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August 16, 2012

Soil Vapor Extraction System Construction Completion Report

Supplemental Site Mitigation Program
Former Miller Container Plant Site
Fulton, New York

(NYSDEC Site # 7-38-029)

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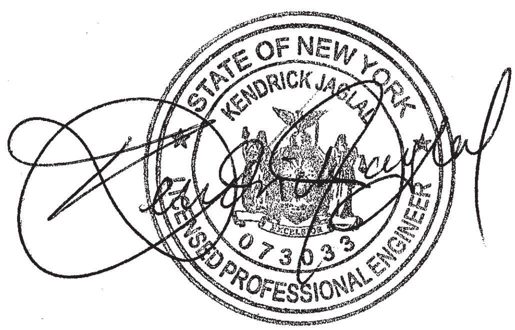

I, Kendrick Jaglal, am currently a registered professional engineer licensed by the State of New York, I had primary direct responsibility for implementation of the remedial program activities, and I certify that the Remedial Design was implemented and that all construction activities were completed in substantial conformance with the Department-approved Remedial Design.

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Acronyms and Abbreviations

AAQS	Ambient Air Quality Standards
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWQS	Ambient Water Quality Standards
COC	Chemicals of concern
DP	Dual phase
DPE	Dual phase extraction
FID	Flame ionization detector
gpm	Gallons per minute
GWTF	Groundwater Treatment Facility
ID HSA	Inside diameter hollow stem auger
LPC	Liquid phase carbon
MDL	Method Detection Limit
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	Operation and Maintenance
PID	Photoionization detector
PVC	Polyvinyl chloride
ROD	Record of Decision (ROD)
RSCO	Recommended Soil Cleanup Objectives
SSI	Supplemental Site Investigation
SV	Soil vapor
SVE	Soil Vapor Extraction
TAGM	Technical and Administrative Guidance Memorandum
USCOs	Unrestricted Soil Cleanup Objectives
USEPA	United States Environmental Protection Agency
VOCs	Volatile organic compounds
VPC	Vapor phase carbon

1.0 Introduction

The Former Miller Container Plant Site is located in Fulton, New York and is listed in the New York State Registry of Inactive Hazardous Waste Disposal Sites with Site Code #7-38-029. In general accordance with a Work Plan for the project entitled “Supplemental Site Mitigation and System Optimization,” that was prepared and finalized in May 2010, a remedial design was developed for the Site in July 2010. The objective of this voluntary remedial action was to supplement the current site remediation program that consists of groundwater extraction and treatment to accelerate remediation at the Site. The design covered the installation of upgrades and operation of a Soil Vapor Extraction (SVE) system with groundwater depression. This report documents construction and evaluation of the SVE system which was constructed between August 2010 and February 2011.

1.1 Purpose and Scope

In general, the SVE systems were intended to treat residuals in impacted soils in the vadose zone and also in the smear zone exposed by the lowering of the water table. The work consisted of installing a series of SVE and groundwater depression wells in two areas (a northern area and a southern area), piping to the existing treatment system building, addition of a second SVE blower, and upgrades to the electrical controls and piping within the treatment system building. Following construction, the system was started, monitored and adjustments made to optimize its operation. Extracted groundwater is being treated in the existing groundwater treatment plant and discharged to the Oswego River under existing approvals. The extracted vapors from the SVE system are being treated by vapor-phase activated carbon.

1.2 Site Background

The Former Miller Container Plant Site is located in an industrial park in the City of Fulton, Oswego County, New York. The main site features include one large building, the Riccelli Fulton, LLC facility (active). The site was originally developed in 1975-76 by Miller Brewing Company (MBCo) and used as an aluminum can manufacturing plant. The Reynolds Metals Company acquired the Site in 1993 when it purchased the can manufacturing division of MBCo. Reynolds operated the facility for less than 1 year and closed it in 1994. The facility was unoccupied from 1994 to 1998 until purchased from Reynolds by Crysteel Manufacturing. Crysteel used the facility from 1988 until 2006 for the manufacturing of specialty steel cargo containers, roll-off containers, and dumpsters. The Facility was purchased from Crysteel by Riccelli Trucking in 2009 and has been used since then as a storage building for agricultural products, primarily corn. Numerous site investigations and remedial actions have been conducted at the Site since 1984 when dissolved chlorinated solvents were detected in samples collected from water supply wells located down gradient at the City of Fulton Municipal Well field.

Contaminants had also been detected at former drum storage areas on the north and south sides of the container plant building. Solvent contaminated oil was also found beneath the south corner of the building in the area where a sub-floor sump was being constructed. An ongoing investigation revealed a plume of contaminants at least 1,300 feet in length. In 1987, recovery wells and an air stripper were placed in operation in order to impede migration of contaminants in the groundwater.

A Record of Decision (ROD) was issued for the site on March 20, 1995 by the New York State Department of Environmental Conservation (NYSDEC). The ROD specified a remedy consisting of a groundwater collection system, SVE and treatment of the collected groundwater. The construction phase of the remedial action was completed in late 1996 and operation began in February, 1997. Operation and Maintenance (O&M) of the system is ongoing. To improve progress on the site remediation efforts, other enhanced groundwater remedial alternatives were evaluated. Based on the results of a Supplemental Site Investigation (SSI) performed at the Site in April-May 2008, recommendations were made to install a soil vapor extraction system in two areas of the Site and make changes to the existing groundwater recovery system. These recommendations were presented to the NYSDEC in November 2008 and were accepted. In August 2010, the NYSDEC approved the Remedial Design that was prepared for implementing the additional remedial activities.

1.3 Remedial Objectives

The overall purpose of the SVE system is to mitigate residual soil impacts and accelerate groundwater recovery at the Site. Specifically, the primary remediation goal of the SVE system is to reduce the concentrations of chemicals of concern (COC) in the soils to levels below NYSDEC Part 375.6-8(b) Protection of Groundwater standards. These standards for protection of groundwater and those for protection of human health are summarized below in Table 1-1.

TABLE 1-1. Remediation Goals

COCs	CAS	Part 375-6.8(b) Restricted Use Soil Clean-up Objectives (mg/kg)	
		Protection of Human Health (Industrial)	Protection of Groundwater
Benzene	71-43-2	89	0.06
Chloroform	67-66-3	700	0.37
1,1-Dichloroethane	75-34-3	480	0.27
1,1-Dichloroethene	75-35-4	1,000	0.33
1,2-Dichloroethane	107-06-2	60	0.02
Ethylbenzene	100-41-4	780	1
Methylene chloride	75-09-2	1,000	0.05
Tetrachloroethene (PCE)	127-18-4	300	1.3
Toluene	108-88-3	1,000	0.7
Trichloroethene	79-01-6	400	0.47
1,1,1-Trichloroethane	71-55-6	1,000	0.68
Vinyl chloride	75-01-4	27	0.02
Xylene (mixed)	1330-20-7	1,000	1.6

Notes:

COCs Chemicals of concern
CAS Chemical Abstract Service
mg/kg Milligram per kilogram

2.0 System Construction

Construction of the SVE system was initiated in August 2010 by completing soil borings and installing the extraction wells and monitoring points. This was followed by installation of underground piping to a series of manifolds and the water treatment building. The SVE blower was then installed and restoration activities performed, as appropriate. The various construction activities are described below. Refer to the Drawings for locations of all installed components and construction details.

2.1 Soil Borings and Well Installation

A new groundwater recovery well, eight dual phase extraction (DPE) wells and 14 soil vapor extraction (SVE) wells, piezometers and vacuum monitoring wells were installed at the Site by GeoLogic NY, Inc. of Homer, New York. Drilling for these features began on August 12, 2010 and continued through September 8, 2010. Soil borings were completed and the DPE and SVE wells were installed in both the Northern and Southern areas targeted for remediation. Well construction details are summarized in Table 2-1 and well construction logs are provided in Appendix A. These wells are further discussed below.

2.1.1 New Groundwater Recovery Well

A new groundwater recovery well (RW-5R) was installed between the northern soil vapor extraction system, SVE-N, and then existing well RW-5 to facilitate better capture of impacted groundwater for treatment. This 6-inch diameter Schedule 40 polyvinyl chloride (PVC) well was installed utilizing a drill rig with 8.25-inch inside diameter hollow stem auger (ID HSA) on August 11, 2010. The well is screened across the observed plume, from 27-37 feet below grade (bg).

2.1.2 Dual-Phase Extraction Wells

Eight DPE wells (5 in the north and 3 in the south) were installed for use in lowering the water table to expose impacted soils within the “smear zone” created by the natural water table fluctuations. The five newly installed DPE wells in the northern SVE system are referred to as DPEN-1 through DPEN-5, and the three newly installed DPE wells in the southern SVE system are referred to as DPES-1 through DPES-3. With the exception of the DPEN-1 well, all wells were drilled utilizing 8.25-inch ID HSA and constructed with 6-inch diameter Schedule 40 PVC. The DPEN-1 well was drilled with a 6.25-inch ID HSA and constructed with 5-inch diameter Schedule 40 PVC. The smaller diameter well was due to the use of smaller equipment as a result of access limitations within the building.

The wells are all screened from 10-30 feet bg with the exception of DPES-1, which is screened from 15’-30’ bg. Recovered groundwater from these wells was plumbed directly to the existing on-site groundwater treatment system (GWTF) for treatment by the on-site air-stripper prior to discharge. These water table depression wells are also being utilized as vapor extraction points. Each dual-phase well is equipped with a flow control valve that can be used to regulate the airflow from each well for balancing the system.

2.1.3 Soil Vapor Extraction Wells

To provide mitigation over the entire zone of impact in each area, the dual-phase wells are augmented with a number of newly installed single-phase SVE wells. The northern SVE system includes 11 SVE wells (SVEN-1 through SVEN-11) and the southern SVE system includes three SVE wells (SVES-1 through SVES-3). The 4” diameter Schedule 20 PVC SVE wells were installed utilizing 6.25-inch ID HSA. These wells are all screened from 12-22 feet bg.

The SVE wells were plumbed to manifolds located in the Riccelli facility and the Groundwater Treatment Facility (GWTF) then to the existing gas-phase activated carbon units located in the GWTF. Each vapor extraction well is equipped with a flow control valve that can be used to regulate the airflow from each well for balancing the system.

2.1.4 Monitoring Points

To facilitate monitoring of the groundwater depression systems, peizometers were installed to measure the water table elevation at the approximate outer limits of the impacted zones. Interstitial vacuum pressure gauging points were also installed to measure subsurface vacuum pressure(s) generated by the SVE systems. The northern SVE system includes two peizometers (PN-1, PN-2), and two (2) groups (TN-1, TN-2) of three (triplet) vacuum gauges. The southern SVE system includes one peizometer (PS-1), and two (2) groups (TS-1, TS-2) of three vacuum gauges. The 1-inch diameter Schedule 20 PVC peizometers were installed utilizing 2.75-inch ID HSA and are screened from 10-30 feet bg. The 1-inch diameter Schedule 20 PVC vacuum gauges were installed utilizing 4.25-inch ID HSA. The shallow well is screened from 8-10 feet bg, the intermediate from 13-15 feet bg, and the deep from 20-22 feet bg.

2.2 Soil Vapor Extraction Systems

As noted above, two SVE networks were installed at the site as part of the SVE system. The two areas of concern where the systems were installed are designated as SVE-N (northern) and SVE-S (southern). The system is based on a design that was approved by the NYSDEC on August 9, 2010. The original design specified the use of a 40 HP SVE blower which was sized to achieve maximum vapor extraction from all wells during startup and had the capacity to sustain this load over the duration of operation. In light of NYSDEC's issuance of its DER-31 Green Remediation Policy, a review was made to assess whether energy use could be reduced as the site cleaned up. During this review it was concluded that a lower power blower could be used on the project which would provide several benefits. Consequently, a request for approval of a design change was made to, and approved by, the NYSDEC. Ultimately, a 20-HP blower was installed in conjunction with a 10 HP blower that was used previously at the Site. Both blowers are located in the on-site GWTF and plumbed to the SVE network. The manufacturer's literature for the new blower is included in Appendix B.

2.3 Piping and Trenching

Air and water recovered from the northern area wells were plumbed to manifolds located in the Riccelli facility and then to the GWTF. The air and water from the southern wells were plumbed directly to the GWTF. A pressurized air supply to DPE well pumps in the North was piped from the GWTF to an air manifold located in the Riccelli facility and then independently to each well pump. Pressurized air supply to DPE well pumps in the South was piped from the manifold located in the GWTF independently to each well pump. All manifold feeds for air supply, water return, and air return are fitted with appropriate control valves, sample ports and check valves to allow for monitoring and control of each SVE and DPE well independently. Piping was run in trenches cut out in the concrete flooring and trenched from the building to the treatment plant. Trenching indoors was performed by saw cutting the concrete flooring and excavating to the required depth. During trenching operations, any excavated soils (not including pea-stone fill) that was targeted for removal was screened with a FID and inspected for visual and/or olfactory evidence of contamination. Soils that appeared to be impacted were staged in roll-off containers, characterized, and transported for off-site disposal. Clean imported fill was utilized to replace any soil removed for disposal. The analytical data for the fill is included in Appendix C

Upon completion of installation of the interior piping, a woven geo-membrane barrier layer was placed on top of the backfill and the remainder of the trench backfilled with structural sand to just above the base of the concrete floor slab. The floor was then restored to its previous condition to the extent practical. Exterior trenching was restored to its previous condition (concrete, asphalt, or grass) as appropriate.

All in-ground piping and conduits were constructed of appropriately sized HDPE piping. All water lines are 1-inch diameter, all vapor lines are 2-inch diameter and all conduits for conveyance of 3/8-inch air hose to the pneumatic well pumps are 2-inch diameter. All conduits of different types sharing a common trench were installed with water bearing pipes at the bottom, air above that and conduits for air hose at the top. Spacers and separation layers of backfill were installed between each type of conduit during pipe installation.

All above grade water piping was insulated and heat traced appropriately, to provide freeze protection.

2.4 Well Pumping Systems and Treatment Plant

Each of the two SVE systems has an independent vacuum pumping system and controls but share common treatment systems. The 10 HP motor and blower from the former SVE system were utilized for the SVE-S system. An additional 20 HP positive displacement blower was installed in the treatment building to provide vacuum pressure for the SVE-N system. Manufacturer's literature for the additional SVE system added to the treatment building is included in Appendix B.

Submersible pneumatic pumps were installed in each of the dual phase extraction wells. These pumps consisted of short bottom loading AP-4 type pumps provided by QED Environmental systems (Dexter, Michigan). Recovered groundwater was plumbed directly to the existing on-site equalization tanks prior to treatment in the existing air-stripper tower. Two existing 10,000-pound capacity vapor phase carbon (VPC) treatment tanks are in place on-line to treat the air-flow from the SVE systems. The air stripper vapor discharge is not directed through the VPC units prior to discharge. Two 10,000-pound capacity liquid phase carbon units (LPC) were placed on-line to treat the liquid effluent from the air-stripper prior to discharge for a period of time (3 consecutive months) necessary to demonstrate effective treatment of the water by the air stripper.

In order to operate the submersible pneumatic pumps a 7.5 HP rotary screw air compressor was installed within the GWTF. The air compressor was installed with appropriate manifolds as necessary to deliver air to each of the pumps through independent lines.

2.5 Community Air Monitoring

Community air monitoring was performed in general accordance with the New York State Department of Health's (NYSDOH's) Generic Community Air Monitoring Plan during intrusive activities. A monitor was used to provide continuous measurement of air quality at the edge of the designated exclusion zone. The monitor was installed at the fence line adjacent to the existing treatment plant (approximately 100-250 feet down gradient of all work zones) at the limits of the site boundary in the down wind direction. It was used to continuously record and measure air quality at the facility property line. When the building was occupied, an additional monitor was used in the occupied space(s) to measure and record air quality during the period of occupation. The results of the air monitoring were submitted to the NYSDEC and NYSDOH.

2.6 Residuals Management

During the well drilling activities, continuous split-spoon soil samples were collected from grade to final depth. Each soil interval was visually inspected, characterized, and screened with a photoionization detector (PID). One soil sample was collected from each well from the interval representing the highest potential concentration of volatile organic compounds (VOCs) based on visual and olfactory evidence of impacts and the results of the PID screening. Soil samples collected were submitted to Test America Laboratories in Amherst, New York (Test America) for analysis by Method 8260B.

The analytical results for these soil samples are provided in Table 2-2. They were compared to the Part 375 Unrestricted Soil Cleanup Objectives (Part 375 USCOs) or the Recommended Soil Cleanup

Objectives (RSCOs) per NYSDEC Technical and Administrative Guidance Memorandum 4046 (TAGM 4046) when no comparable standard was available in Part 375. For the RW-5R sample, only acetone and 1,1-dichloroethane were at concentrations that exceeded their standards. In the north, SVEN-9 collected from 10-12 feet bg had a concentration of 1,1-dichloroethane that exceeded the standard. SVEN-7 collected from 18-20 feet bg and SVEN-11, collected from 13-15 feet bg, had concentrations of acetone that exceeded the standard. In addition, DPEN-1 collected from 11-12.5 feet bg, also had a concentration of acetone that exceeded the standard. Results for both the DPE and the SVE soil samples collected during the installation of the wells in the south were above standards for acetone in all six locations.

The soil cuttings that were generated were stored in an on-site roll-off container and sampled for waste characterization. Two composite, representative samples were subjected to the Toxicity Characteristic Leaching Procedure (TCLP) and the leachate analyzed for VOCs, SVOCs, herbicides, pesticides and metals. The detected concentrations were all below the TCLP regulatory limits (Table 2-3). The materials were subsequently disposed off-site at the Oswego County Bristol Hill Landfill. Construction materials from the trenches were re-used on site following approval from NYSDEC. Wastewater produced during well construction and development activities was directed to the existing on-site water treatment system for treatment by the air-stripper prior to discharge.

TABLE 2-3. Toxicity Characteristic Leaching Procedure – Leachate Concentrations

Analytes	Regulatory limit	TCLP Concentrations, mg/L			
		Waste Char-1		Waste Char-2	
VOCs	Varies	ND		ND	
SVOCs	Varies	ND		ND	
Herbicides	Varies	ND		ND	
Pesticides	Varies	ND		ND	
Metals					
Arsenic	5.0	ND		ND	
Barium	100	0.762	B	0.572	B
Cadmium	1.0	0.0004	J	0.0003	J
Chromium	5.0	0.0022	J, B	0.0031	J, B
Lead	5.0	ND		ND	
Mercury	0.2	ND		ND	
Selenium	1.0	ND		ND	
Silver	5.0	ND		ND	

Notes:

B Analyte detected in associated Method blank

J Estimated concentration below the Reporting Limit

ND Not Detected

TCLP Toxicity Characteristic Leaching Procedure

mg/L Milligram per liter

3.0 System Startup

In January 2011, well drawdown was commenced and water levels were measured at accessible wells to track the water table depression. Some of the northern wells were covered by corn and were inaccessible for water level measurements. At various points in time following well installation, some of the wells have been not been accessible due to grains or soil being stored over them. As a result, there are gaps in some of the data collected (e.g. water levels), which required direct access to the wells for collection. Depression of the groundwater table and a turbidity issue are discussed below.

3.1 Groundwater Depression

An initial round of groundwater levels was taken at select accessible wells in October and November, 2010. On January 4, 2011 upon completion of the initial start-up test the dual phase extraction wells at the Site were activated. During start up, specific capacity and recovery tests were performed on the five accessible wells (three wells were buried under corn and could not be accessed). The results of the start-up tests indicated that the wells were performing as anticipated producing water flow rates of approximately 0.5 - 1.0 gallons per minute (gpm) each. The pumping proceeded to lower the water table which was confirmed periodically. The most recent rounds of water level measurements were taken at the accessible wells on February 9 and July 12, 2012. Even after a very brief unscheduled shut-down of the system, the water table was significantly depressed in February. Three of the wells (SVEN-2, SVEN-5, and SVEN-9) and three of the monitoring points (VG1-1, VG1-2 and TGN1-22) were dry. Drawdown in the DPES wells was up to 7.5 feet where the target for the center wells was 7 feet and the outer points two feet. In July, eight of the 11 SVE wells surveyed were dry while the other three had water depths of 0.2, 1.6 and 2.7 feet above the bottom of the well. Table 4-1B entitled “Operation Monitoring (Recovered Water)” presents system parameters indicating individual well recovery rates.

3.2 Excessive Turbidity

As pumping of the DPE wells proceeded, it was noted that the water pumped from a couple of the wells had unusually high levels of solids which had the potential to clog the water treatment system. To address this issue, filter socks were installed at the pump intakes for the most impacted wells (i.e. DPES-2 and DPES-3) but this solution did not prove viable. In February 2011 a 21,000 gallon fractional tank was installed in line between the influent water manifold and the equalization tank in order to settle out solids before directing the water through the treatment system. This approach was effective but was not considered a permanent solution (due in part to the additional maintenance required), and additional approaches were considered. It was ultimately concluded that an inner 4-inch well screen of smaller size, with an appropriate sand size should be installed within the three southern area wells.

These wells (DPES-1, DPES-2 and DPES-3) were installed as 6-inch diameter wells with 20 slot screen and #1-sized sand. They were specified and constructed in a similar manner to the rest of the dual-phase wells at the Site. It appears that the conditions in the vicinity of these three wells may be somewhat different from the rest of the Site and hence the excess solids. In order to address excess solids recovery these wells were retrofitted with pre-pack 4-inch well screens inside each of the of the two existing problem wells. The pre-packed wells have a 6 slot screen and surrounded by #00 sized sand. This modification has reduced the concentration of solids drawn by these wells and no adverse effects on the drawdown capability of the wells were noted.

4.0 System Monitoring

4.1 Overview

Since startup system operational data were collected and logged on a regular basis. Regular field readings consisted of monitoring vacuum, flows, temperatures, and VOC concentrations throughout the SVE system, and checking/verifying operation of the pneumatic pumps. The data collected during this period are presented in Tables 4-1A Operation Monitoring (Recovered Vapor) and 4-1B Operation Monitoring (Recovered Water). In addition, following startup, recovered groundwater, recovered soil vapor and sub-slab vapor were sampled and analyzed. These sampling events are discussed below. Laboratory data sheets for the various rounds of sampling are provided in Appendix C. Tabulated results for critical data are summarized in Tables 4-2 through 4-8 and discussed below.

4.2 Groundwater

The dual phase extraction wells at the Former Miller Container Plant were activated on January 4, 2011 upon completion of the initial start-up test for these wells. During start-up, specific capacity and recovery tests were performed on the accessible wells (i.e. not buried under corn). The results of the start-up tests indicate that the wells were performing as anticipated producing approximately 0.5 - 3.6 gpm each. The data collected during the test together with the estimated hydraulic conductivity are summarized below. Transmissivity was taken from Driscoll (1986) for an unconfined T = 200*SC and aquifer thickness, b, was assumed to be 38 feet for all wells.

TABLE 4-2. Hydraulic Conductivity Estimates.

DPE Wells (with color coding)	Pumping Rate Q (gpm)	Hydraulic Gradient ΔH (ft)	Specific Capacity SC (gpm/ft)	Transmissivity T* (ft^2/day)	Hydraulic Conductivity K = T/b (ft/day)	Hydraulic Conductivity k (cm/sec)
DPEN-1 (RED)	1.25	7.32	0.17	34.15	0.899	3.17E-04
DPEN-2 (YELLOW)	2.34	7.62	0.31	61.42	1.616	5.70E-04
DPEN-3 (GREEN)	1.08	7.47	0.14	28.92	0.761	2.68E-04
DPEN-4 (BLUE)	1.08	7.47	0.14	28.92	0.761	2.68E-04
DPEN-5 (WHITE)	1.12	7.47	0.15	29.99	0.789	2.78E-04
DPES-1 (R/W)	1.27	10.19	0.12	24.93	0.656	2.31E-04
DPES-2 (Y/R)	1.18	17.93	0.07	13.16	0.346	1.22E-04
DPES-3 (Y)	1.40	18.70	0.07	14.97	0.394	1.39E-04

Where,

$$K = \frac{Q}{\Delta H}\left(\frac{200}{b}\right)$$

and b = aquifer thickness taken to be 38 feet. The hydraulic conductivity is converted from K (ft/day) to k (cm/sec) by multiplying by 3.53×10^{-4}.

Baseline samples were collected from the in-line sampling ports for each well on January 4, 2001 and analyzed for VOCs. Subsequent sampling was performed on April 19, September 6 and December 13, 2011. Table 4-3 includes a summary of the field data collected during the groundwater sampling. Table

4-4 presents a summary of the analytical results for the groundwater sampling and analysis. Reported concentrations of some compounds were noted to exceed ambient water quality standards (AWQS). Concentrations of VOCs in water samples increased relative to baseline following activation of the SVE system. The compound and well with the highest overall concentration was tetrachloroethene in well DPEN-2. Based on the total flow from each of the DPE wells and the average total VOC concentrations noted over the four sampling rounds, it is estimated that 3,261 g (3.3 kg) of VOCs (Table 4-5) have been removed from the groundwater as of December 2011.

TABLE 4-5. Estimated Mass of VOCs Removed in Groundwater.

System	Dual-Phase Well	Average VOC Concentration, µg/L	Cycle count	Mass Removed, g
SVE-N	**DPEN-1**	328	1,753,239	575
	DPEN-2	666	2,661,888	1,773
	DPEN-3	137	2,875,414	394
	DPEN-4	113	2,171,298	245
	DPEN-5	106	1,713,483	182
SVE-S	**DPES-1**	42	2,003,430	84
	DPES-2	6	1,185,887	7
	DPES-3	0.71	1,612,745	1
TOTAL VOC mass removed				**3,261**

Notes:

VOC concentrations averaged data collected in January, April, September and December 2012.
A cycle count represents 1 Liter of flow.

As noted above, Tables 4-1 A and B provide all data collected since the system start up, and documents individual well performance based on sample ports and flow meters installed at the local manifold for each operable well.

4.3 Soil Vapor Extraction

The SVE system was started in late February 2011 and allowed to operate. It was originally planned to bring the SVE systems on-line as the water table was being depressed through groundwater extraction. However, based on the timing of the construction, it was possible to begin depressing the water table several weeks before the blower system was installed and made operational. Consequently, the sampling was adjusted to the collection of soil vapor samples in April, September and December 2011 for laboratory analysis. In addition, a round of influent and effluent samples was collected for the Vapor Phase Carbon (VPC) unit on March 24, 2011. The VPC data are summarized in Table 4-6 and shows an initial removal efficiency of 98% with a gradual decrease in efficiency as system operation progressed. Plans will be initiated for replacement and/or regeneration of the carbon, as appropriate.

Analytical results for the system wide soil vapor samples are summarized in Table 4-7. The highest VOC concentrations are being observed in wells DPEN-2 and DPEN-4 in the north and SVES-2 in the south. Overall, tetrachloroethene is the most dominant VOC in terms of quantity recovered. Following the initial round of data collected in April, VOC concentrations peaked in September but declined in December, albeit at levels still greater than the initial round in April.

During startup of the blower system, a Flame Ionization Detector (FID) was used to monitor VOC concentrations across the system. However, the data correlated poorly when compared with laboratory analytical data. A photoionization detector (PID) was evaluated and found to correlate better with laboratory data than did the FID. A PID was then employed for monitoring from July 21, 2011 onwards.

The combined influent FID/PID readings for the SVE system were consistently in excess of 100 ppm VOCs during the initial months of operation, and have decrease to 1.5 ppm as of the last record in October 2011. The SVE system operated with individual well vacuum between 3 and 10 inches of mercury ("Hg) with corresponding extracted vapor flow typically in the range of 20 to 50 SCFM (Table 4-1 A). Induced total flow rates were consistently measured to be between 400 and 500 (265 to 300 from the North System) standard cubic feet-per-minute (SCFM). These results are consistent with the original total design flow of up to approximately 550 SCFM.

More recent flow rates between July and October 2011 resulting from wells in the southern portion of the SVE system have dropped to less than 10 SCFM. These lower flow rates are a result of decreasing recovery rates in order to control condensate collection during the colder months. The design flow rate targeted in order to achieve adequate radius of influence based on subsurface characteristics is 25 SCFM from each well. Therefore, the system has regularly achieved or exceeded design requirements and can be operated at design levels during most conditions. In addition, the maximum VOC influent concentration was 6,718 ppm (Table 4-1 A) seen during the initial stages of operation at DPEN-4. During the latest round, the maximum VOC concentration observed was 22.7 ppm at DPEN-2. In general, all individual well VOC readings have decreased significantly during this period. Table 4-1A presents all data relative to Operations Monitoring of the vapor system.

Based on field screening results collected monthly, SVE influent concentrations and recorded flow rates indicate that the system has removed approximately 1,050 pounds of VOCs from the site (Table 4-1A). Furthermore, the mass removal rate has dropped from a rate of just over 1 pound per hour during the beginning stages of operation to less than 0.02 pounds per hour during the last record. These results and the overall decrease in influent concentrations indicate that the system has been consistently removing mass (albeit at lower rates during infrequent instances of lower flow rate), and that the available mass within the subsurface has diminished. Overall, the system has been operating as designed, and with continued operation and optimization the site is expected to progress towards ultimate remedial goals.

4.4 Soil Vapor Intrusion

Two permanent soil vapor intrusion monitoring points were installed within occupied areas of the building. One is located to the north and referred to as SVI-N and the other is located to the south and referred to as SVI-S. Soil vapor intrusion samples were collected on February 16, 2011 as a baseline before all supplemental mitigation systems were installed and brought on-line. One sample was collected from each of the two sub-slab locations (SVI-N and SVI-S), one from an occupied office area and one sample at an ambient location. These samples were collected over a 24-hr period using 1-liter capacity Summa canisters and submitted to Test America Laboratory (Burlington, Vermont) for analysis of VOCs using USEPA Method TO-15. It was initially planned for a subsequent round of samples to be collected six months thereafter; however, this sampling was postponed to later in the year because the time was outside the heating season window. The next round of SVI sampling was performed on December 14, 2011. The results of the SVI sampling are provided in Table 4-8.

The data packages were submitted for data quality review and all data were deemed acceptable for its intended purpose. The applicable results were compared to the available guidelines provided in the New York State Department of Health (NYSDOH) "Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York" dated October 2006. The only chemicals exceeding the available guidelines in the baseline round were tetrachloroethene and trichloroethene in the sub-slab sample taken in the north of the building.

The subsequent round had no exceedances of the available guidelines which suggest that VOCs initially noted in the subslab were being removed by the SVE system.

5.0 Operation and Maintenance

Continued operation of the SVE systems will involve routine maintenance and monitoring. These activities are discussed below.

5.1 Operation

Based on a review of the data, it appears that the system is operating as designed and is likely to progress the site towards the established remedial goals through continued operation. Over time, SVE influent and individual well VOC readings have decreased significantly. It also appears that the system is achieving adequate radius of influence based on achieved flow rates. Furthermore, based on both field screening results and laboratory data collected, significant mass removal has been accomplished through this period of operation. In the coming months, plans are to optimize recovery rates from site-specific areas, conduct further monitoring to confirm that adequate drawdown is being maintained throughout the treatment areas, and then to optimize mass removal from specific areas of the site. The applied vacuum to wells that are showing asymptotic decline in concentrations will be decreased in order to increase recovery in areas that still require remediation.

5.2 Monitoring

Routine monitoring of the system will include monthly collection of the system data identified in the Data Collection forms provided in Appendix D. This will include system operating parameters, recovered groundwater and extracted air parameters. The monitoring data collected will be used to assess the effectiveness of the system in recovering VOCs and adjustments to the operation will be made accordingly.

5.3 Maintenance

General operation and maintenance procedures for the mechanical systems are provided in the manufacturer's literature. The need and extent of other routine maintenance will be determined by field measurements such as air and water flow rates, depth to water, total depth of well etc. Possible maintenance indicated by these readings may include removal of silt from production or monitoring wells, sealing off of areas where short circuiting may be taking place or physical repair of infrastructure.

5.4 System Shut-Down

The SVE systems will be evaluated in conjunction with the entire site remedial systems and a determination will be made to either pulse the system or cease the operation of the vacuum extraction systems or the water recovery from the DPE wells or both. Confirmatory sampling will be performed to verify the effectiveness of the system after a series of pulse episodes are performed and acceptable results obtained. Once it has been determined the SVE systems have reached their useful life, a petition will be made to the Department to permanently shut the systems off.

6.0 References

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NYSDEC, Technical and Administrative Guidance Memorandum (TAGM) 4046 entitled “Determination of Soil Cleanup Objectives and Cleanup Levels” dated January 24, 1994.