	0.001	<1	0.000
Phenol	270	0.081	80%	54	0.016	54	0.016	0.000	0.000	0.016	<1	0.000

Conversions:
lbs/day = (gpm)(1,440 gpd/ 1 gpm)(3.7853 liters/ 1 gal)(µg/liter)(1 lb/ 453,592,370 µg)

1 gpm = 1,440 gpd
1 gal = 3.7853 liters
1 lb = 453,592,370 micrograms

TABLE 3
DEWEY LOEFFEL LANDFILL SUPERFUND SITE
NASSAU, NEW YORK
AIR EMISSION MODELING RESULTS

Pollutant	Emission Rate T-100 (lb/hr)	Emission Rate T-200 (lb/hr)	Emission Rate T-300 (lb/hr)	Emission Rate T-400 (lb/hr)	Emission Rate T-410 (lb/hr)	Emission Rate AS-500 (lb/hr)	Total Emission Rate (lb/hr)	Total Emission Rate (g/s)	Max Annual Impacts (µg/m^3)	AGC (µg/m^3)	% of AGC	Short Term Impacts (µg/m^3)	SGC (µg/m^3)	% of SGC
Acetone	4.59E-05	3.18E-05	2.27E-10	1.69E-06	4.97E-07	0.00E+00	7.98E-05	1.01E-05	0.00	30,000	0%	0.08	180,000	0%
Benzene	3.57E-04	6.21E-04	2.44E-06	1.38E-04	3.93E-05	5.88E-07	1.16E-03	1.46E-04	0.03	0.13	21%	1.15	1,300	---
2-Butanone	1.27E-05	1.77E-05	5.10E-10	1.25E-06	2.96E-07	0.00E+00	3.20E-05	4.03E-06	0.00	5,000	0%	0.03	13,000	0%
Chlorobenzene	1.21E-04	1.11E-04	1.20E-06	9.24E-05	2.63E-05	4.27E-07	3.53E-04	4.44E-05	0.01	110	0%	0.35	---	---
Chloroethane	1.65E-06	1.06E-06	3.39E-08	9.82E-07	2.79E-07	2.63E-09	4.01E-06	5.05E-07	0.00	10,000	0%	0.00	---	
Chloroform	2.20E-07	4.75E-05	4.56E-07	3.95E-05	1.12E-05	1.66E-07	9.91E-05	1.25E-05	0.00	0.043	6%	0.10	150	0%
Chloromethane	1.29E-06	2.90E-06	8.89E-08	2.42E-06	6.87E-07	1.28E-08	7.39E-06	9.31E-07	0.00	90.000	0%	0.01	22,000	0%
1,1-Dichloroethane	4.50E-06	7.96E-06	1.13E-07	6.63E-06	1.89E-06	2.63E-08	2.11E-05	2.66E-06	0.00	0.63	0%	0.02	---	---
1,2-Dichloroethane	0.00E+00	0.00E+00	8.90E-08	2.36E-05	6.72E-06	1.01E-07	3.05E-05	3.84E-06	0.00	0.038	2%	0.03	---	---
1,1-Dichloroethene	1.21E-07	2.65E-06	1.74E-07	2.20E-06	6.27E-07	8.26E-09	5.78E-06	7.28E-07	0.00	70	0%	0.01	---	---
cis-1,2-Dichloroethene	1.32E-04	1.68E-04	6.25E-06	1.40E-04	3.97E-05	5.40E-07	4.86E-04	6.13E-05	0.01	63	0%	0.48	---	---
trans-1,2-Dichloroethene	4.18E-06	3.98E-06	6.14E-07	3.42E-06	9.72E-07	1.16E-08	1.32E-05	1.66E-06	0.00	63	0%	0.01	---	---
Ethylbenzene	1.28E-05	1.33E-05	7.41E-08	2.96E-06	8.42E-07	1.19E-08	3.00E-05	3.78E-06	0.00	1,000	0%	0.03	54,000	0%
Methylene Chloride	2.59E-05	2.56E-04	1.81E-06	2.13E-04	6.06E-05	0.00E+00	5.57E-04	7.02E-05	0.01	2	1%	0.55	14,000	0%
4-Methyl-2-Pentanone	7.84E-06	7.25E-06	6.12E-10	4.01E-07	1.14E-07	4.17E-09	1.56E-05	1.97E-06	0.00	3,000	0%	0.02	31,000	0%
Tetrachloroethene	2.51E-08	6.77E-06	3.57E-07	5.64E-06	1.61E-06	2.63E-08	1.44E-05	1.82E-06	0.00	1	0%	0.01	1,000	0%
Toluene	5.07E-04	4.14E-04	2.24E-06	9.19E-05	2.61E-05	4.68E-07	1.04E-03	1.31E-04	0.02	5,000	0%	1.04	37,000	0%
1,1,1-Trichloroethane	8.41E-08	5.32E-06	2.63E-07	4.44E-06	1.26E-06	1.95E-08	1.14E-05	1.43E-06	0.00	5,000	0%	0.01	9,000	0%
Trichloroethene	3.37E-07	9.80E-04	2.35E-06	8.14E-04	2.32E-04	3.83E-06	2.03E-03	2.56E-04	0.05	0.5	10%	2.02	14,000	0%
Vinyl Chloride	6.81E-05	4.22E-05	6.77E-07	9.37E-06	2.67E-06	0.00E+00	1.23E-04	1.55E-05	0.00	0.11	3%	0.12	180,000	0%
Total Xylenes	6.10E-05	4.74E-05	2.05E-07	1.05E-05	2.99E-06	5.42E-08	1.22E-04	1.54E-05	0.00	100	0%	0.12	4,300	0%
2-Chlorophenol	5.69E-08	6.38E-08	4.65E-12	3.29E-08	9.90E-09	0.00E+00	1.64E-07	2.06E-08	0.00	0.1	0%	0.00	---	---
1,2-Dichlorobenzene	1.57E-07	9.80E-07	5.43E-09	7.56E-07	2.15E-07	3.30E-09	2.12E-06	2.67E-07	0.00	200	0%	0.00	30,000	0%
1,4-Dichlorobenzene	1.44E-06	1.75E-06	1.78E-08	1.52E-06	4.32E-07	6.46E-09	5.17E-06	6.51E-07	0.00	0.09	0%	0.01	---	---
2,4-Dimethylphenol	8.65E-06	4.85E-06	8.77E-09	2.69E-06	7.66E-07	0.00E+00	1.70E-05	2.14E-06	0.00	0.1	0%	0.02	---	---
2-Methylphenol	1.59E-07	3.37E-07	1.61E-11	1.72E-07	5.22E-08	0.00E+00	7.21E-07	9.09E-08	0.00	52	0%	0.00	---	---
4-Methylphenol	5.16E-07	5.30E-07	2.43E-11	2.69E-07	8.20E-08	0.00E+00	1.40E-06	1.76E-07	0.00	52	0%	0.00	---	---
Pentachlorophenol	1.66E-08	3.70E-07	9.88E-11	2.02E-07	5.83E-08	0.00E+00	6.47E-07	8.15E-08	0.00	0.2	0%	0.00	---	---
Phenol	1.10E-07	8.92E-07	3.93E-11	4.54E-07	1.38E-07	0.00E+00	1.59E-06	2.01E-07	0.00	20	0%	0.00	5,800	0%
1,2,4-Trichlorobenzene	2.58E-07	1.66E-05	9.68E-08	1.38E-05	3.93E-06	6.68E-08	3.47E-05	4.38E-06	0.00	0.1	1%	0.03	3,700	0%

	At Road	Max	
Annual Normalize Conc. (µg/m^3 per g/s)	190	13713	West of parking area fenceline
Short Term Normalized (µg/m^3 per g/s)	7900	843	North of parking area fenceline

Notes:

1. AGC = Annual Guideline Concentration
2. SGC = Short-term Guideline Concentration
3. lb/hr = pounds per hour
4. µg/m3 = micrograms per cubic meter
5. g/s = grams per second

TABLE 4
DEWEY LOEFFEL LANDFILL SUPERFUND SITE
NASSAU, NEW YORK
EQUIPMENT SCHEDULE

Equipment Tag	Manufacturer	Model Number
Extraction Wells		
P-101--P-103	GRUNDFOS	10REDI-FLO3-260
FIT-101--FIT-103	BADGER	RECORDALL MODEL 55 WITH RTR FLOW TRANSMITTER
LSH-101--LSH-103	GEMS	LS750
Leachate Collection Tank (Located at the Landfill)		
P-001	GOULDS	XGOWS0712BF
FIT-001	BADGER	RECORDALL MODEL 55 WITH RTR FLOW TRANSMITTER
Main Treatment System		
T-100	SNYDER INDUSTRIES	1800000N
LSHH/LSLL-100	GEMS	LS750
LE/LT-100	WIKA	LS10
P-100	LMI	SD8387P
FIT-100	BADGER	1" MAGNETOFLOW
MV-200	HAYWARD	SERIES EMJ ELECTRIC ACTUATOR
T-200	SNYDER INDUSTRIES	1780200N
LSHH/LSLL-200	GEMS	LS750
LE/LT-200	WIKA	LS10
P-200A/B	GOULDS	2ST2C4K4
FIT-200	BADGER	1" MAGNETOFLOW
AE-300	FOXBORO	870ITPH
AE-310	HACH	5790000
TT-300	FOXBORO	RTT15-T1WCQNAF-L1
T-300	SEE CONTRACT DRAWING M7	
FIT-300A/B/C	DWYER INSTRUMENTS	RMB-52
PIT-300C	FOXBORO	IGP20-T22B21F-M1L1
B-300	DRESSER INDUSTRIES	PC-12-22
P-300--P-301	PULSAFEEDER PULSATRON	LE03
T-400	SEE CONTRACT DRAWING M8	
LSHH/LSLL-410	GEMS	LS750
LE/LT-410	WIKA	LS10
P-400	MOYNO	33152
PF-400	ROSEDALE	8-30
T-410	SNYDER INDUSTRIES	8060000N
P-410A/B	GOULDS	1ST1D4E4
FIT-410	BADGER	1" MAGNETOFLOW
PIT-410	FOXBORO	IGP10-T22D1F-M1L1
PF-410A/B	ROSEDALE	8-30
MV-410 A/B/C/D	ASAHI	3730020
PIT-420	FOXBORO	IGP10-T22D1F-M1L1
P-420	GOULDS	1ST2C4A4
DUCT HEATER	INDEECO	QUZ
TT-500	FOXBORO	RTT15-T1WCQNAF-L1
AS-500	NEEP SYSTEMS	SHALLOWTRAY MODEL 2650
FIT-500	SIERRA	620S-L06M1EN2V4DD0
B-500	NEW YORK BLOWER COMPANY	2606A
PIT-510	FOXBORO	IGP20-T22B21F-M1L1
GAC-501--GAC-503	TIGG	N-4000-PDB
PPZ-504--PPZ-505	SIEMENS	FB-2000
P-500 A/B	GOULDS	1ST1D4E4
FIT-510	BADGER	1" MAGNETOFLOW
PIT-520	FOXBORO	IGP10-T22D1F-M1L1
MV-500	HAYWARD	SERIES EMJ ELECTRONIC ACTUATOR
MV-510	HAYWARD	SERIES EMJ ELECTRONIC ACTUATOR
GAC-601--GAC-602	SIEMENS	PV-2000
FIT-800	BADGER	1" MAGNETOFLOW
P-800	GOULDS	2ST1E4E4
T-800	SNYDER INDUSTRIES	1831000N
LSH/LSL-800	GEMS	LS750
LE/LT-800	WIKA	LS10
P-810	DAVEY	HS12-40HT1
P-820A/B	GOULDS	1ST1D4E4
FIT-900	BADGER	1" MAGNETOFLOW
AIT-900	FOXBORO	870ITPH
P-900	GOULDS	WE0312M
PROCESS WASH VESSEL	EAGLE GROUP	314-16-1-18-R
Heating and Ventalation		
UH-1--UH-4, UH-6--UH-7	CHROMALOX	LUH-07-21-34
L-1/L-3	RUSKIN	ELC6375DAX, 36"W X 36" W
EF-1	GREENHECK	AWB 24A6B
UH-5	CHROMALOX	LUH-04-21-34
L-2	RUSKIN	ELC6375DAX, 12"W X 18" H
EF-2	GREENHECK	SE1-12-432-E-1

ARCADIS

Attachment A

ARCADIS, U.S., Inc.
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MEMO

To:
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Timothy Miller, P.E., ARCADIS
Christopher Lutz, P.E., ARCADIS
Steven Battaglia, ARCADIS

From:
Donald Sauda, P.E., ARCADIS

Date:
February 13, 2013

ARCADIS Project No.:
B0031174

Subject:
Dewey Loeffel Landfill Superfund Site
Nassau, New York
Treatment System
Phase III Treatability Test Report

The purpose of the treatment system is to eliminate the need for the continued, year-round trucking of extracted groundwater and landfill leachate from the Dewey Loeffel Landfill Superfund Site (site) located in Nassau, New York. The treatment system will also facilitate the extraction of additional groundwater (from eight extraction wells, including five new extraction wells in addition to the three existing extraction wells). The treatment system is primarily designed to address volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) in the extracted groundwater and landfill leachate prior to discharge to surface water (i.e., the Valatie Kill).

The treatment system includes an aerobic fixed-film bioreactor that is designed primarily to destroy benzene, toluene, ethylbenzene, and xylenes (BTEX), vinyl chloride, and acetone, but will also address VOCs and SVOCs to some extent. In addition, although the bioreactor is not specifically designed to treat metals, some metals removal is expected to occur as dissolved metals are taken up by the biomass and removed from the system with the biological sludge. The design of the aerobic fixed-film bioreactor is based on the observed operation performance of existing biological treatment systems operated by ARCADIS U.S., Inc. (ARCADIS), discussions with equipment suppliers, results of two bench-scale laboratory treatability tests, and the results from a pilot-scale on-site treatability test which was completed at the end of January 2013.

OVERVIEW OF BENCH-SCALE TREATABILITY TESTS

As part of the Preliminary Design Plan (PDP) implementation, two phases of bench-scale treatability tests were performed to confirm that the proposed full-scale biological treatment system (e.g., bioreactor), in conjunction with the other treatment processes, can meet the effluent limitations to be established by the United States Environmental Protection Agency (USEPA) for discharge to surface water. A summary of the procedures followed and the results from those tests were included in the Preliminary Design Data Report (PDDR) submitted to USEPA on December 4, 2012. The test procedures can also be found in Appendix H of the PDP conditionally approved by USEPA.

The first treatability test was conducted in aerated seven-gallon buckets using blended feedstock water from the site. The blended feedstock was added to an aerated batch reactor seeded with activated sludge to approximate the actual influent conditions that will be present in the full-scale bioreactor. Sludge was not added to a second bucket that functioned as a control cell. The results of the first bench-scale test showed excellent removal of most VOCs and SVOCs. However, the control also showed significant removal of VOCs and SVOCs, which is attributed to stripping caused by the air that was added to both the test and control vessels along with biodegradation by organisms potentially present in the groundwater from the extraction wells and leachate from the leachate collection tank.

The design of the second treatability test was modified to minimize concentration changes in the control cells while still allowing biological processes to occur in the treatment vessels. The second test was conducted in one-liter bottles using blended feedstock water from the site. Three bottles were seeded with activated sludge and designated as test cells. Sludge was not added to three control bottles. Oxygen was added to the treatment cells to support the biological activity while nitrogen was added to the controls. The results of the second bench scale test showed little or no removal of VOCs or SVOCs in the control vessels, indicating that modification of the test procedures was successful in limiting stripping and biodegradation in the control vessels. The results for the treatment vessels showed significant removal of SVOCs over the 48-hour test interval, including more than 60% removal of phenol, m,p-methylphenol and 2,4-dimethylphenol, and nearly 40% removal of 2-methylphenol. Most of the BTEX compounds also showed significant removal in the treatment vessels, with about 50% removal of toluene and o-xylene, more than 60% removal of ethylbenzene and more than 90% removal of m&p-xylenes. Benzene was the only BTEX compound that did not show significant removal in the treatment vessels. With respect to the chlorinated ethenes, trichloroethene (TCE) showed a slight reduction in the treatment vessels over the 48-hour test interval, while cis-1,2-dichlroethene (cDCE) showed a slight increase and vinyl chloride (VC) showed a reduction of about 15%. It should be noted that cDCE is a product of the biodegradation of TCE, and VC is a product of the biodegradation of TCE and/or cDCE. The reason(s) for the limited removal of benzene and vinyl chloride during the second treatability test are not known, but it appears that the biological process was impacted by one or more factors.

PHASE III TREATABILITY TEST SET-UP

Following submittal of the PDDR, the need for and scope of additional biological process testing was discussed with USEPA. A plan for a pilot-scale on-site treatability test was submitted to USEPA on December 31, 2013, and USEPA approved implementation of this plan on January 7, 2013.

The third phase of treatability testing was conducted in the pole barn at the site using groundwater from the frac tanks and allowed for a longer acclimation period for the biological process. The test vessel utilized growth media, aeration, and nutrient addition, and was an approximate 0.75% scale of the bioreactor included in the Design Report/Implementation Plan (DR/IP). Given that the full-scale bioreactor design is based on a maximum water flow rate of 25 gallons per minute (gpm) and aeration rate of up to 36 cubic feet per minute (cfm), the testing was conducted using a water flow of about 0.2 gpm and air flow of about 0.1 cfm. The water and air flows to the test vessel were measured by roto-meters.

A 55-gallon drum was placed on top of the north frac tank to function as a constant head feed tank. The head tank was necessary to minimize variations in flow to the test vessel caused by changes in the frac tank water level during the ongoing trucking operations. Groundwater was transferred to the head tank by a submersible pump. Groundwater in the head tank overflowed back into the top of the north frac tank. The drum was located inside a secondary containment area that also drained back into the top of the north frac tank.

A second 55-gallon drum was placed on top of the south frac tank to function as the test vessel or reactor tank. This drum positioned lower than the constant head feed tank on the north frac tank. The treatment drum was located inside a secondary containment area that drained back into the top of the south frac tank. The phase III treatability test set-up is shown on Figure 1.

The 55-gallon reactor tank contained biological growth media (i.e., ACCU-FAS submerged fixed-film media from Brentwood Industries). The full-scale bioreactor design was based on 450 cubic feet of growth media; therefore, approximately 3.5 cubic feet of growth media was used in the reactor tank to maintain the approximate 0.75% scale.

Groundwater from the head tank flowed through piping to the reactor tank via gravity. After running the test apparatus for three days, the treatment drum was seeded with activated sludge from the bioreactor at General Electric Company's (GE's) groundwater treatment system in Auburn, New York. It was assumed that the activated sludge was 0.5% biomass solids (5,000 parts per million [ppm]) and by adding a 25% contingency volume, five gallons of sludge was sufficient to yield the required concentration of about 500 ppm volatile suspended solids (representing biomass) within the 55-gallon reactor tank following addition of the water.

After three days of operation, the 55-gallon reactor tank vessel was also supplemented with nutrients to promote biological activity. The nutrient mix added was Power X 7525 from Milliport Enterprises, which contains 75% urea and 25% diammonium phosphate. Nutrients were added to maintain an approximate ratio of carbon/nitrogen/phosphorus of 100/5/1. Based on a test flow rate of 0.2 gpm and an average total organic carbon (TOC) concentration of about 10 milligrams per liter (mg/L) based on the results for the extraction well samples collected in September 2012, the carbon loading was calculated to be 0.02 pounds per day, which resulted in nitrogen and phosphorus requirement of 0.001 and 0.0002 pounds per day, respectively. The nutrient solution was metered into the reactor tank vessel to maintain the desired carbon/nitrogen/phosphorus ratio.

The reactor tank was aerated using diffusers placed in the bottom of the drum below the biological growth media with air supplied from a linear blower, which drew ambient air from inside the pole barn. The exhaust air (if any) was vented outside the pole barn. The air flow requirement of 0.1 cfm maintained the approximate 0.75% scale but was adjusted down to account for lower biochemical oxygen demand (BOD) concentration in groundwater in the frac tank without leachate from the leachate collection tank. The dissolved oxygen (DO) in the reactor tank water discharge was periodically measured using a portable meter and the air flow was adjusted as necessary to maintain a target DO concentration of a least 4 mg/L.

PHASE III TREATABILITY TEST IMPLEMENTATION

The phase III treatability test equipment was assembled on January 10 and 11, 2013. The completed set-up is shown in the photo on the left side of Figure 2. To estimate the impact of aeration (necessary to maintain the biological processes), the testing began on January 11, 2013 (Test Day 0) with the growth media in the drum and aeration but before adding the activated sludge and nutrients.

Samples were initially collected from two sample locations: the water feed into the reactor tank and the discharge from the reactor tank. Samples were taken during the first (Test Day 1 – January 12, 2013) and third (Test Day 3 - January 14, 2013) days of operation with just aeration. After the sample was collected on Test Day 3, the activated sludge was added to the reactor tank and nutrient addition started. The reactor tank was allowed to acclimate for two days before additional samples were collected. Samples were collected from the reactor tank feed and discharge after two (Test Day 5 - January 16, 2013), four (Test Day 7 - January 18, 2013), seven (Test Day 10 - January 21, 2013), nine (Test Day 12 - January 23, 2013), and eleven (Test Day 14 - January 25, 2013) days following addition of the activated sludge and nutrients. Analytical results were obtained on a quick turn-around basis to monitor the progress of the test. To investigate anomalously low VOC concentrations in the reactor tank feed sample on Test Day 7 (January 18, 2013), samples were collected directly from the head tank on Test Day 12 (January 23, 2013) and Test Day 14 (January 25, 2013). Samples were also collected directly from the north and south frac tanks on Test Day 14 (January 25, 2013) for comparison purposes, as suggested by USEPA.

All samples were analyzed for VOCs by USEPA Method 8260. The samples were also analyzed for SVOCs by USEPA Method 8270, except the reactor tank feed sample on Test Day 12 (January 23, 2013) and all of the samples on Test Day 14 (January 25, 2013).

PHASE III TREATABILITY TEST RESULTS

Laboratory analytical results from Pace Analytical Services, Inc. (Pace) for the pilot-scale treatability test were included in the January 2013 Monthly Progress Report submitted to USEPA on February 8, 2013. Complete analytical data packages and Analytical Services Tracking System (ANSETS) forms will be submitted to USEPA in February 2013. The laboratory analytical results for the third treatability test are summarized in Table 1. The field parameters collected during this test are summarized in Table 2. The six VOC parameters that generally had the highest concentrations in the reactor tank feed water (i.e., benzene, chlorobenzene, cDCE, methylene chloride, toluene, and TCE) are highlighted in yellow. As presented in the Basis of Design included as Appendix A to the DR/IP, these six VOCs are also expected to have the highest concentrations in the treatment system influent.

Samples taken during the first (Test Day 1 – January 12, 2013) and third (Test Day 3 - January 14, 2013) days of operation with just aeration showed limited removal of some VOCs and little or no removal of SVOCs. On Test Day 3, there was 30 to 35% removal of benzene and toluene, about 25% removal of chlorobenzene and cDCE, and less than 10% removal of methylene chloride, TCE, and SVOCs.

After the sample was collected on Test Day 3 (January 14, 2013), the activated sludge was added to the reactor tank and nutrient addition started. The results for the reactor tank discharge showed significant removal of VOCs and SVOCs over the remaining eleven days of the test. On Test Day 14 (January 25, 2013), the removal rate between the reactor tank feed water and the discharge was over 80% for benzene and was almost 70% for toluene. The removal rated for chlorobenzene, cDCE, methylene chloride, and TCE increased to the 50 to 60% range. Among the SVOCs, on Test Day 12 (January 23, 2013), the removal rate for phenol and m,p-methylphenol increased to over 80%.

Key observations regarding the data presented on Table 1 are summarized below.

- There was an anomalously high concentration of 2-butanone in the reactor tank discharge on Test Day 1 (January 12, 2013), and this was the only detection of 2-butanone at any sampling location throughout the test. Also known as methyl ethylene ketone, 2-butanone was likely contained in the glue used during the test set-up assembly. 2-Butanone is also a USEPA-recognized laboratory contaminant.

- As stated above, the activated sludge was added to the reactor tank and nutrient addition started after samples were collected on Test Day 3 (January 14, 2013). Removal rates for Test Day 5 (January 16, 2013) are not consistent with the results from the other later sampling dates, presumably because biological growth and acclimation was still occurring. The photo on the right side of Figure 2 shows the growth media with attached biomass submerged in the reactor at the end of the test. At the end of the test, biomass did not yet appear to be sloughing off the media and exiting the drum. As discussed below, this is evidence that the biomass was still in a growth mode.

- As stated above, there were anomalously low VOC concentrations in the reactor tank feed water sample on Test Day 7 (January 18, 2013). The concentrations in this sample were much lower than the reactor tank feed water samples on all other test days. For most parameters, the reactor tank discharge VOC concentrations were greater than the reactor tank feed water on Test Day 7 (January 18, 2013), resulting in negative removal rates inconsistent with the results from the other sampling dates. While the cause of the low VOC concentrations in the reactor tank feed water on Test Day 7 (January 18, 2013) is not known, the resultant removal rates on this day should be ignored.

- Many of the results were not-detect at the reported detection limits in both the reactor tank feed and reactor tank discharge samples and therefore the number of removal rate calculations that could be performed were limited. However, there were detections in the reactor tank feed and reactor tank discharge samples on most days for the six VOCs with the highest concentrations, which are most critical to the full-scale bioreactor design. In addition, when there was just one detection of a given constituent in the reactor tank feed and reactor tank discharge samples, the maximum (or minimum) removal rate was calculated using the reporting limit for the non-detect sample.

ANTICIPATED BIOREACTOR REMOVAL RATES

The results of the pilot-scale treatability test performed at the site confirmed that a biological treatment process can effectively reduce the concentrations of VOCs and SVOCs in an environmentally sustainable manner rather than transferring those contaminants from the water to another media. It is also anticipated that the VOC and SVOC removal rates in the full-scale bioreactor will be higher than achieved during the pilot-scale treatability test for the reasons presented below.

1. The pilot-scale treatability test set-up was based on an approximate 0.75% scale of the full-scale bioreactor using the maximum flow rate of 25 gpm. However, the average flow rate through the actual bioreactor will be equal to or less than 15 gpm based on the current flow rates from the three existing extraction wells and the landfill collection tank; the maximum design flow rate of 25 gpm is unlikely. With a flow rate of 15 gpm, the hydraulic retention time within the bioreactor will be about 66% longer than at 25 gpm. Additionally, the flow rate at initial start-up (before the five new extraction wells are brought on line) will only be about 4 gpm, so the bioreactor hydraulic retention time will be almost 24 hours, or more than six times more than during this treatability test. Start-up at this current flow rate will allow biological growth to occur and the biological colonies to adapt before the flow rate is increased when the new extraction wells are phased into operation.

2. The full-scale bioreactor design includes 450 cubic feet of growth media, while the pilot-scale treatability test contained approximately 3.5 cubic feet of growth media for the approximate 0.75% scale. At the test flow rate of 0.2 gpm, the ratio of growth media volume (in cubic feet) to flow rate (in gpm) was about 18, which is similar to the full-scale design at 25 gpm. However, that ratio becomes 30 and 112 at flow rates of 15 gpm and 4 gpm, respectively. Similar to the longer hydraulic retention times, greater volumes of growth media (which is directly related to greater surface area) at lower flow rates should result in higher VOC and SVOC removal rates.

3. The photo on the right side of Figure 2 shows the growth media with attached biomass submerged in the reactor tank at the end of the test. In the course of a biological process, biomass will slough off the growth media and exit the reactor tank. In the full-scale system, effluent from the reactor tank, which will include this biomass and other solids, will flow to a clarifier to be settled out and removed. During the pilot-scale treatability test, biomass did not appear to be sloughing off and exiting the drum. This is evidence that the biomass was still in a growth mode so the biological treatment process had not reached maximum effectiveness during the test.

4. As previous mentioned, in addition to the treatability test results, the design of the aerobic fixed-film bioreactor for this site was also based on an observed operation performance from existing ARCADIS-operated biological treatment systems and discussions with equipment suppliers regarding other biological treatment systems. These systems have been fully acclimated and the observed removal rates for constituents similar to the site are presented below.

Parameters	Observed Removal Rates
Acetone and other ketones (e.g., 2-butanone and 4-methyl-2-pentanone)	98 to 100%
BTEX and vinyl chloride	94 to 100%
Phenols (non-chlorinated)	89 to 94%
Other chlorinated VOCs	83 to 99%

As presented in the Basis of Design included as Appendix A to the DR/IP, the anticipated removal rates through the full-scale bioreactor for various constituents are as follows:

Parameters	Anticipated Removal Rates
Acetone and other ketones (e.g., 2-butanone and 4-methyl-2-pentanone)	98 to 99%
BTEX and vinyl chloride	92 to 99%
Phenols (non-chlorinated)	80 to 95%
Other chlorinated VOCs	70 to 90%

While similar biological treatment systems are achieving higher removal rates, a more conservative approach is included in the Basis of Design. For the purposes of developing the mass balances in the DR/IP, the lower removal rates presented above were used. Additionally, while the hydraulic retention times increase below the maximum design flow rate of 25 gpm, the removal rates were not varied on the mass balances for flow rates down to 5 gpm. The full-scale bioreactor, in conjunction with the other treatment processes described in the DR/IP, is designed to meet the effluent limitations for discharge to the Valatie Kill that USEPA provided to the Respondents on February 6, 2013 (see Appendix B of the DR/IP).

Tables

TABLE 1
DEWEY LOEFFEL LANDFILL SUPERFUND SITE
NASSAU, NEW YORK
PHASE III TREATABILITY TEST RESULTS

Parameter	Reactor Tank Feed							Head Tank		North Tank	South Tank
	Day 1 Sat, 1/12	Day 3 Mon, 1/14	Day 5 Wed, 1/16	Day 7 Fri, 1/18	Day 10 Mon, 1/21	Day 12 Wed, 1/23	Day 14 Fri, 1/25	Day 12 Wed, 1/23	Day 14 Fri, 1/25	Day 14 Fri, 1/25	Day 14 Fri, 1/25
VOCs (µg/L)											
1,1,1-Trichloroethane	100 U	100 U	50 U	100 U	50 U	100 U	100 U	100 U	100 U	100 U	100 U
1,1,2-Trichlorothane	100 U	100 U	50 U	100 U	50 U	100 U	100 U	100 U	100 U	100 U	100 U
1,1-Dichloroethane	103	100 U	50 U	100 U	50 U	100 U	100 U	100 U	100 U	100 U	100 U
1,1-Dichloroethene	100 U	100 U	50 U	100 U	50 U	100 U	100 U	100 U	100 U	100 U	100 U
1,2,3-Trichlorobenzene	157	154	98.2	100 U	50 U	100 U	100 U	100 U	100 U	100 U	126
1,2,4-Trichlorobenzene	779	681	386	110	322	321	279	315	287	351	487
1,2-Dichloroethane	592	544	297	127	271	309	270	316	274	277	355
1,2-Dichlorobenzene	100 U	100 U	50 U	100 U	50 U	100 U	100 U	100 U	100 U	100 U	100 U
1,3-Dichlorobenzene	100 U	100 U	50 U	100 U	50 U	100 U	100 U	100 U	100 U	100 U	100 U
1,4-Dichlorobenzene	100 U	100 U	50 U	100 U	50 U	100 U	100 U	100 U	100 U	100 U	100 U
2-Butanone	100 U	100 U	50 U	100 U	50 U	100 U	100 U	100 U	100 U	100 U	100 U
4-Methyl-2-Pentanone	100 U	100 U	50 U	100 U	50 U	100 U	100 U	100 U	100 U	100 U	100 U
Acetone	605	500 U	250 U	500 U	250 U	500 U	500 U	500 U	500 U	500 U	500 U
Benzene	3410	3350	1890	676	1640	1790	1610	1840	1560	1700	2620
Chlorobenzene	847	894	484	150	410	100 U	375	100 U	384	420	579
Chloroform	514	515	285	100 U	209	243	210	248	204	228	318
cis-1,2-Dichloroethene	2070	2000	1080	401	910	1020	958	1060	953	993	1350
Ethylbenzene	147	149	77.1	100 U	71	100 U	100 U	100 U	100 U	100 U	118
Isopropylbenzene	100 U	100 U	50 U	100 U	50 U	100 U	100 U	100 U	100 U	100 U	100 U
m&p-Xylene	326	336	172	100 U	150	158	150	160	151	161	256
o-Xylene	212	200	114	100 U	93.1	104	100 U	101	100 U	102	141
Methylcyclohexane	100 U	100 U	50 U	100 U	50 U	100 U	100 U	100 U	100 U	100 U	100 U
Methylene Chloride	2160	1980	1170	382	919	1030	1290	1210	830	1250	1570
Styrene	100 U	100 U	50 U	100 U	50 U	100 U	100 U	100 U	100 U	100 U	100 U
Tetrachloroethene	116	113	50 U	100 U	50 U	100 U	100 U	100 U	100 U	100 U	100 U
Toluene	3980	3940	2130	878	2020	2060	1890	2060	1890	1970	3000
trans-1,2-Dischlorothene	100 U	100 U	50 U	100 U	50 U	100 U	100 U	100 U	100 U	100 U	100 U
Trichloroethene	8880	8520	7350	2540	6080	6140	5630	6360	5370	6070	9050
Vinyl Chloride	110	102	50 U	100 U	50 U	100 U	100 U	100 U	100 U	100 U	100 U
Other VOCs	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs (µg/L)											
2,4-Dimethylphenol	10.6	9.26 U	10.4	12.7	10.7	-	-	14.2	-	-	-
2-Methylphenol	54	51.7	66.3	75.6	97.2	-	-	74.4	-	-	-
bis(2-Ethylhexyl)phthalate	9.62 U	9.26 U	9.80 U	28.8	66.4	-	-	9.26 U	-	-	-
m&p-Methylphenol	132	118	128	95.5	79.3	-	-	172	-	-	-
Pentachlorophenol	9.62 U	9.26 U	10.4	9.52 U	9.62 U	-	-	10.3	-	-	-
Phenol	228	207	223	99.4	88.5	-	-	230	-	-	-
Other SVOCs	ND	ND	ND	ND	ND	-	-	ND	-	-	-

Parameter	Reactor Tank Discharge							% Reduction								
	Day 1 Sat, 1/12	Day 3 Mon, 1/14	Day 5 Wed, 1/16	Day 7 Fri, 1/18	Day 10 Mon, 1/21	Day 12 Wed, 1/23	Day 14 Fri, 1/25	Day 1 Sat, 1/12	Day 3 Mon, 1/14	Day 5 Wed, 1/16	Day 7 Fri, 1/18	Day 10 Mon, 1/21	Day 12 Wed, 1/23	Day 14 Fri, 1/25	Head Tank Day 12 Wed, 1/23	Head Tank Day 14 Fri, 1/25
VOCs (µg/L)																
1,1,1-Trichloroethane	100 U	20.1	50 U	50 U	50 U	100 U	50 U	-	<80%	-	-	-	-	-	-	-
1,1,2-Trichlorothane	100 U	1.72	50 U	50 U	50 U	100 U	50 U	-	<98%	-	-	-	-	-	-	-
1,1-Dichloroethane	100 U	37.2	50 U	50 U	50 U	100 U	50 U	>3%	<63%	-	-	-	-	-	-	-
1,1-Dichloroethene	100 U	5.69	50 U	50 U	50 U	100 U	50 U	-	<94%	-	-	-	-	-	-	-
1,2,3-Trichlorobenzene	158	71	89.9	50 U	50 U	100 U	59.4	-1%	54%	8%	-	-	-	<41%	-	<41%
1,2,4-Trichlorobenzene	692	717	402	234	215	235	211	11%	-5%	-4%	-113%	33%	27%	24%	25%	26%
1,2-Dichloroethane	531	553	362	245	204	257	228	10%	-2%	-22%	-93%	25%	17%	16%	19%	17%
1,2-Dichlorobenzene	100 U	13.3	50 U	50 U	50 U	100 U	50 U	-	<87%	-	-	-	-	-	-	-
1,3-Dichlorobenzene	100 U	2.86	50 U	50 U	50 U	100 U	50 U	-	<97%	-	-	-	-	-	-	-
1,4-Dichlorobenzene	100 U	22.9	50 U	50 U	50 U	100 U	50 U	-	<77%	-	-	-	-	-	-	-
2-Butanone	757	100 U	50 U	50 U	50 U	100 U	50 U	<657%	-	-	-	-	-	-	-	-
4-Methyl-2-Pentanone	100 U	19	50 U	50 U	50 U	100 U	50 U	-	<81%	-	-	-	-	-	-	-
Acetone	749	500 U	347	250 U	250 U	500 U	250 U	-24%	-	<39%	-	-	-	-	-	-
Benzene	2090	2190	1330	737	575	398	286	39%	35%	30%	-9%	65%	78%	82%	78%	82%
Chlorobenzene	632	675	398	261	208	100 U	164	25%	24%	18%	-74%	49%	-	56%	-	57%
Chloroform	386	391	231	132	118	147	121	25%	24%	19%	>-32%	44%	40%	42%	41%	41%
cis-1,2-Dichloroethene	1470	1460	890	545	470	539	503	29%	27%	18%	-36%	48%	47%	47%	49%	47%
Ethylbenzene	100 U	54	53.9	50 U	50 U	100 U	50 U	>32%	64%	30%	-	>30%	-	-	-	-
Isopropylbenzene	100 U	1.44	50 U	50 U	50 U	100 U	50 U	-	<99%	-	-	-	-	-	-	-
m&p-Xylene	205	110	120	69.4	66.1	100 U	50 U	37%	67%	30%	<31%	56%	>37%	>67%	>38%	>67%
o-Xylene	150	81.6	91.8	53.8	50 U	100 U	50 U	29%	59%	19%	<46%	>46%	>4%	-	>0.01%	-
Methylcyclohexane	176	1 U	50 U	50 U	50 U	100 U	50 U	<76%	-	-	-	-	-	-	-	-
Methylene Chloride	1580	1810	1080	902	786	712	633	27%	9%	8%	-136%	14%	31%	51%	41%	24%
Styrene	100 U	2.18	50 U	50 U	50 U	100 U	50 U	-	<98%	-	-	-	-	-	-	-
Tetrachloroethene	100 U	23.4	50 U	50 U	50 U	100 U	50 U	>14%	79%	-	-	-	-	-	-	-
Toluene	2500	2680	1510	971	841	707	615	37%	32%	29%	-11%	58%	66%	67%	66%	67%
trans-1,2-Dischlorothene	100 U	2.60	50 U	50 U	50 U	100 U	50 U	-	<97%	-	-	-	-	-	-	-
Trichloroethene	8210	8680	50 U	2230	2170	2480	2180	8%	-2%	>99%	12%	64%	60%	61%	61%	59%
Vinyl Chloride	100 U	13.9	50 U	50 U	50 U	100 U	50 U	>9%	86%	-	-	-	-	-	-	-
Other VOCs	ND	ND	ND	ND	ND	ND	ND	-	-	-	-	-	-	-	-	-
SVOCs (µg/L)																
2,4-Dimethylphenol	9.43 U	10.5	11	12.2	9.26 U	9.26 U	-	>11%	<13	-6%	4%	>13%	-	-	>35%	-
2-Methylphenol	52.5	56.4	62.6	76.9	114	208	-	3%	-9%	6%	-2%	-17%	-	-	-180%	-
bis(2-Ethylhexyl)phthalate	9.43 U	9.26 U	9.26 U	9.43 U	9.26 U	9.26 U	-	-	-	-	>67%	>86%	-	-	-	-
m&p-Methylphenol	125	130	99.8	73.5	44.6	26.2	-	5%	-10%	22%	23%	44%	-	-	85%	-
Pentachlorophenol	9.43 U	9.26 U	9.40	9.43 U	9.26 U	9.60	-	-	-	10%	-	-	-	-	7%	-
Phenol	228	191	179	54.4	46.1	41.1	-	0%	8%	20%	45%	48%	-	-	82%	-
Other SVOCs	ND	ND	ND	ND	ND	ND	-	-	-	-	-	-	-	-	-	-

Notes:

1. Water samples were collected by ARCADIS
2. Water samples were analyzed by Pace
3. The activated sludge was added and the nutrient addition began after sampling on Day 3
4. µg/L = Micrograms per liter
5. VOCs = Volatile organic compounds
6. SVOCs = Semi-volatile organic compounds
7. U = Analyte not detected at the reported detection limit
8. ND = Not detected
9. A positive % reduction shows a decrease in concentration from the reactor tank.
10. A negative % reduction shows an increase in concentration from the reactor tank.
11. Bolded concentrations are detected results.
12. Bolded % reductions show % reductions where there was a detection in both the reactor tank feed and the reactor tank discharge.

TABLE 2
DEWEY LOEFFEL LANDFILL SUPERFUND SITE
NASSAU, NEW YORK
PHASE III TREATABILITY TEST FIELD PARAMETERS

Date	Time	Air Flow (cfh)	Water Flow (gpm)	Nutrient Addition Rate (mL/h)	Water Temperature (°C)	pH (SU)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Comments
1/11/13	14:30	6.0	0.20	0	9	8.54	8.90	4.6	Reactor Tank Discharge
1/12/13	08:25	6.0	0.20	0	15	8.31	6.77	2.4	Reactor Tank Discharge
1/12/13	08:30	6.0	0.20	0	16	8.22	7.70	2.6	Reactor Tank Feed
1/14/13	11:10	6.0	0.20	0	15	8.36	6.23	2.2	Reactor Tank Discharge
1/14/13	11:40	6.0	0.20	0	14	8.44	5.94	2.4	Reactor Tank Feed
1/15/13	09:30	6.0	0.20	60	12	8.34	6.35	2.7	Reactor Tank Discharge
1/15/13	10:00	6.0	0.20	60	12	8.45	6.05	2.5	Reactor Tank Feed
1/16/13	08:45	6.0	0.20	60	17	8.28	5.60	2.8	Reactor Tank Discharge
1/16/13	09:20	6.0	0.20	60	16	8.37	6.09	3.0	Reactor Tank Feed
1/17/13	11:20	6.0	0.20	60	18	8.23	6.22	2.6	Reactor Tank Discharge
1/17/13	11:40	6.0	0.20	60	16	8.28	5.95	3.0	Reactor Tank Feed
1/18/13	08:30	6.0	0.20	60	18	8.24	5.54	2.9	Reactor Tank Discharge
1/18/13	09:15	6.0	0.20	60	16	8.29	6.90	4.0	Reactor Tank Feed
1/21/13	11:00	6.0	0.20	60	20	8.25	5.30	0.5	Reactor Tank Discharge
1/21/13	11:10	6.0	0.20	60	18	8.30	5.92	0.9	Reactor Tank Feed
1/23/13	08:15	6.0	0.20	60	19	8.30	5.42	0.8	Reactor Tank Discharge
1/23/13	08:30	6.0	0.20	60	16	8.30	5.18	6.5	Reactor Tank Feed
1/23/13	08:45	6.0	0.20	60	15	8.39	6.99	7.0	Head Tank
1/24/13	10:25	6.0	0.20	60	19	8.26	5.67	0.0	Reactor Tank Discharge
1/24/13	10:40	6.0	0.20	60	16	8.31	9.56	3.0	Reactor Tank Feed
1/25/13	10:45	6.0	0.20	60	17	8.35	5.68	0.0	Reactor Tank Discharge
1/25/13	11:00	6.0	0.20	60	14	8.31	4.85	2.2	Reactor Tank Feed
1/25/13	11:15	6.0	0.20	60	14	8.36	9.04	2.8	Head Tank

Notes:

1. cfh = Cubic feet per hour
2. gpm = Gallons per minute
3. mL/h = Milliliters per hour
4. °C = Degrees celcius
5. SU = Standard units
6. mg/L = Milligrams per liter
7. NTU = Nephelometric turbidity unit

Figures

CITY:SYRACUSE-NY DIV/GROUP:ENVCAD DB:K.SARTORI LD:G.STEINBERGER PIC:P.FARR PM:/ TM: D.SAUDA (Opt)ON=*;OFF=*REF*
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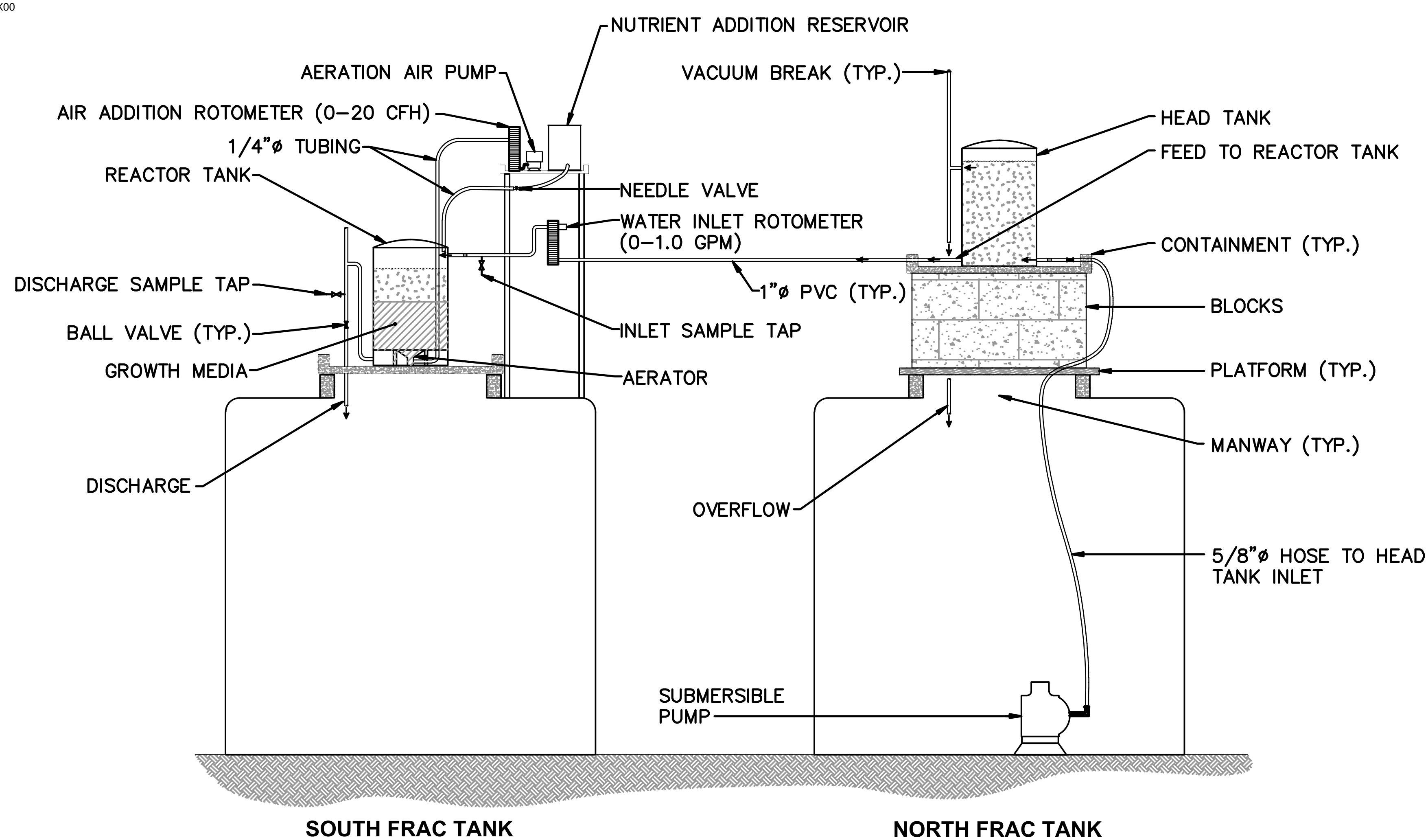

NOT TO SCALE

NOTES:

1. GPM – GALLONS PER MINUTE
2. CFH – CUBIC FEET PER HOUR
3. PVC – POLYVINYL CHLORIDE

DEWEY LOEFFEL LANDFILL SUPERFUND SITE
NASSAU, NEW YORK

PHASE III TREATABILITY TEST SET-UP

ARCADIS

FIGURE
1

TEST SET-UP
(TREATMENT VESSEL ON LEFT, CONSTANT
HEAD FEED VESSEL ON RIGHT)

BIOLOGICAL GROWTH ON SUBMERGED MEDIA

DEWEY LOEFFEL LANDFILL SUPERFUND SITE
NASSAU, NEW YORK

PHASE III TREATABILITY TEST PHOTOS

ARCADIS

FIGURE
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