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New York State Department of Environmental Conservation

Focused Feasibility Study, Former Plaza Cleaners OU#1 Port Washington, NY

New York State Department of Environmental Conservation Site #130108

December 2014

ARCADIS

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Focused Feasibility Study, Former Plaza Cleaners OU#1 Port

New York State Department of Environmental Conservation Site #130108

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Malcolm Pirnie, Inc. was acquired by ARCADIS in July 2009.

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Acronyms and Abbreviations

AS/SVE	air sparge/soil vapor extraction
bff	below finished floor
bgs	below ground surface
BWD	Bethpage Water District
CSM	conceptual site model
EVO	emulsified vegetable oil
DAR	Division of Air Resources
DCE	dichloroethene
FFS	focused feasibility study
FS	feasibility study
ft	feet
ft/day	feet per day
GAC	granular activated carbon
gpm	gallons per minute
GPR	ground-penetrating radar
HHRA	human health risk assessment
ISCO	in-situ chemical oxidation
IRM	interim remedial measure
lbs	pounds
LEED	Leadership in Energy and Environmental Design
ft msl	feet above mean sea level
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	operation and maintenance
OM&M	operation, maintenance, and monitoring
OU#1	operable unit #1
OU#2	operable unit #2

PCE	tetrachloroethene
PID	photoionization detector
ppm	parts per million
PRAP	Proposed Remedial Action Plan
PWWD	Port Washington Water District
RAP/FS	remedial action plan/feasibility study
RAO	remedial action objective
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
RSE	remedial system evaluation
SCGs	standards, criteria and guidance
SCO	soil cleanup objective
site	former Plaza Cleaners operable unit #1
SSD	sub-slab depressurization
SVOC	semi-volatile organic compound
SVE	soil vapor extraction
TCE	trichloroethene
µg/L	micrograms per liter
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VC	vinyl chloride

1. Introduction

This report presents a Focused Feasibility Study (FFS) of the former Plaza Cleaners Operable Unit 1 (OU-1) located at 966 Port Washington Blvd in the Town of North Hempstead, Village of Port Washington, New York (site) (Figure 1). The New York State Department of Environmental Conservation (NYSDEC) has defined OU-1 as the parcel that is the site of the building where dry cleaning operations were conducted. Operable Unit 2 (OU-2) was managed under a separate Remedial Investigation/Feasibility Study to include off-site soil and groundwater. The site (NYSDEC Site #130108) has operated as a dry cleaner for 50 years. Historical operations have resulted in the presence of chlorinated solvents, primarily tetrachloroethene (PCE) and trichloroethene (TCE) in soil, groundwater, and soil vapor.

This FFS Report has been developed to screen and evaluate select remedial measure alternatives for contaminants in groundwater, soil, and soil vapor at OU-1. The purpose of this report is to:

- Define Remedial Action Objectives (RAOs);
- Identify potentially feasible groundwater, soil, and soil vapor remedial alternatives;
- Evaluate these alternatives based on standard evaluation criteria;
- Compare remedial alternatives that could meet RAOs; and
- Provide information with which to select a preferred remedial alternative.

This FFS was completed in accordance with DER-10, NYSDEC DER program policy for Presumptive/Proven Remedial Technologies (DER-15), and NYSDEC DER program policy for Green Remediation (DER-31).

1.1 Site Description

The site is located at the junction of Port Washington Boulevard and Maple Street in an urban area in the Hamlet of Port Washington, Town of North Hempstead, Nassau County, Long Island, New York (Figures 1 and 2). Port Washington is located on the approximately 13.5 square-mile, Manhasset Neck peninsula. The Manhasset Neck is surrounded by the Long Island Sound toward the north, Manhasset Harbor to the east and Hempstead Harbor to the west.

The 0.25-acre site includes a one-story building in the southwestern corner of the lot that is currently being used as a dry cleaner business (Figure 3). The remaining portion of the property is covered with asphalt paving and is used for parking. This property has operated as a dry cleaner since 1964.

2. Previous Investigation and Remediation Activities

A series of environmental investigations and remedial activities have been conducted at the site since 1998. Previous investigations completed near the former Plaza Cleaners OU-1 site included off-site remedial investigations of the former Munsey Cleaners OU-1 (on-site soil and groundwater) and former Munsey Cleaners/former Plaza Cleaners OU-2 (off-site groundwater). The former Munsey Cleaners OU-1 site is located at the southeastern corner of Port Washington Boulevard and Main Street and is approximately 250 feet northeast of the former Plaza Cleaners site. Historical operations at both of these sites have resulted in the presence of volatile organic compounds (VOCs), primarily PCE and TCE in soil, groundwater, and soil vapor. The environmental investigations and remedial activities conducted at the Plaza Cleaners site prior to 2008, the Munsey Cleaners OU-2 and former Plaza Cleaners OU-2 sites Remedial Investigation (RI), and the 2013/2014 RI are summarized below.

2.1 Pre-2008 Site Investigations and Remediation

Site activities conducted prior to 2008 are summarized herein and in the NYSDEC environmental site remediation database (NYSDEC, 2014). In 1998, a Phase I Environmental Site Assessment indicated recognized environmental conditions associated with an underground storage tank (UST) on-site and the long-term operation of a dry cleaner. PCE was subsequently identified in a floor drain within the building and in sub-slab soils during a Phase II Environmental Audit. In 1998 and 1999, under the oversight of the Nassau County Department of Health, approximately 940 tons of contaminated soil was excavated and disposed of off-site at a permitted disposal facility. An Order on Consent was negotiated between NYSDEC and the responsible party in March 2001. During a 2003 Phase II subsurface soil and groundwater investigation conducted under NYSDEC oversight, PCE was detected in on-site groundwater samples at concentrations ranging from 3 micrograms per liter (µg/L) to 809 µg/L. Residual PCE was detected in on-site soil ranging from non-detect to 1 part per million (ppm). A Remedial Investigation/Feasibility Study (RI/FS) was initiated by the responsible party and, in February 2007, a Remedial Action Plan/Feasibility Study (RAP/FS) plan was submitted to NYSDEC; however, in May 2007, the Consent Order was terminated by NYSDEC. In October 2007, the Plaza

Cleaners site was listed as a Class 2 site and the completion of the RI/FS was referred to the State Superfund.

2.2 Munsey Cleaners OU#2 and former Plaza Cleaners OU#2

During 2010 and 2011, a RI was conducted on the offsite contamination associated with both the former Munsey Cleaners and former Plaza Cleaners (Malcolm Pirnie, Inc., 2011). An extensive analytical and field data collection program was implemented during this RI. Under the direction of the NYSDEC, the two remedial investigations (one for the former Munsey Cleaners OU-2 and one for the former Plaza Cleaners OU-2) were combined because of the likelihood of comingled dissolved-phase VOC plumes downgradient of these sites.

The dissolved-phase VOC plume associated with former dry cleaning activities has been generally defined both horizontally and vertically within the underlying upper glacial aquifer. A site plan and on-site sampling locations are shown on Figure 3. The dissolved-phase VOC plume consists primarily of PCE, TCE, and cis-1,2-dichloroethene (DCE). Total VOC concentrations were detected as high as 1,207 µg/L in the groundwater sampled in May 2010 from MW-5. The PCE concentration in this sample was 1,200 µg/L (Figure 4). PCE degradation products, TCE and cis-1,2 DCE, were detected at relatively lower concentrations in groundwater and VC was not detected, indicating that minimal natural attenuation of PCE is occurring within the aquifer.

Based on data collected prior to and during the Munsey and Plaza Cleaners OU-2 RI (Malcolm Pirnie, Inc., 2011), an investigation of soil vapor intrusion was implemented. Sub-slab depressurization systems were installed at recommended locations with owner approval to mitigate the potential for vapor intrusion. Six sub-slab depressurization (SSD) systems were installed under a NYSDEC work assignment to address potential soil vapor intrusion at 10 properties located above the dissolved-phase VOC plumes. Soil vapor and indoor air samples are collected on an annual basis at other locations where concentrations did not warrant the installation of a SSD system. The Sandy Hollow Well Field, the local source of drinking water is in the general vicinity of the dissolved-phase VOC plume; however, water treatment capabilities have already been established to remove VOCs from drinking water at this facility. The Port Washington Water District routinely monitors water quality, including VOC concentrations. Groundwater sampling conducted during the Plaza and Munsey Cleaners OU-2 RI has not detected VOCs at concentrations greater than NYS Standards at these potable water supply wells.

Two soil vapor samples were collected in June 2010. One sub-slab sample was collected at SG-9S, which is located inside the former Plaza Cleaners building, and the second sample was collected outside the building at ESG-3D. PCE was detected at both locations at concentrations of 400,000 µg/m^{3}and 19,000 µg/m^3, respectively (Figure 5).

In November 2011, a Final Remedial Investigation Report for the former Munsey Cleaners OU-2 and former Plaza Cleaners OU-2 (Malcolm Pirnie, Inc., 2011) was submitted to NYSDEC summarizing the results of the off-site RI activities for both sites. A remedial alternative Feasibility Study was conducted upon finalization of the RI Report. A final Feasibility Study (ARCADIS, 2012) was submitted to NYSDEC in February 2012, which developed remedial alternatives, presented implementation and long-term maintenance costs, and evaluated the effectiveness of alternatives to remediate VOC concentrations in groundwater to pre-existing conditions. Ultimately, the remedy of No Further Action with Monitoring was selected in the Proposed Remedial Action Plan (PRAP) for the former Munsey and Plaza Cleaners OU-2 (NYSDEC, 2012).

The final remedy selected for the former Munsey OU-1 site was Soil Vapor Extraction (SVE), however, the SVE system has since been shut down and the site is in the long term monitoring stage. Given the similarities in site contaminants and surficial geology between both the former Munsey Cleaners and former Plaza Cleaners, an air sparge/soil vapor extraction (AS/SVE) system (Figure 3) was installed at the former Plaza Cleaners OU-1 site by the potentially responsible party without NYSDEC oversight or approval. Based on information provided by the site owner’s consultant, Mr. Russell Furia of Zytel Industries, the system was brought online in March 2012.

2.3 2013/2014 Remedial Investigation

A RI (Malcolm Pirnie, Inc., 2014) was conducted between 2013 and 2014 at the site to obtain additional data relating to a potential underground storage tank (UST), potential impacts to a storm water sewer, and to conduct an evaluation on the existing AS/SVE system.

2.3.1 Soil

Previous investigations of the site included a ground-penetrating radar (GPR) survey to evaluate the potential for buried USTs. The results of the GPR survey indicated a subsurface anomaly north of the on-site building. On June 21, 2013 a confirmatory excavation occurred under the direction of the current property owner and their consultant. During the excavation, an UST was located approximately 1 foot below ground surface (bgs). The UST was approximately 6 feet in length and 4 feet in diameter and contained a small amount of liquid believed to be fuel oil. The UST and excavated soils were removed from the site. Soil results of samples collected from the excavation were consistent with fuel oil. One soil sample was collected directly beneath the UST (PC-01) and one soil sample was collected at the bottom of the excavation (PC-02). Concentrations of total xylenes in the shallower soil sample had a result equal to the 6 NYCRR Part 375 Unrestricted Use Soil Cleanup Objective (260 µg/kg). Other concentrations of detected compounds were less than the respective 6 NYCRR Part 375 Unrestricted Use Soil Cleanup Objective.

2.3.2 Soil Vapor

Soil vapor sampling was conducted at the site on September 12, 2013 (Figure 5). Soil vapor samples were collected from 13 sampling locations and analyzed for USEPA TO-15 constituents by Con-Test Analytical Laboratory in East Longmeadow, MA. The soil vapor sampling event included five sampling locations from outside the site building and eight locations from inside the building. An outdoor ambient air sample was also collected at the northeast corner of the building.

The results of the soil vapor sampling event conducted at the site indicate the presence of PCE, TCE and cis-1,2-DCE (Figure 5). The highest concentration of PCE detected in soil vapor sampled at the site was at ESG-6S (16,000 µg/m^3 [micrograms per cubic meter]), which is a shallow soil vapor sampling point. The second highest detected concentration of PCE in soil vapor sampled occurred from nearby soil vapor sampling point, ESG-7S (4,500 µg/m^3). Concentrations of TCE were also higher at the ESG-6S sampling location (110 µg/m^3) than other soil vapor locations sampled during the September 2013 event. Cis-1,2-DCE was detected at ESG-6S (25 µg/m^3) during the September 2013 soil vapor sampling event. Based on information provided by the site owner's consultant, Mr. Russell Furia of Zytel Industries, the approximate depths of soil vapor sampling screens at ESG-6S and ESG-7S are 10.5 and 8.5 feet bgs, respectively. As shown on Figure 5, ESG-6S and ESG-7S sampling points are located in the parking area east of the former Plaza Cleaners building.

Four sub-slab soil vapor samples were collected at the site on September 12, 2013 (Figure 5) at soil vapor monitoring locations SG-1D, SG-6D, SG-7D, and SG-10D. PCE was detected in each of the sub-slab sampling locations. The highest concentration of PCE detected in the sub-slab samples was observed at SG-10D (2,600 µg/m^3), which is located in the southwest portion of the building, according to the site owner's consultant, Mr. Russell Furia of Zytel Industries, this soil vapor monitoring location is screened approximately 17 feet below finished floor (bff).

During the September 2013 soil vapor sampling event, deep SVE system soil vapor samples were collected from influent (pre- granular activated carbon [GAC] vessels, mid-GAC, and effluent (i.e., post-GAC) sample locations to evaluate the system's effectiveness at soil vapor extraction and treatment. The PCE concentrations in the deep SVE system influent samples ranged from 2,400 µg/m^3 to 2,700 µg/m^3.

On February 18, 2014 influent soil vapor from each of the deep and shallow SVE wells was screened for VOCs via sample ports using a photoionization detector (PID). The concentrations ranged from 343 parts per billion by volume [ppbv]) to 2,889 ppbv at SVE-5D and SVE-3D, respectively. One influent soil vapor sample was collected from SVE-3D and analyzed for VOCs using Method TO-15, PCE was detected a concentration of 9,400 µg/m^3.

The highest concentration of PCE detected in the sub-slab was reported at SVE-3D (9,400 µg/m^3). This well located in the central part of the building and the screen extends to approximately 19 feet bff.

2.3.3 Stormwater and Sediment

During the September 2013 soil vapor sampling event, one sediment and one stormwater sample were collected from the stormwater manhole on the former Plaza Cleaners property. The sediment and water samples were analyzed for VOC constituents to evaluate the extent of the contamination at the site. No constituents of concern were detected in the sediment and water samples collected in the manhole on the former Plaza Cleaners property.

2.3.4 Groundwater

Groundwater samples were collected on February 18, 2014 from five on-site wells, monitoring well MW-3 and air sparge wells AS-3, AS-4, and AS-5. Well locations are shown on Figure 4. All groundwater samples were analyzed for VOCs by USEPA Method 8260C. The groundwater sample collected at AS-5 was also analyzed for semi-volatile organic compounds (SVOCS) (USEPA Method 8270D), metals (USEPA Methods 6010C and 7470A), cyanide (SM 4500-CN E), pesticides (USEPA Method 8081B), and PCBs (USEPA Method 8082A). PCE was the primary contaminant, and was detected in each groundwater sample at concentrations that exceeded the NYSDEC Class GA Standard.

PCE concentrations ranged from 7.1 µg/L (AS-5) to 46 µg/L (MW-1). The only other VOC detected in these five groundwater samples was TCE (0.14 µg/L) at AS-3. The SVOC detected was bis (2-Ethylhexyl) phthalate at AS-5 (5.7 µg/L), which exceeded the NYSDEC Class GA Standard (5 µg/L). No other SVOCs were detected in this groundwater sample. No PCBs were detected in the groundwater sample collected at AS-5, and no pesticides were detected at concentrations that exceeded NYSDEC Class GA Standards. Iron (1.3 milligram per liter [mg/L]) and sodium (66 mg/L) were the only two metals detected in the groundwater sample collected at AS-5 at a concentration that exceeded the NYSDEC Class GA Standards of 0.3 mg/L and 20 mg/L, respectively.

2.4 Conceptual Site Model

Information obtained during the RI and previous investigations was used to develop a conceptual site model (CSM), which summarizes the site-specific hydrogeology, the depth and flow of groundwater that affect the distribution, fate, and migration of the chlorinated VOCs. This CSM is used herein to facilitate the evaluation of possible remedial technologies and provide a summary for data collected during multiple investigations. These data include site-specific information on VOCs in soil, groundwater, soil vapor, sub-slab vapor, outdoor air, and the potential VOC sources.

Analytical data indicate that groundwater in the water-table aquifer contains VOCs commonly used in former dry cleaning practices, primarily PCE and TCE (Figure 4). These occur in a dissolved-phase VOC plume migrating from the site to the west-northwest. The dissolved-phase VOC plume consists primarily of PCE, TCE, and cis-1,2 DCE. PCE concentrations in groundwater have been detected as high as 1,200 µg/L in the sample collected from MW-5 in May 2010. PCE concentrations in groundwater sampled in 2010 through 2014 from other wells on-site ranged from 1.4 µg/L (MW-6) to 640 E µg/L (MW-2). Degradation products of PCE include TCE, cis-1,2 DCE, and vinyl chloride (VC). TCE and cis-1,2 DCE were detected at relatively lower concentrations in groundwater, and VC was not detected, indicating that little natural attenuation of PCE is occurring within the aquifer.

Sub-slab vapor and indoor air sampling results indicate that VOC vapors have migrated upward through the vadose zone overlying the dissolved-phase VOC plume. Consistent with groundwater quality, PCE and TCE were the primary VOCs present in the sub-slab soil vapor samples. PCE, the primary VOC present in the sub-slab soil vapor samples was detected at concentration as high as 400,000 µg/m^3 (SG-9D, 2010). The PCE concentration in outdoor air sample, OA-1, collected outside of the former Plaza Cleaners building sub-slab vapor was detected at 1.3 µg/m^3.

Limited soil sampling has been completed at the former Plaza Cleaners OU-1 site, and as such is not available for evaluation or comparison to regulatory standards. However, based on the PCE concentrations detected in soil vapor samples collected on-site, and the limited soil excavation that was completed within the western half of the building, it is likely that impacted soils remain beneath the eastern half of the building and site.

The CSM developed for the former Plaza Cleaners OU-1 site is summarized as follows:

- Subsurface soils at the Site are composed of fine, medium and coarse sand with occasional fine to medium gravel. A soil excavation at the site in 1998 and 1999 resulted in a portion of the site being composed of fill material. The hydraulic properties of this fill material were not provided, but are implied to be similar to native soils at the Site given the generally uniform radius of influence observed during the AS/SVE evaluation.

- Groundwater flow underneath, and in the vicinity of the former Plaza Cleaners OU-1 site, is generally to the west-northwest.

- Depth to groundwater at the former Plaza Cleaners OU-1 site ranges from 20 feet to 27 feet, depending on seasonal fluctuation.

- Based on the groundwater elevation data the hydraulic gradient is approximately 0.03.

- Assuming a hydraulic conductivity typical for well sorted sands and gravels of 10^{-3} to 10^{-1} centimeters per second (cm/s) (Fetter, 2001) and an effective porosity of 15%, the estimated groundwater seepage velocity for the site is approximately 1 to 10 feet per day.

- VOC releases from the site resulted in VOC impacts to groundwater, which exceed NYSDEC Class GA Standards.

- Impacted soils may remain below ground surface at the site, and may continue to impact groundwater and soil vapor.

- Sub-slab soil vapor PCE concentrations exceed NYSDOH mitigation action levels. Soil vapor is likely being impacted by dissolved-phase contaminants in shallow groundwater and residual impacted soil in the unsaturated zone.

2.5 Current Remedial Operations

An AS/SVE system was constructed by the property owner to remediate chlorinated VOCs in groundwater beneath the site, primarily PCE and TCE. The AS/SVE is currently being operated by the site owner's consultant, Zytel Industries. According to Mr. Russell Furia of Zytel Industries, the AS/SVE system has been operational since approximately March 2012.

A brief overview of the primary AS/SVE system components is provided below:

- Shallow SVE system: Inline radon fan (Specifications, unknown) and five shallow SVE wells (SVE-1S through SVE-5S)

- Deep SVE system: Regenerative blower (specifications, flow rate of 330 cubic feet per minute [cfm] at an applied vacuum of 10 inches of water column [in. W.C.] and five deep SVE wells [SVE-1D through SVE-5D])

- AS system: Oil-less rotary vane air compressor (Specifications, 28 cfm at an applied pressure output of 21 pounds per square inch gauge [psig]) and five air sparge wells (AS-1 through AS-5).

- AS/SVE wells are located within the northern interior portion of the building footprint. There are no AS/SVE wells located outside of the building.

No system operational or analytical data was provided by the site owner, or their consultant. An inspection of the existing AS/SVE system and recording of system operational data were completed in August and September 2013. A general description of the AS/SVE system is provided below.

2.5.1 Shallow SVE

As noted above a minimum vacuum is being applied on the shallow SVE well network. However, it is unclear whether the induced vacuum at each shallow SG well located within the building is being influenced by the shallow or deep SVE system. Based on the measured applied vacuum and flow rates at both systems, and the close proximity of both deep and shallow well screens, the majority of the induced vacuum and flow rates is more than likely being generated by the deep SVE system. As a result, it is unlikely that the shallow SVE system is providing any remedial benefit.

2.5.2 Deep SVE system

Extracted soil vapor flow from the deep SVE system ranged from 206 to 215 cfm at an applied vacuum of 20 in. W.C. Applied vacuums at each deep SVE well were recorded at approximately 15 in. W.C., indicating relatively equal flow recovery from each location, which corresponds to approximately 41 cfm per well.

The deep SVE system achieved an induced radius of vacuum influence greater than 60 feet, indicating homogeneity of the subsurface soils. Induced vacuums at each of the soil vapor and groundwater monitoring wells also indicate pneumatic conductivity in the subsurface, which suggests that the deep SVE system is generating lateral air flow movement in the subsurface on-site.

2.5.3 Air Sparge System

Based on the field measurements and AS well construction details provided by Zytel Industries, the air sparge system is injecting air into the vadose through the upper portion of the AS well screens which are screened well above the groundwater surface. As a result, it is unlikely that the AS system is providing the benefit of in-situ air stripping. Additionally, the AS system at the site is likely short-circuiting the deep SVE system by injecting clean air into the vadose zone.

2.5.4 Estimated Mass Removal

Based on the single pre-dilution influent vapor sample result and the measured deep SVE system effluent vapor flow rate, the system has removed an estimated 34 pounds (lbs) of PCE between March 2012 and February 2014, this assumes that SVE system has maintained a runtime of greater than 99% since startup. This cumulative mass removed value corresponds to 0.05 lbs per day.

Additional details regarding the current AS/SVE system and its operation are provided in the former Plaza Cleaners OU-1 RI (Malcolm Pirnie, Inc., 2014).

3. Human Health Exposure Pathways Analysis

A qualitative human health exposure assessment was performed to identify potential exposure pathways of site contaminants to the general public. A quantitative assessment was not conducted.

The environmental media containing site-related contaminants that could be potential points of exposure are soil, groundwater and soil vapor. The exposure points and routes of exposure where humans could potentially contact these media include dermal contact with soil during excavation activities, ingestion of soil or groundwater, and inhalation of indoor air. Receptors that could potentially be exposed to soil, groundwater, or soil vapor containing site-related contaminants include construction workers and site building occupants.

The environmental media, exposure pathways, and human exposure assessment are discussed below.

3.1 Soil

Soils at the site are capped by the existing building and the parking lot. Surficial soils are not accessible at the site, which prevents direct contact with contaminated soil. There is a potential for human contact with soil containing site-related contaminants if ground-intrusive work is conducted at the site.

As noted in Section 2, approximately 940 tons of contaminated soil was excavated and disposed of off-site in 1998 and 1999. Based on information provided by the site owner’s consultant, Mr. Russell Furia of Zytel Industries, the soil was excavated from within the western half of the building. Based on the PCE concentrations detected in the 2013 soil vapor and 2014 sub-slab vapor samples, subsurface soil beneath the eastern half of the building and site could contain PCE. These subsurface soils do not presently have a direct exposure point or route, as they are below the building slab and asphalt paved areas. However, contact with the impacted soils by construction or utility workers represents a possible future exposure pathway.

3.2 Groundwater

Overburden groundwater at the site contains VOCs at concentrations greater than the NYSDEC Class GA Standards. The potential for direct contact with groundwater during ground-intrusive work is extremely low because the water table is more than 15 feet below ground surface. Groundwater is not used at the site because municipal water is provided by the Port Washington Water District (PWWD). However, there are no institutional controls to prevent the pumping and use of groundwater at the site.

Groundwater in the vicinity of the site is a source of municipal drinking water; however, water pumped from the ground is treated to remove VOCs from drinking water at the Sandy Hollow well field facility. The PWWD routinely monitors water quality, including VOC analysis, to verify that it meets drinking water standards prior to distribution to area consumers.

3.3 Soil Vapor

Soil vapor (the air in the pore spaces between soil particles) at the site has become contaminated with VOCs when VOCs in soil and groundwater volatilize. As such, there is the potential for soil vapor containing VOCs to migrate into indoor air (soil vapor intrusion) at the site. Given the current groundwater VOC concentrations at the site and known sub-slab soil vapor concentrations beneath the on-site building, soil vapor intrusion represents a possible exposure pathway. Indoor air samples have not been collected inside the site building; however, the SVE system ventilates and depressurizes the sub-slab of the site building to minimize the potential for indoor air quality to be affected by the subsurface contamination. Soil vapor at the site is captured and discharged to the atmosphere at concentrations and flow rates within applicable NYSDEC Division of Air Resources (DAR) guidelines.

4. Remedial Action Objectives and Evaluation Criteria

This section outlines the Remedial Action Objectives (RAOs) for the former Plaza Cleaners OU-1 remedy, taking into account the applicable or relevant and appropriate federal, state, and local Standards, Criteria, and Guidance (SCGs) and overall objectives for the project, the appropriate remedial alternatives, and the scope and extent to which retained remedial alternatives can be implemented. The SCGs identified for this FFS and evaluation criteria to be considered in addressing the RAOs are discussed below.

4.1 Remedial Action Objectives

RAOs are goals set for environmental media, such as soil, groundwater, sediment, surface water, soil vapor, and indoor air, which are intended to provide protection for human health and the environment. Section 27-1301 of the New York State Environmental Conservation Law states that the goals of the inactive hazardous waste disposal site remedial program are to "eliminate, remove, abate, control or monitor health and/or environmental hazards or potential hazards."

Pursuant to Title 6 NYCRR Part 375-2.8(a), (b), and (c) (NYSDEC, 2006) and the DER-10 guidance document (NYSDEC, 2010), remedial goals for all remedial actions should include:

- Restoring the site to pre-disposal/pre-release conditions, to the extent feasible,
- Eliminating or mitigating all significant threats to public health and the environment through proper application of scientific and engineering principles,
- Removing sources of contamination to the extent feasible. “Feasible” is defined as suitable to site conditions, capable of being successfully carried out with available technology, implementable, and cost effective (6 NYCRR Part 375-1.2).

RAOs form the basis for the FFS by providing overall goals for site remediation. The RAOs are considered during the identification of appropriate remedial technologies and during the evaluation of remedial alternatives. RAOs are based on sound engineering judgment, and potentially applicable or relevant and appropriate SCGs.

For the purposes of this FFS, and based on the results of previous site investigations, the RAOs for the former Plaza Cleaners OU-1 site are to:

- Eliminate, to the extent practicable, on-site exposures to VOCs in groundwater, soil, and indoor air;
- Reduce, to the extent practicable, the concentration of site-related contaminants [e.g., PCE, TCE, cis-1,2-DCE] in groundwater at the site to less than NYSDEC Class GA Ambient Water Quality Criteria or guidance values;
- Reduce, to the extent practicable, VOC concentrations in soil at the site that exceed NYSDEC CP-51/Soil Cleanup Up Guidance; and

- Minimize the potential for soil vapor intrusion.

4.2 Standards, Criteria, and Guidance

6 NYSCRR Part 375 requires that SCGs are identified and that remedial actions conform with SCGs unless “good cause exists why conformity should be dispensed with.”

“Standards and criteria” are cleanup standards, standards of control, and other substantive environmental requirements, criteria or limitations that are generally applicable, consistently applied, and officially promulgated under federal or state law that are either directly applicable to a contaminant, remedial action, location or other circumstance, or that are not directly applicable but are relevant and appropriate.

“Guidance” consists of non-promulgated criteria, advisories, and/or other guidance that are not legal requirements and do not have the same status as “standards and criteria”; however, remedial alternatives should consider guidance that, based on professional judgment, may be applicable to the project.

The principle SCGs for the former Plaza Cleaners OU-1 site area are listed below:

General

- 6 NYCRR Part 375 – Environmental Remediation Programs, including the Inactive Hazardous Waste Disposal Site Remedial Program.

- 6 NYCRR Part 371 – Identification and Listing of Hazardous Wastes.

Water

- 6 NYCRR Part 700-705, Water Quality Regulations for Surface Water and Groundwater.

- NYSDEC Division of Water TOGS 1.1.1 – Ambient Water Quality Standards and Groundwater Effluent Limitations

Air

- NYSDEC Division of Air Resources Policy DAR-1 – Guidelines for Control of Toxic Ambient Air Contaminants.

- NYSDOH October 2006 Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York.

Soil

- NYSDEC CP-51 / Soil Cleanup Guidance.

4.3 Evaluation Criteria

In accordance with DER-10 Technical Guidance for Site Investigation and Remediation (DER-10) (NYSDEC, 2010), the remedial measure alternatives developed in this FFS will be screened based on an evaluation of the following criteria:

- Overall Protection of Human Health and the Environment;

- Compliance with Standards, Criteria, and Guidance (SCGs);

- Long-term Effectiveness and Permanence;

- Reduction of Toxicity, Mobility, and Volume;

- Short-term Effectiveness;

- Implementability;

- Cost; and,

- Sustainability/Green Remediation Practices.

The land-use evaluation criterion listed in DER-10 was not used in this FFS because the land use at the site is the same for each of the alternatives evaluated.

4.3.1 Overall Protection of Human Health and the Environment

This criterion serves as a final check to assess whether each alternative meets the requirements that are protective of human health and the environment. The overall assessment of protection is based on a composite of factors assessed under other evaluation criteria; especially long-term effectiveness and performance, short-term effectiveness; and compliance with SCGs. The evaluation focuses on how a specific alternative achieves protection over time and how site risks are reduced. The analysis includes how each source of contamination is to be eliminated, reduce, or controlled for each alternative.

4.3.2 Compliance with SCGs

This evaluation criterion assesses how each alternative complies with 6 NYCRR Part 375 Unrestricted Use Soil Cleanup Objectives, 6 NYCRR Part 375 Residential Soil Cleanup Objectives, NYSDEC Class GA Standards, and the guidelines set forth in the NYSDOH October 2006 Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York.

4.3.3 Long-Term Effectiveness and Permanence

This evaluation criterion addresses the results of a remedial action in terms of its permanence and quantity/nature of waste or residual remaining at the site after response objectives have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the waste or residual remaining at the site and operating system necessary for the remedy to remain effective. The factors being evaluated include the permanence of the remedial alternative, magnitude of the remaining risk, adequacy of controls used to manage residual waste, and reliability of controls used to manage residual waste.

4.3.4 Reduction of Toxicity, Mobility, and Volume

This evaluation criterion assesses the remedial alternative's use of the technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous wastes as their principal element. The NYSDEC's policy is to give preference to alternatives that eliminate any significant threats at the site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in the contaminants mobility, or reduction of the total volume of contaminated media. This evaluation includes: the amount of the hazardous materials that would be destroyed or treated, the degree of expected reduction in toxicity, mobility, or volume measured as a percentage, the degree in which the treatment would be irreversible, and the type and quantity of treatment residuals that would remain following treatment.

4.3.5 Short-Term Effectiveness

This evaluation criterion assesses the effects of the alternative during the construction and implementation phase. Alternatives are evaluated with respect to the effects on human health and the environment during implementation of the remedial action. The aspects evaluated include: protection of the community during remedial actions, environmental impacts as a result of remedial actions, time until the remedial response objectives are achieved, and protection of workers during the remedial action.

4.3.6 Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. The evaluation includes: feasibility of construction and operation; the reliability of the technology; the ease of undertaking additional remedial action; monitoring considerations; activities needed to coordinate with other offices or agencies; availability of adequate off-site treatment, storage, and disposal services; availability of equipment; and the availability of services and materials.

4.3.7 Cost

Cost estimates are prepared and evaluated for each alternative. The cost estimates include capital costs, operation and maintenance (O&M) costs, and future capital costs. A cost sensitivity analysis is performed which includes the following factors: the effective life of the remedial action, the O&M costs, the duration of the cleanup, the volume of contaminated material, and other design parameters. Cost estimates developed at the detailed analysis of alternatives phase of a feasibility study generally have an expected accuracy range of -30 to +50 percent.

4.3.8 Sustainability/Green Remediation Practices

In addition to the above regulatory-driven evaluation criteria, sustainability and green remediation practices have been considered. These practices would provide alternatives that conserve energy and other resources and will continue to be evaluated during the remedy design, construction, and operation phases, such as:

- Maximize use of existing equipment (e.g., use of AS/SVE components and well network),
- Specify energy-efficient equipment (e.g., use variable frequency drives to reduce energy demands),
- Reduce equipment footprints to minimize land disturbance,
- Use green structures, if required, for housing equipment (e.g., Leadership in Energy and Environmental Design [LEED]-certified materials), and
- Conduct remedial system evaluations (RSEs) to routinely assess and optimize system performance and evaluate opportunities to reduce energy needs and downsize or reduce equipment, as appropriate.

5. Identification and Screening of Remedial Technologies

The first step in developing remedial alternatives is to identify technologies that are suitable for further evaluation as part of a remedial alternative. Because the scope of this report is considered focused, the initial list of remedial technologies screened concentrated on those technologies that are considered by NYSDEC to be presumptive remedies for VOCs in soil and groundwater (NYSDEC, 2007). The selected technologies are developed into alternatives, which are then further evaluated during the detailed analysis of the remedial alternatives presented in Section 6 of this report.

In accordance with NYSDEC guidance, the identified technologies were screened using the following criteria:

- Effectiveness – Potential effectiveness in achieving RAOs; reliability of technology; and potential impacts to human health and the environment,
- Implementability – Technical and administrative feasibility of implementing the technology at the site, and
- Relative cost – Relative cost to implement the technology, including capital cost and cost for OM&M.

The results of the remedial technology screening are presented in Table 5-1. The technologies that passed the screening step are baseline/continued action, soil cap, environmental easement (including a Site Management Plan), optimized SVE, optimized AS, in-situ chemical oxidation (ISCO), enhanced bioremediation, and natural attenuation.

6. Remedial Alternative Development and Analysis

Remedial alternatives were developed using the retained technologies identified in Section 5. A description and analysis of each of the remedial alternatives is provided below.

6.1 Remedial Alternative Common Elements

Common elements are those that are already implemented and/or are common across all alternatives. Common elements for the site include:

- Operation of the existing SVE system;
- Groundwater monitoring;
- Engineering controls (e.g., existing soil cover established through the existing building foundation/slab, sidewalks, and paved areas);
- Institutional controls (e.g., an environmental easement and deed restrictions to prevent the use of site groundwater and to require the implementation of a soil management plan);
- Implementation of a Site Management Plan; and,
- Natural attenuation of groundwater after active treatment is discontinued.

Common elements provide protection of human health and the environment by preventing direct exposure to site-related constituents of concern and providing a long-term mechanism for enforcement of the active and passive remedial actions.

6.2 Description of Remedial Alternatives

Remedial alternatives were developed using the technology screening evaluation and through consultation with the NYSDEC. Remedial alternative common elements are included in each of the following alternatives:

Alternative 1: *Baseline/Continued Action* - Continued operation of existing AS/SVE system.

Alternative 2: *Optimized AS/SVE System* - Continued operation of the existing SVE system with expansion to address areas outside of the building. Installation and operation of a new, properly constructed AS system for site groundwater.

Alternative 3: *In-situ Chemical Oxidation* (*ISCO) using persulfate with Optimized SVE* – Continued operation of the existing SVE system with expansion to address areas outside of the building, ISCO using persulfate for site groundwater.

Alternative 4: *Enhanced Bioremediation using Emulsified Vegetable Oil (EVO) with Optimized SVE* - Continued operation of the existing SVE system with expansion to address areas outside of the building, enhanced bioremediation using EVO for site groundwater.

The remedial alternatives are described in further detail below.

6.2.1 Alternative 1 - Baseline/Continued Action

Under Alternative 1, the existing SVE system would continue to operate as-is along with implementation of the common elements. As described previously, the existing AS wells are screened too shallow to be effective. Alternative 1 would not achieve the RAOs because it does not address groundwater or potential soil contamination outside of the footprint of the existing building. For cost evaluation purposes, it is estimated that the SVE would continue to operate for five additional years and that implementation of the common elements would occur for 30 years. A site plan showing the existing site features applicable to Alternative 1 is provided on Figure 3.

6.2.2 Alternative 2 – Optimized AS/SVE System

Under Alternative 2, the existing AS/SVE system would be optimized, along with implementation of the common elements, to address soil and groundwater contamination beneath the entire site using components of the existing AS/SVE system where appropriate. Specifically, Alternative 2 includes the installation of 16 new AS wells down to a depth of approximately 50 feet below ground surface; or, 20 feet below the top of the water table. In addition, five new SVE wells would be installed to a depth of approximately 25 to 30 feet bgs and one existing SVE well would be utilized. The existing SVE blower would be reused for the SVE system and a new 10 horsepower compressor would be installed to supply air for the AS system. Alternative 2 would be capable of achieving the RAOs as it adequately addresses the RAOs for each media. For cost evaluation purposes, it is estimated that the AS/SVE would continue to operate for five years and that implementation of the common elements would occur for a total of 10 years (five years of active treatment plus five years of post-treatment monitoring). A site plan showing the existing and proposed site features applicable to Alternative 2 is provided on Figure 6.

6.2.3 Alternative 3 – ISCO using Persulfate with Optimized SVE

Under Alternative 3, the existing AS system would be decommissioned, the existing SVE system would be optimized, and groundwater would be treated site-wide through the injection of persulfate to promote ISCO of contaminants. In addition, the common elements would be implemented as described previously. Specifically, Alternative 3 includes the installation of 16 new ISCO injection wells down to a depth of approximately 50 feet bgs; or, 20 feet below the top of the water table. In addition, five new SVE wells would be installed to a depth of approximately 25 to 30 feet bgs and one existing SVE well would be utilized. The existing SVE blower would be reused for the SVE system. Sodium persulfate activated with ferrous iron would be injected to drive ISCO of the contaminants. Based upon preliminary calculations, it is estimated that approximately 250,000 gallons of injection solution and 106,000 lbs of sodium persulfate would be needed, per injection, to address groundwater beneath the entire site. Alternative 3 would be capable of achieving the RAOs as it adequately addresses the RAOs for each media. For cost evaluation purposes, it is estimated that the SVE would continue to operate for five years and that implementation of the common elements will occur for a total of 10 years (five years of active treatment plus five years of post-treatment monitoring). In addition, it is anticipated that two ISCO injections will be required and will occur during the first year of operation. A site plan showing the existing and proposed site features applicable to Alternative 3 is provided on Figure 7.

6.2.4 Alternative 4 – Enhanced Bioremediation using EVO with Optimized SVE

Under Alternative 4, the existing AS system would be decommissioned, the existing SVE system would be optimized, and groundwater would be treated site-wide through the injection of EVO to promote enhanced bioremediation of contaminants. In addition, the common elements would be implemented as described previously. Specifically, Alternative 4 includes the installation of 16 new EVO injection wells down to a depth of approximately 50 feet bgs; or, 20 feet below the top of the water table. In addition, five new SVE wells would be installed to a depth of approximately 25 to 30 feet bgs and one existing SVE well would be utilized. The existing SVE blower would be reused for the SVE system. A commercially available EVO product will be injected to drive enhanced bioremediation of the contaminants. Based upon preliminary calculations, it is estimated that approximately 250,000 gallons of injection solution and 52,000 lbs of EVO would be needed, per injection, to address groundwater beneath the entire site. Alternative 4 would be capable of achieving the RAOs as it adequately addresses the RAOs for each media. However, as described on Table 6-1 and in Section 6.3, it is possible that the high groundwater velocity at the site could limit the effectiveness of enhanced bioremediation and its ability to meet the RAOs for groundwater. For cost evaluation purposes, it is estimated that the SVE would continue to operate for five years and that implementation of the common elements will occur for a total of 10 years (five years of active treatment plus five years of post-treatment monitoring). In addition, it is anticipated that EVO injections would be completed on an annual basis for a period of five years due to the relatively high groundwater flux at the site. A site plan showing the existing and proposed site features applicable to Alternative 4 is provided on Figure 7.

6.3 Remedial Alternatives Comparative Evaluation

The remedial alternatives were compared to each of the evaluation criteria identified in Section 4.3. In addition, each evaluation criterion (with the exception of sustainability) were given a relative screening score for each of the remedial alternatives using a 1 to 5 scaling system where a rating of 1 represents the least favorable outcome relative to the evaluation criteria and a rating of 5 represents the most favorable outcome relative to the evaluation criteria. The individual criteria screening scores were than summed for each alternative to provide an overall screening score for each alternative. The overall screening scores were used as the basis for the comparative evaluation. A summary of the remedial alternatives comparative evaluation is provided in Table 6-1.

6.3.1 Protection of Human Health and the Environment

Alternatives 2, 3, and 4 each provide for equal protection of human health and the environment by achieving the RAOs for all media through active treatment and through implementation of the common elements. Alternative 1 prevents direct contact with impacted media, but is slightly less protective of human health and the environment because it does not provide for treatment of groundwater and only provides partial treatment of soil (e.g., the portion beneath the existing building).

6.3.2 Compliance with Regulatory Requirements

Alternatives 2 and 3 will meet regulatory requirements through active treatment of all media. Alternative 4 will likely achieve compliance with regulatory requirements; however, the high groundwater velocity at the site may limit the effectiveness of the enhanced bioremediation groundwater remedy. As such, Alternative 4 was rated lower than Alternatives 2 and 3. Alternative 1 will minimize the potential for soil vapor intrusion and will meet regulatory requirements for soil at a portion of the site, but it will not meet regulatory requirements for groundwater or soil outside of the existing building.

6.3.3 Long-Term Effectiveness and Permanence

Alternative 3 was given the highest rating because it is capable of achieving all RAOs in the long-term and is anticipated to include the most reliable technologies when compared to the other alternatives. Alternatives 2 and 4 are also considered reliable and capable of the achieving the RAOs in the long-term. Alternative 2 received a slightly lower screening score due to the requirement to maintain above-grade mechanical equipment. Alternative 4 received a slightly lower screening score due to the potential that the high groundwater velocity at the site could limit the effectiveness of enhanced bioremediation.

Alternative 1 is not considered effective in the long term since it is not capable of achieving the site RAOs.

6.3.4 Reduction of Toxicity, Mobility, and Volume with Treatment

Alternatives 2, 3, and 4 are equally capable of reducing the toxicity, mobility, and volume of VOCs assuming each remedial technology is implemented effectively.

Alternative 1 would only result in a partial reduction in the toxicity, mobility, and volume of VOCs through operation of the SVE system beneath the site building.

6.3.5 Short-Term Effectiveness

Alternative 2 was ranked the highest because it is capable of achieving the RAOs in the short-term and it is protective of human health and site workers in the short term. Alternatives 3 and 4 are also considered effective in the short term; however, Alternative 3 was ranked slightly lower due to the hazards associated with handling and injecting a hazardous material in close proximity to the public and site workers. Alternative 4 was ranked slightly lower due to the possibility that high groundwater velocity would limit the effectiveness of the groundwater remedy in the short term.

Alternative 1 prevents direct contact with impacted media, but is generally considered not effective in the short term because it does not provide for treatment of groundwater and only provides partial treatment of soil (e.g., the portion beneath the existing building).

6.3.6 Implementability

Alternative 1 was ranked the highest relative to implementability because most of the components are already implemented and the remaining components are easily implemented. Alternative 2 ranked the second highest relative to implementability because AS/SVE is easily implemented and proven implementable at the site through the previous remedial action. Alternatives 3 and 4 are also implementable; however, Alternative 3 will be slightly less implementable due to the handling and injection of a hazardous substance in close proximity to the public. As described previously, the high groundwater velocity at the site could affect the implementability and effectiveness of enhanced bioremediation under Alternative 4.

6.3.7 Cost

A summary of the cost estimates for each alternative is provided in Appendix A. A comparison of the costs for each alternative is provided in Table A-5 (Appendix A). As shown in Table A-5, Alternative 1 represents the lowest cost alternative followed by Alternative 2, Alternative 4, and Alternative 3. The relative cost distribution is expected as Alternative 1 requires no additional active remediation beyond operation of the existing system; Alternative 2 represents an expansion of the existing AS/SVE infrastructure; and ISCO (Alternative 3) is typically more cost prohibitive when compared to enhanced bioremediation (Alternative 4).

7. Conclusions

A detailed and comparative evaluation of select remedial alternatives was completed for the Former Plaza Cleaners OU-1 site in accordance with NYSDEC DER-10. As presented in Table 6-1, the feasibility study considered a focused set of remedial alternatives based on applicable technologies and evaluated these alternatives using standard criteria. A remedial alternative will be selected for the site in consultation with NYSDEC and other involved parties.

8. References

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Tables

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Table 5-1. Summary of Remedial Technology Screening Evaluation, Former Plaza Cleaners OU#1, Port Washington, New York.

General Response Action	Remedial Technology Type	Process Options	Technology Description	Effectiveness	Implementability	Relative Cost	Retained for Detailed Evaluation?
Baseline/Continued Action	Continued Operation of Existing Remedial System, Groundwater Monitoring, Surface Water Monitoring, and Indoor Air Monitoring	Continued Operation of Existing Remedial System, Groundwater Monitoring, Surface Water Monitoring, and Indoor Air Monitoring	Existing remedial system includes an air sparge and soil vapor extraction system (AS/SVE) located inside the existing commercial building, groundwater monitoring, and indoor air sampling.	**Moderately Effective** - AS/SVE is a NYSDEC presumptive remedy for volatile organic compounds (VOCs) in soil and groundwater per DER-15. However, existing air sparge wells are constructed too shallow for the remediation of groundwater. In addition, soil and groundwater contamination is likely present outside of the existing systems influence area.	**Implementable** - Already Implemented; however, additional infrastructure would need to be implemented to meet RAOs. Additional infrastructure is readily implementable.	**Low -** no additional cost beyond current operation.	Yes - The site geology and contaminants are conducive for treatment through AS/SVE. SVE is also effective at mitigating the potential for indoor air migration.
Engineering Controls/Institutional Controls	Physical Barrier/Access Restrictions	Soil Cap	Existing site cover features including the building foundation, concrete walkway, and parking lot serve as a physical barrier to prevent contact with potentially impacted soils.	**Moderately Effective -** Existing site cover features will prevent human contact with potentially impacted soil, prevent stormwater infiltration to minimize leaching to groundwater, and prevent vapor intrusion to indoor air. Not effective at achieving the RAOs alone (would need to be implemented in conjuction with active treatment measures and institutional controls).	**Implementable** - Already Implemented	**Low** - no additional cost beyond current operation.	Yes - The majority of the site is already covered through existing site features. Would require implementation of a Site Management Plan (SMP) to remain enforceable/protective over the long-term.
	Deed Restrictions/Property Use Limitations	Environmental Easement	Implementation of an environmental easement to prevent on-site use of impacted groundwater and require the preparation of a soil management plan for all instrusive construction activities. Typically implemented in conjunction with a SMP that defines the long-term operation and maintenance requirements (both active and administrative) for the site.	**Moderately Effective -** Effective at providing a long-term mechanism for ensuring implementation of the site remedy and preventing the use of site groundwater. Not effective at achieving the RAOs alone (would need to be implemented in conjuction with active treatment measures and engineering controls).	**Implementable** - Easily implemented/proven implementable in New York State.	**Low** - primarily surveying, legal, and adminstrative costs.	Yes - The majority of the site is already covered through existing site features. Effective at meeting the RAOs when implemented in conjunction with active treatment and implementation of institutional controls.
Collection/Treatment/ Discharge	Groundwater Extraction	Extraction Wells	Groundwater pumped from vertical extraction wells and conveyed to an ex-situ treatment system.	**Not Effective** - Conventional technology to control migration of, and extract, contaminated groundwater from the aquifer. Typically not suitable for source treatment or the elimination of soil gas impacts. NYSDEC presumptive remedy for volatile organic compounds (VOCs) per DER-15.	**Moderately Implementable** - Readily implementable, conventional, proven technology for groundwater containment; however, would require significant extraction volume to provide effective hydraulic capture due to the extremely high groundwater flux at the site. Requires monitoring program to confirm effectiveness.	**High -** will require high flow rates and robust above grade treatment infrastructure to control site groundwater.	No - The technology is generally not effective for source remediation within a reasonable timeframe. Will require significant pumping volume due to extremely high groundwater flux in the project area.
	Physical Removal	Soil Excavation	Contaminated soil is excavated using mechanical equipment. Excavated soil is stockpiled, characterized, and disposed of at an approved off-site disposal facility.	**Effective** - Conventional technology to control migration of, and extract, contaminated soil from the vadose zone. NYSDEC presumptive remedy for volatile organic compounds (VOCs) per DER-15.	**Not Implementable** - Existing building and operations would make implementation difficult.	**High** - would require shut down of existing site operations and modification to the existing building and parking lot. Generally considered a high capital cost technology relative to other technologies like soil vapor extraction.	No - The technology will be difficult to implement due to the existing, operating, commercial structure that overlays the majority of the site.

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Table 5-1. Summary of Remedial Technology Screening Evaluation, Former Plaza Cleaners OU#1, Port Washington, New York.

General Response Action	Remedial Technology Type	Process Options	Technology Description	Effectiveness	Implementability	Relative Cost	Retained for Detailed Evaluation?
Collection/Treatment/Discharge (con't)	In-Situ Groundwater Treatment (con't)	In-Situ Chemical Oxidation	Sodium persulfate is injected and activated using an iron catalyst to promote in-situ chemical oxidation of VOCs into non-toxic compounds.	**Effective** - Conventional technology to treat VOCs in groundwater. Can achieve RAOs. NYSDEC presumptive remedy for VOCs per DER-15.	**Implementable** - Proven implementable for sites with similar geology and COCs.	**High -** in-situ chemical oxidation treatment reagents are expensive compared to other in-situ technologies	Yes - The technology is implementable and an effective means of source treatment of the site-related COCs.
		Optimized Soil Vapor Extraction	Soil vapor is extracted from the vadose zone using passive (e.g., barometric pumping) or active (e.g., regenerative blower) pumping to promote mass transfer of VOCs from the soil into the vapor phase. Collected vapors are treated above grade using treatment media such as granular activated carbon.	**Effective** - NYSDEC presumptive remedy for VOCs per DER-15.	**Implementable** - Already implemented at the site.	**Low to moderate -** technology is already implemented at site; as such, a portiono of the existing system and infrastructure can be reused.	Yes
		Optimized Air Sparging	Air is injected into groundwater enabling the transfer of dissolved phase VOCs into the vapor phase. Volatilized VOCs are captured by a vapor extraction system for treatment prior to discharge to the atmosphere.	**Effective** - NYSDEC presumptive remedy for VOCs per DER-15.	**Implementable** - Site is accessible for injection well installation and geology is suitable for this technology.	**Low to moderate -** technology is already implemented at site; as such, a portiono of the existing system and infrastructure can be reused.	Yes
		Enhanced Biodegradation	An organic carbon substrate is injected into groundwater to stimulate existing microbial communities that degrade VOCs through reductive dechlorination.	**Effective** - NYSDEC presumptive remedy for VOCs per DER-15.	**Moderetely Implementable** - Construction of injection infrastructure implementable; however, it may be difficult to maintain conditions condudive for complete reductive dechlorination due to extremely high groundwater flux at the site. If strongly reducing conditions can be maintained, would generate significant quantities of dissolved methane that may pose a risk to human health at downgradient receptors.	**Moderate -**technology will be more expensive that air sparge, but less expensive than in-situ chemical oxidation, typically.	Yes - The technology is proven effective for source reduction of VOCs.
		Natural Attenuation	Naturally occurring processes (e.g., dilution, dispersion, sorption, biodegradation) used following active remediation to attenuate low concentrations of contaminants.	**Effective** - Site-related groundwater contaminants treatable by natural attenuation processes. Can achieve RAOs when used as a polishing step following use of active remedial actions.	**Implementable** - Readily implementable; no construction required, except for additional monitoring well installation.	**Low -** groundwater monitoring is generally inexpensive when compared to active treatment technologies	Yes

DEFINITIONS:

AS/SVE	Air sparge/Soil Vapor Extraction
COCs	Constituents of Concern
DER-15	NYSDEC Division of Environmental Remediation's Presumptive /Proven Remedial Technologies Policy (dated February 27, 2007)
NYSDEC	New York State Department of Environmental Conservation
RAOs	Remedial Action Objectives
Site Management Plan	Site Management Plan

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Table 6-1. Detailed and Comparative Evaluation of Remedial Alternatives, Former Plaza Cleaners OU#1, Port Washington, New York. (1)

Remedial Alternative	Protection of Human Health and the Environment	Compliance with Regulatory Requirements	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility and Volume	Short-Term Effectiveness	Implementability	Cost	Sustainability/Green Remediation Practices
	Threshold Criteria		Balancing Criteria					
Alternative 1 – Baseline/Continued Action								
Continued operation of existing air sparge/soil vapor extraction (AS/SVE) system and common elements (see note 1)	Mitigates vapor intrusion and provides soil remediation for a portion of the site through operation of the existing SVE system. Common elements prevent direct contact with contamination and provide a mechanism to enforce long-term operation of systems.	Does not achieve regulatory limits in groundwater and soil within a reasonable timeframe; however, residual risk is controlled by common elements. Reliable and easily maintained.	Does not achieve regulatory limits for soil or groundwater within a reasonable timeframe; however, remedy is easily maintained and protective of human health and the environment in the long-term.	Reduction in toxicity, mobility, and volume of soil COCs beneath existing building footprint through SVE. However, existing AS system is not screened properly for groundwater treatment. In addition, soil and groundwater outside of the existing commercial building are not addressed.	Does not achieve regulatory limits or a reduction of mass for soil or groundwater within a reasonable timeframe. However, protective of human health, the environment, and workers in the short-term.	AS/SVE and common elements easily implemented and/or already implemented at the site.	Total present worth opinion of probable cost = $744,000. Lowest cost alternative when compared to the other alternatives.	Continuous operation of the AS/SVE and treatment system will generate a remediation based carbon footprint Does not restore groundwater to a useable resource. Generation of a continuous waste stream required for the management of off-gas treatment media (assuming treatment with activated carbon).
Screening Score: 23 (Overall)	Screening Score: 4 (Moderate to High)	Screening Score: 3 (Moderate)	Screening Score: 2 (Low to Moderate)	Screening Score: 2 (Low to Moderate)	Screening Score: 2 (Low to Moderate)	Screening Score: 5 (High)	Screening Score: 5 (Low to Moderate)	Not included in screening score
Alternative 2 – Optimized Air Sparge/Soil Vapor Extraction								
Continued operation of the existing SVE system with expansion to address areas outside of the building for soil treatment. Installation and operation of a new, properly constructed AS system for site groundwater plus implementation of common elements (see note 1).	Mitigates vapor intrusion and provides soil and groundwater remediation for the entire site through AS/SVE. Common elements prevent direct contact with contamination and provide a mechanism to enforce long-term operation of systems.	Capable of achieving regulatory limits in groundwater and soil within a reasonable timeframe. Any residual risks and/or mass are controlled by common elements.	Capable of achieving regulatory limits for soil and groundwater within a reasonable timeframe. Protective of human health and the environment in the long-term. Remedy is reliable and easily maintained; however, AS requires routine long-term operation and maintenance and is slightly less reliable than other in-situ technologies evaluated.	Significant reduction in toxicity, mobility, and volume of soil and groundwater COCs site wide through AS/SVE.	Capable of achieving a significant reduction of mass in the short-term. High likelihood that regulatory limits can be reached in the short-term; however, natural attenuation may be needed for residual groundwater impacts. Protective of human health, the environment, and workers in the short-term.	AS/SVE and common elements easily implemented and/or already implemented at the site.	Total present worth opinion of probable cost = $1,084,000. Second lowest cost when compared to the other alternatives.	Continuous operation of the AS/SVE and treatment system will generate a remediation based carbon footprint Capable of restoring groundwater to a useable resource. Generation of a continuous waste stream required for the management of off-gas treatment media (assuming treatment with activated carbon).
Screening Score: 30 (Overall)	Screening Score: 5 (High)	Screening Score: 5 (High)	Screening Score: 4 (Moderate to High)	Screening Score: 5 (High)	Screening Score: 4 (Moderate to High)	Screening Score: 4 (Moderate to High)	Screening Score: 3 (Moderate)	Not included in screening score

Notes:

1. Common elements to all alternatives include operation of the existing sub-slab depressurization system, groundwater monitoring, indoor air monitoring, engineering controls (e.g., existing soil cover), institutional controls (e.g., an environmental easement and deed restrictions to prevent the use of site groundwater and to require the implementation of a soil management plan), the implementation of a Site Management Plan, and the natural attenuation of groundwater after active treatment is discontinued. Common elements provide protection of human health and the environment by preventing direct exposure to site-related constituents of concern and providing a long-term mechanism for enforcement of the active and passive remedial actions.

2. Screening scores based on a 1 to 5 numerical scoring system where 1 represents the least favorable outcome and 5 represents the most favorable outcome for the referenced evaluation criteria.

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Table 6-1. Detailed and Comparative Evaluation of Remedial Alternatives, Former Plaza Cleaners OU#1, Port Washington, New York. (1)

Remedial Alternative	Protection of Human Health and the Environment	Compliance with Regulatory Requirements	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility and Volume	Short-Term Effectiveness	Implementability	Cost	Sustainability/Green Remediation Practices
	Threshold Criteria		Balancing Criteria					
Alternative 3 – In-Situ Chemical Oxidation Using Persulfate with Optimized Soil Vapor Extraction								
Continued operation of the existing SVE system with expansion to address areas outside of the building for soil treatment, ISCO using persulfate for site groundwater, plus implementation of common elements (see note 1).	Mitigates vapor intrusion and provides soil remediation for the entire site through SVE. Provides groundwater treatment through ISCO. Common elements prevent direct contact with contamination and provide a mechanism to enforce long-term operation of systems.	Capable of achieving regulatory limits in groundwater and soil within a reasonable timeframe. Any residual risks and/or mass are controlled by common elements.	Capable of achieving regulatory limits for soil and groundwater within a reasonable timeframe. Protective of human health and the environment in the long-term. Remedy is reliable and easily maintained.	Significant reduction in toxicity, mobility, and volume of soil and groundwater COCs site wide through ISCO and SVE.	Capable of achieving a significant reduction of mass in the short-term. High likelihood that regulatory limits can be reached in the short-term; however, natural attenuation may be needed for residual groundwater impacts. Slightly less protective of workers due to handling of hazardous ISCO chemicals.	ISCO, SVE, and the common elements are easily implemented and/or already implemented at the site. Handling and management of ISCO reagents in close proximity to the public and site workers make ISCO slightly less implementable when compared to other in-situ technologies. Extremely high groundwater flux could wash out the ISCO reagents rapidly.	Total present worth opinion of probable cost = $1,457,000. Third lowest cost when compared to the other alternatives.	Continuous operation of the SVE treatment system will generate a remediation based carbon footprint Capable of restoring groundwater to a useable resource. Generation of a continuous waste stream required for the management of off-gas treatment media (assuming treatment with activated carbon).
Screening Score: 28 (Overall)	Screening Score: 5 (High)	Screening Score: 5 (High)	Screening Score: 5 (High)	Screening Score: 5 (High)	Screening Score: 3 (Moderate)	Screening Score: 3 (Moderate)	Screening Score: 2 (Low to Moderate)	Not included in screening score
Alternative 4 – Enhanced Bioremediation Using Emulsified Vegetable Oil (EVO) with Optimized Soil Vapor Extraction								
Continued operation of the existing SVE system with expansion to address areas outside of the building for soil treatment, enhanced bioremediation using EVO for site groundwater, plus implementation of common elements (see note 1).	Mitigates vapor intrusion and provides soil remediation for the entire site through SVE and groundwater treatment through enhanced bioremediation. Common elements prevent direct contact with contamination and provide a mechanism to enforce long-term operation of systems. Enhanced bioremediation will generate dissolved methane that may need to be managed both onsite and offsite.	Likely capable of achieving regulatory limits in groundwater and soil within a reasonable timeframe; however, extremely high groundwater flux could limit the effectiveness of enhanced bioremediation. Any residual risks and/or mass are controlled by common elements.	Likely capable of achieving regulatory limits for soil and groundwater within a reasonable timeframe; however, extremely high groundwater flux could limit the effectiveness of enhanced bioremediation. Protective of human health and the environment in the long-term. Remedy is reliable and easily maintained.	Assuming conditions conducive for enhanced bioremediation can be maintained, results in a significant reduction in toxicity, mobility, and volume of soil and groundwater COCs site wide through AS/SVE.	Capable of achieving a significant reduction of mass in the short-term. High likelihood that regulatory limits can be reached in the short-term; however, natural attenuation may be needed for residual groundwater impacts. Will generate dissolved methane which will require vapor mitigation beneath existing building for the protection of workers.	Enhanced bioremediation, SVE, and the common elements are easily implemented and/or already implemented at the site. Extremely high groundwater flux could replenish unfavorable electron acceptors (e.g., oxygen) faster than they can be consumed by bacteria resulting in unfavorable conditions for enhanced bioremediation (e.g., aerobic).	Total present worth opinion of probable cost = $1,631,000. Highest cost when compared to the other alternatives.	Continuous operation of the SVE treatment system will generate a remediation based carbon footprint Capable of restoring groundwater to a useable resource. Generation of a continuous waste stream required for the management of off-gas treatment media (assuming treatment with activated carbon).
Screening Score: 25 (Overall)	Screening Score: 4 (Moderate to High)	Screening Score: 4 (Moderate to High)	Screening Score: 4 (Moderate to High)	Screening Score: 5 (High)	Screening Score: 3 (Moderate)	Screening Score: 3 (Moderate)	Screening Score: 2 (Low to Moderate)	Not included in screening score

Notes:

1. Common elements to all alternatives include operation of the existing sub-slab depressurization system, groundwater monitoring, indoor air monitoring, engineering controls (e.g., existing soil cover), institutional controls (e.g., an environmental easement and deed restrictions to prevent the use of site groundwater and to require the implementation of a soil management plan), the implementation of a Site Management Plan, and the natural attenuation of groundwater after active treatment is discontinued. Common elements provide protection of human health and the environment by preventing direct exposure to site-related constituents of concern and providing a long-term mechanism for enforcement of the active and passive remedial actions.

2. Screening scores based on a 1 to 5 numerical scoring system where 1 represents the least favorable outcome and 5 represents the most favorable outcome for the referenced evaluation criteria.

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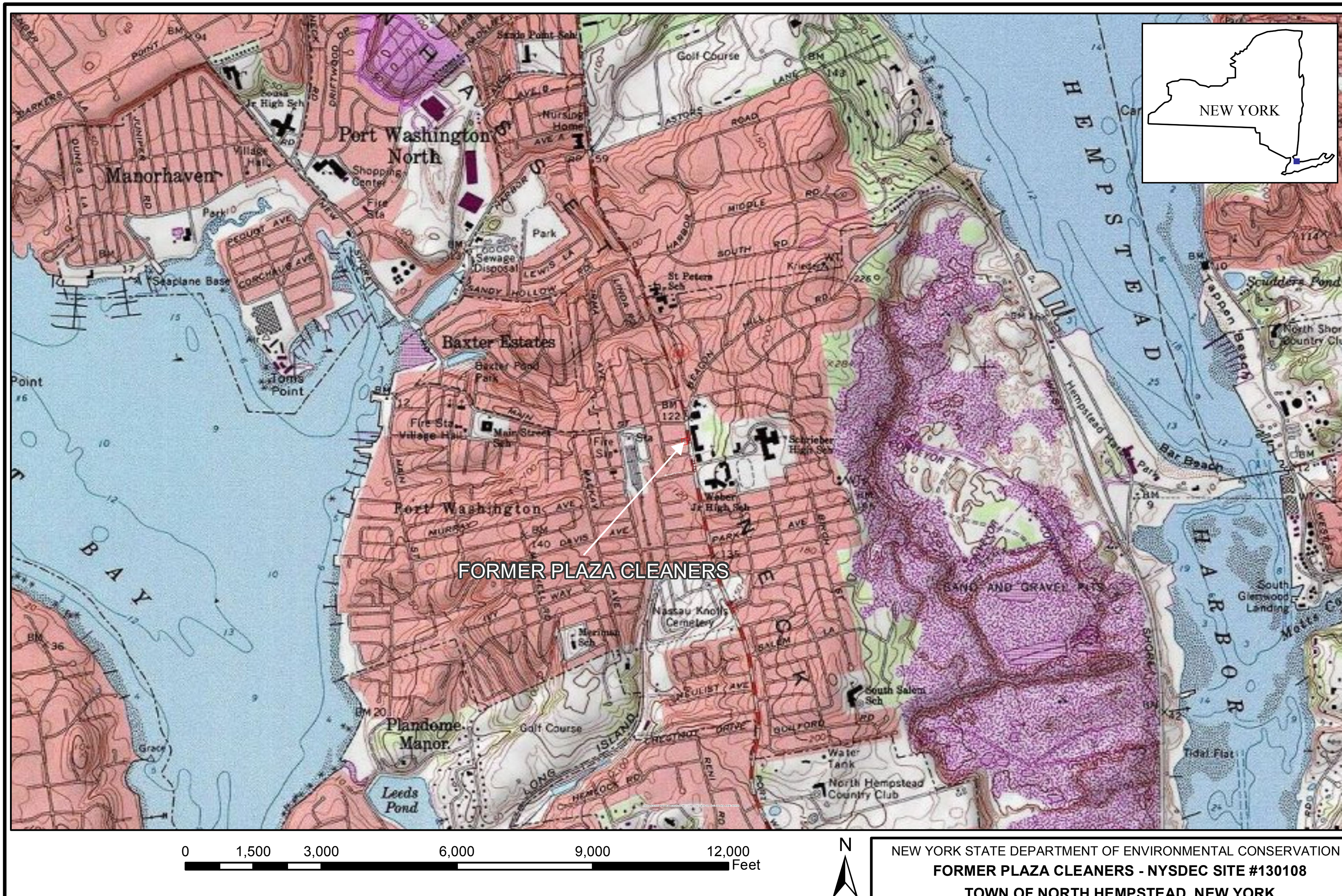
Figures



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FORMER PLAZA CLEANERS - NYSDEC SITE #130108

TOWN OF NORTH HEMPSTEAD, NEW YORK

SITE LOCATION

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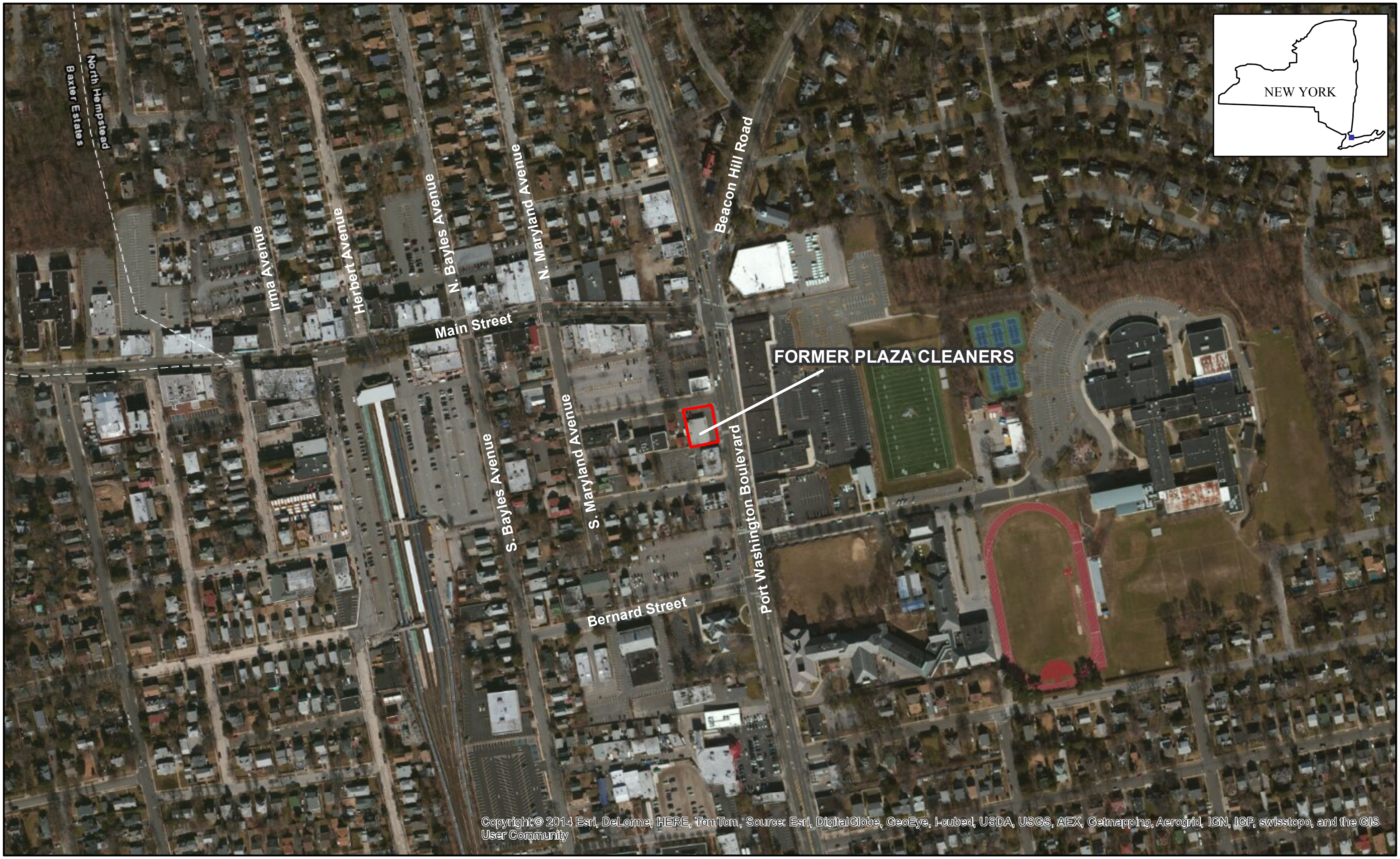
FIGURE

1

G:\GISMOD\00266408.0000\Topo.mxd
G:\PROJECT\00266408.0000\FILE\RI REPORT\Figure 1 - Site Location.pdf



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FORMER PLAZA CLEANERS - NYSDEC SITE #130108

TOWN OF NORTH HEMPSTEAD, NEW YORK

AERIAL PHOTOGRAPH

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FIGURE **2**

Legend

Site Boundary

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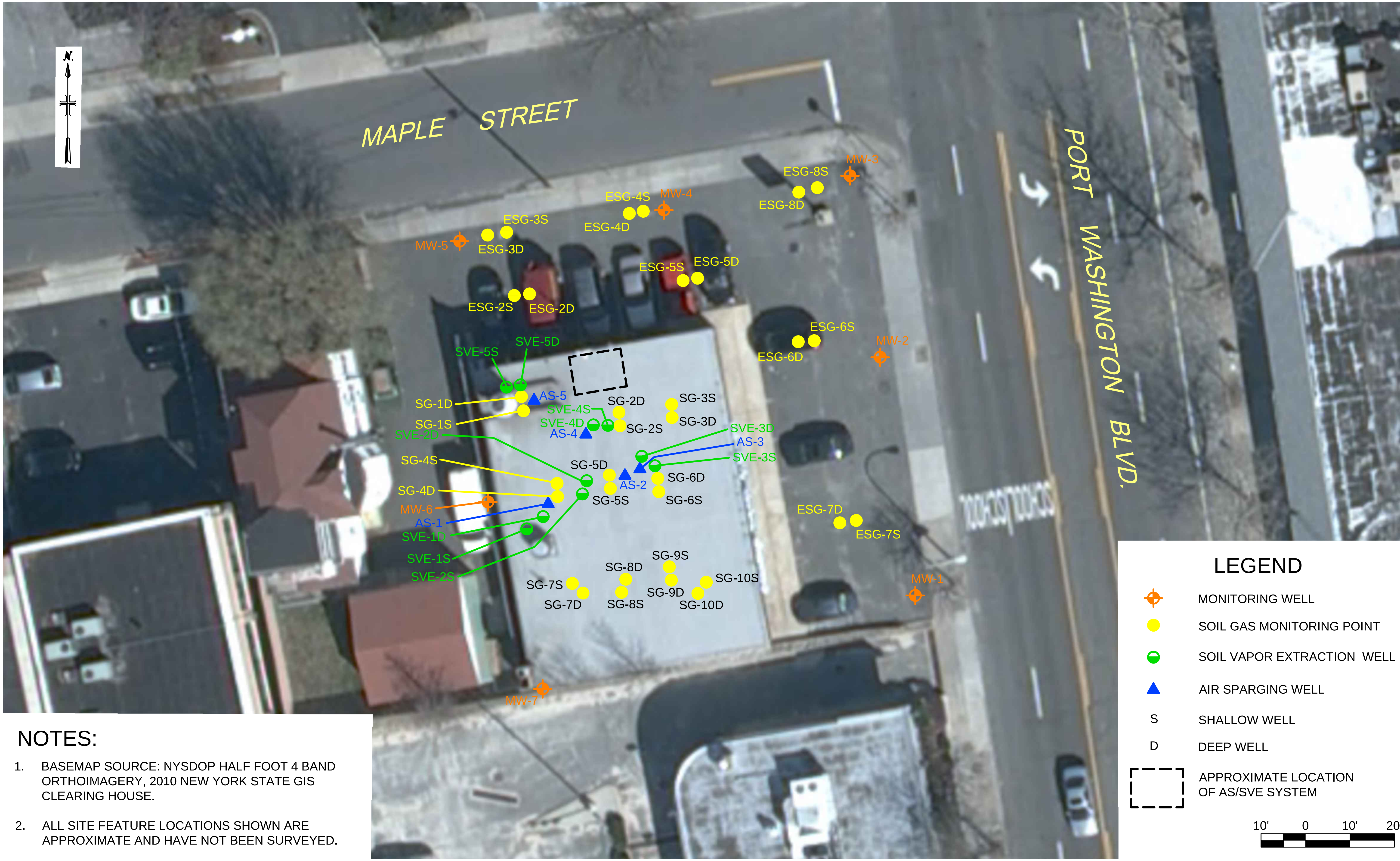
G:\PROJECT\00266408.0000\FILE\RI REPORT\Figure 2 - Aerial.pdf



NOTES:

1. BASEMAP SOURCE: NYSDOP HALF FOOT 4 BAND ORTHOIMAGERY, 2010 NEW YORK STATE GIS CLEARING HOUSE.
2. ALL SITE FEATURE LOCATIONS SHOWN ARE APPROXIMATE AND HAVE NOT BEEN SURVEYED.

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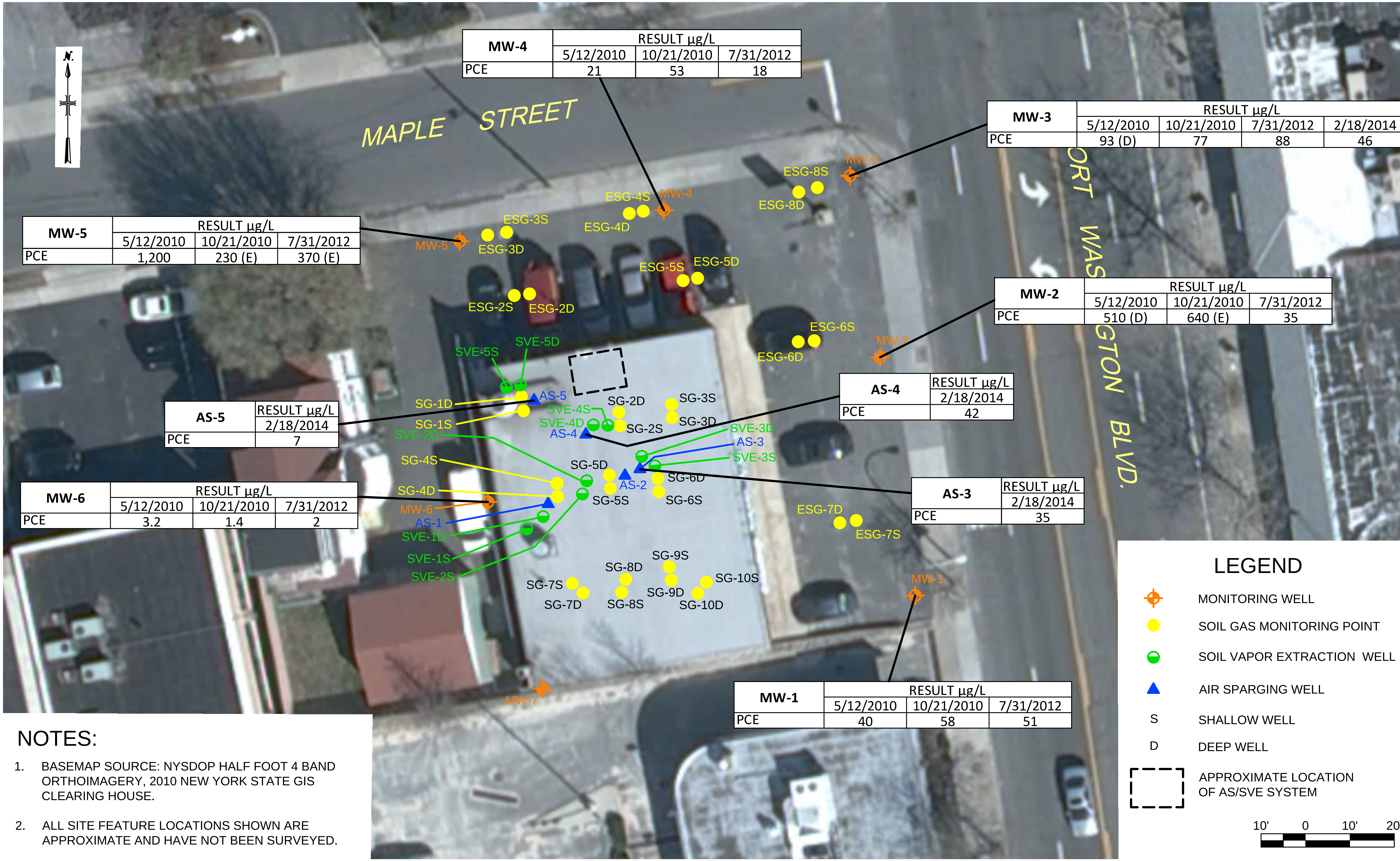
PLAZA CLEANER SITE, OU-1
TOWN OF NORTH HEMPSTEAD, NEW YORK

SITE PLAN AND IRM AIR SPARGE / SOIL VAPOR EXTRACTION SYSTEM LAYOUT

SCALE: AS SHOWN

JUNE 2014

FIGURE 3



MW-4	RESULT µg/L		
	5/12/2010	10/21/2010	7/31/2012
PCE	21	53	18

MW-3	RESULT µg/L			
	5/12/2010	10/21/2010	7/31/2012	2/18/2014
PCE	93 (D)	77	88	46

MW-5	RESULT µg/L		
	5/12/2010	10/21/2010	7/31/2012
PCE	1,200	230 (E)	370 (E)

MW-2	RESULT µg/L		
	5/12/2010	10/21/2010	7/31/2012
PCE	510 (D)	640 (E)	35

AS-4	RESULT µg/L
	2/18/2014
PCE	42

AS-5	RESULT µg/L
	2/18/2014
PCE	7

MW-6	RESULT µg/L		
	5/12/2010	10/21/2010	7/31/2012
PCE	3.2	1.4	2

AS-3	RESULT µg/L
	2/18/2014
PCE	35

MW-1	RESULT µg/L		
	5/12/2010	10/21/2010	7/31/2012
PCE	40	58	51

LEGEND

- MONITORING WELL
- SOIL GAS MONITORING POINT
- SOIL VAPOR EXTRACTION WELL
- AIR SPARGING WELL
- S SHALLOW WELL
- D DEEP WELL
- APPROXIMATE LOCATION OF AS/SVE SYSTEM

10' 0 10' 20'

NOTES:

1. BASEMAP SOURCE: NYSDOP HALF FOOT 4 BAND ORTHOIMAGERY, 2010 NEW YORK STATE GIS CLEARING HOUSE.
2. ALL SITE FEATURE LOCATIONS SHOWN ARE APPROXIMATE AND HAVE NOT BEEN SURVEYED.

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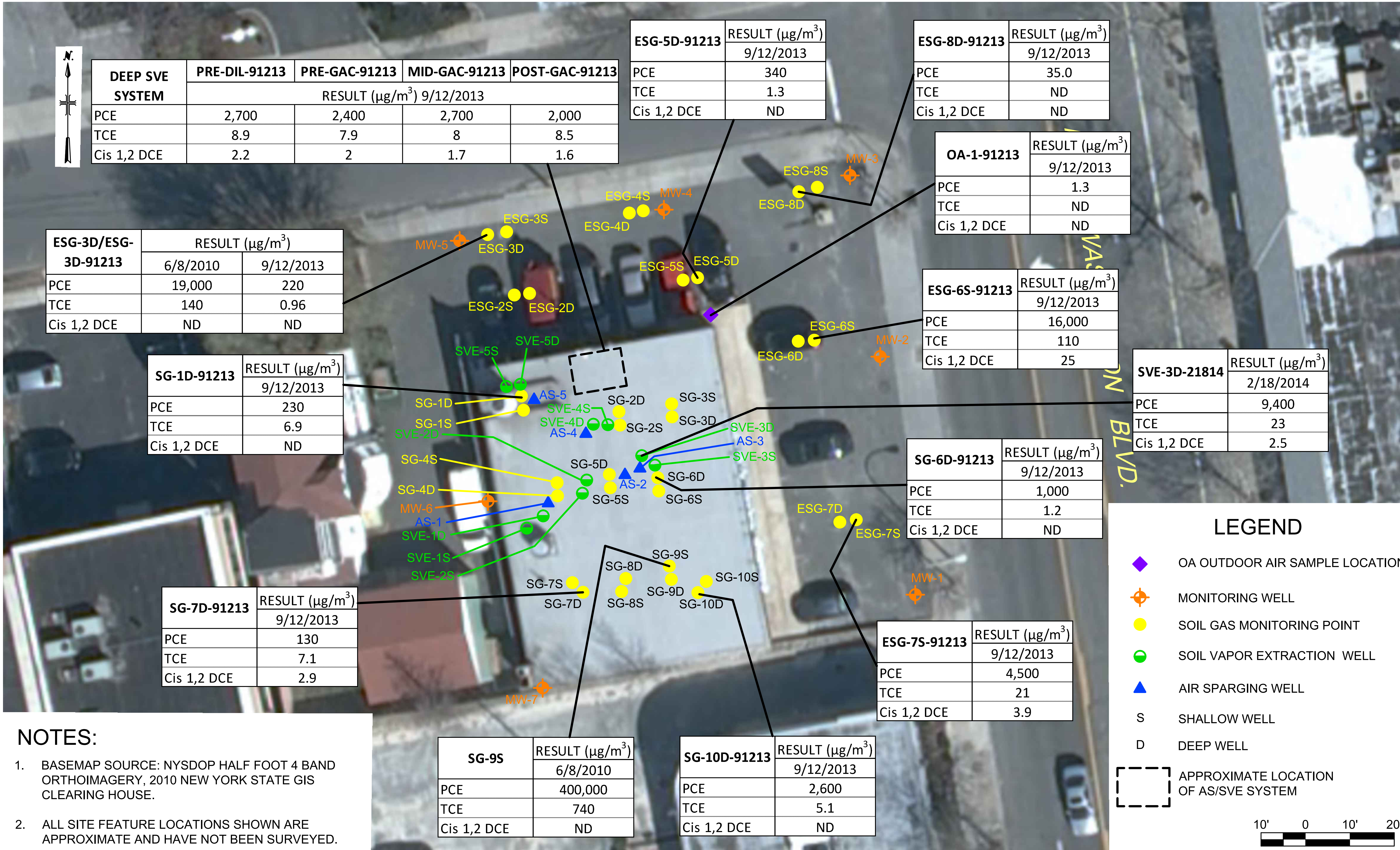
PLAZA CLEANER SITE, OU-1
TOWN OF NORTH HEMPSTEAD, NEW YORK

GROUNDWATER SAMPLING RESULTS

SCALE: AS SHOWN

JUNE 2014

FIGURE 4



DEEP SVE SYSTEM	PRE-DIL-91213	PRE-GAC-91213	MID-GAC-91213	POST-GAC-91213
	RESULT (µg/m^3) 9/12/2013			
PCE	2,700	2,400	2,700	2,000
TCE	8.9	7.9	8	8.5
Cis 1,2 DCE	2.2	2	1.7	1.6

ESG-5D-91213	RESULT (µg/m^3) 9/12/2013
PCE	340
TCE	1.3
Cis 1,2 DCE	ND

ESG-8D-91213	RESULT (µg/m^3) 9/12/2013
PCE	35.0
TCE	ND
Cis 1,2 DCE	ND

OA-1-91213	RESULT (µg/m^3) 9/12/2013
PCE	1.3
TCE	ND
Cis 1,2 DCE	ND

ESG-3D/ESG-3D-91213	RESULT (µg/m^3) 6/8/2010	9/12/2013
PCE	19,000	220
TCE	140	0.96
Cis 1,2 DCE	ND	ND

ESG-6S-91213	RESULT (µg/m^3) 9/12/2013
PCE	16,000
TCE	110
Cis 1,2 DCE	25

SG-1D-91213	RESULT (µg/m^3) 9/12/2013
PCE	230
TCE	6.9
Cis 1,2 DCE	ND

SVE-3D-21814	RESULT (µg/m^3) 2/18/2014
PCE	9,400
TCE	23
Cis 1,2 DCE	2.5

SG-6D-91213	RESULT (µg/m^3) 9/12/2013
PCE	1,000
TCE	1.2
Cis 1,2 DCE	ND

SG-7D-91213	RESULT (µg/m^3) 9/12/2013
PCE	130
TCE	7.1
Cis 1,2 DCE	2.9

ESG-7S-91213	RESULT (µg/m^3) 9/12/2013
PCE	4,500
TCE	21
Cis 1,2 DCE	3.9

SG-9S	RESULT (µg/m^3) 6/8/2010
PCE	400,000
TCE	740
Cis 1,2 DCE	ND

SG-10D-91213	RESULT (µg/m^3) 9/12/2013
PCE	2,600
TCE	5.1
Cis 1,2 DCE	ND

NOTES:

1. BASEMAP SOURCE: NYSDOP HALF FOOT 4 BAND ORTHOIMAGERY, 2010 NEW YORK STATE GIS CLEARING HOUSE.
2. ALL SITE FEATURE LOCATIONS SHOWN ARE APPROXIMATE AND HAVE NOT BEEN SURVEYED.

LEGEND

- OA OUTDOOR AIR SAMPLE LOCATION
- MONITORING WELL
- SOIL GAS MONITORING POINT
- SOIL VAPOR EXTRACTION WELL
- AIR SPARGING WELL
- S SHALLOW WELL
- D DEEP WELL
- APPROXIMATE LOCATION OF AS/SVE SYSTEM

10' 0 10' 20'

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PLAZA CLEANER SITE, OU-1
TOWN OF NORTH HEMPSTEAD, NEW YORK

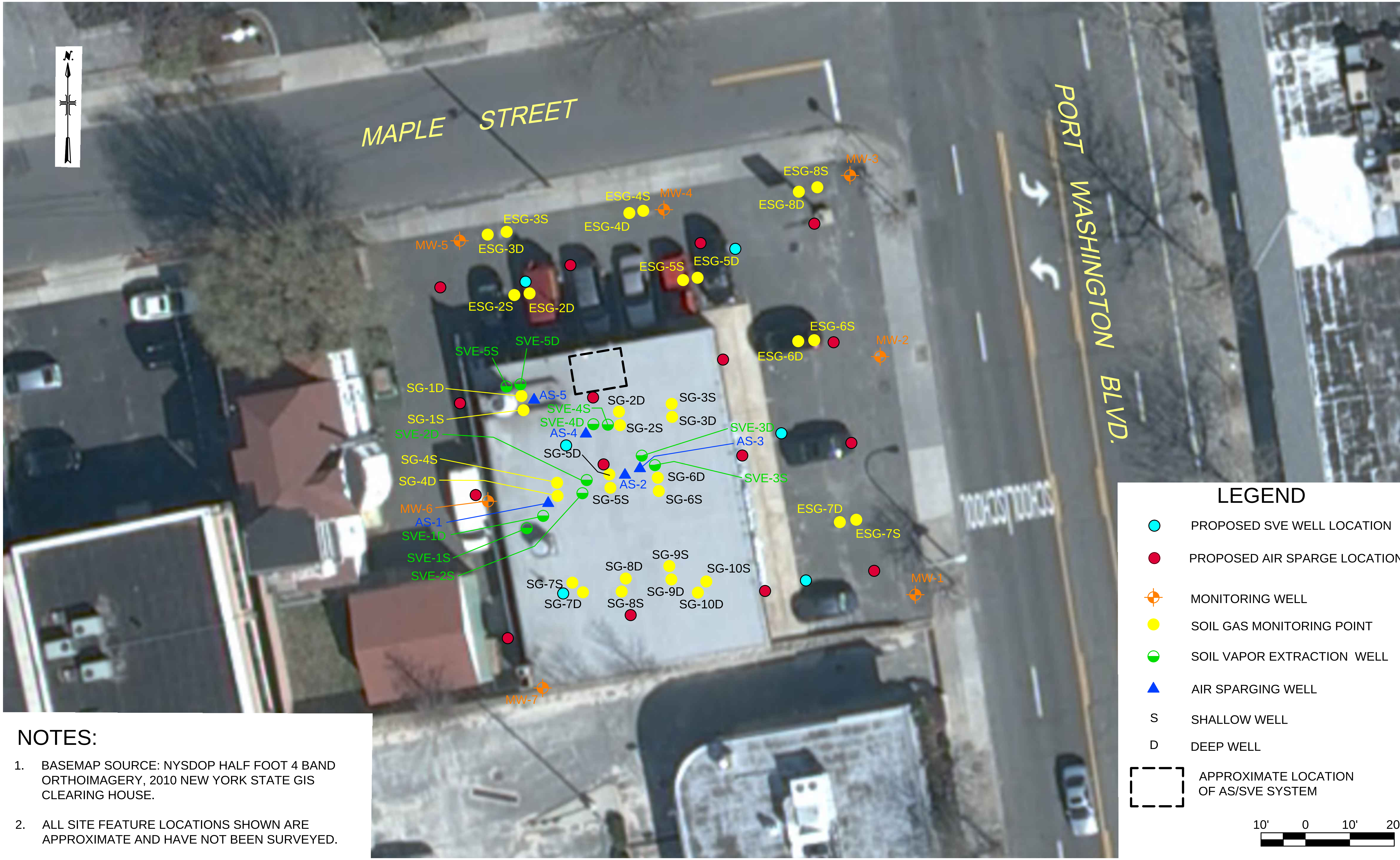
SUBSLAB SOIL VAPOR SAMPLING RESULTS

SCALE: AS SHOWN

JUNE 2014

FIGURE 5

SPEC: AUS-NCSMOD USER: HAUSMANN FILENAME: G:\PROJECT\0266380\FILE\CADD\FIGURES\FIG 5.DWG SAVE DATE: 6/30/2014 1:25 PM PLOT DATE: 6/30/2014 1:25 PM



NOTES:

1. BASEMAP SOURCE: NYSDOP HALF FOOT 4 BAND ORTHOIMAGERY, 2010 NEW YORK STATE GIS CLEARING HOUSE.
2. ALL SITE FEATURE LOCATIONS SHOWN ARE APPROXIMATE AND HAVE NOT BEEN SURVEYED.

LEGEND

- PROPOSED SVE WELL LOCATION
- PROPOSED AIR SPARGE LOCATION
- MONITORING WELL
- SOIL GAS MONITORING POINT
- SOIL VAPOR EXTRACTION WELL
- AIR SPARGING WELL
- S SHALLOW WELL
- D DEEP WELL
- APPROXIMATE LOCATION OF AS/SVE SYSTEM

10' 0 10' 20'

SPEC: AUS-NCSMOD USER: ####### FILENAME: G:\PROJECT\0266380\FILE\CADD\FIGURES\FIG 6.DWG SAVE DATE: 7/2/2014 6:59 AM PLOT DATE: 7/2/2014 7:02 AM

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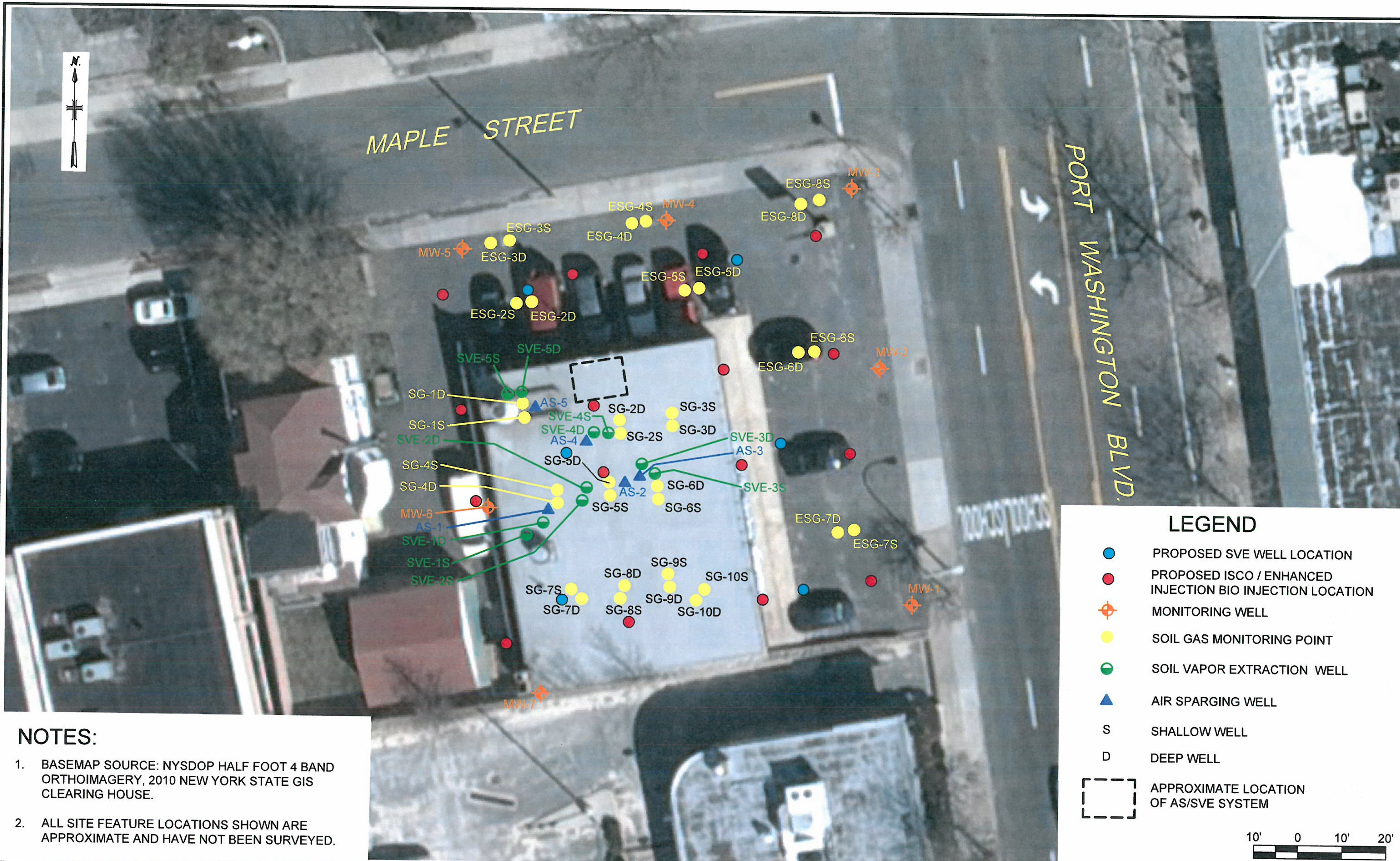
PLAZA CLEANER SITE, OU-1
TOWN OF NORTH HEMPSTEAD, NEW YORK

ALTERNATIVE 2
OPTIMIZED AIR SPARGE/SOIL VAPOR EXTRACTION LAYOUT
SCALE: AS SHOWN

JUNE 2014

FIGURE 6

SPEC: AUS-NCSMOD USER: HAUSMANN FILENAME: G:\PROJECT\0266380\FILE\CADD\FIGURES\FIG 7.DWG SAVE DATE: 6/30/2014 1:13 PM PLOT DATE: 6/30/2014 1:13 PM



LEGEND

- PROPOSED SVE WELL LOCATION
- PROPOSED ISCO / ENHANCED INJECTION BIO INJECTION LOCATION
- MONITORING WELL
- SOIL GAS MONITORING POINT
- SOIL VAPOR EXTRACTION WELL
- AIR SPARGING WELL
- S SHALLOW WELL
- D DEEP WELL
- APPROXIMATE LOCATION OF AS/SVE SYSTEM

10' 0 10' 20'

NOTES:

1. BASEMAP SOURCE: NYSDOP HALF FOOT 4 BAND ORTHOIMAGERY, 2010 NEW YORK STATE GIS CLEARING HOUSE.
2. ALL SITE FEATURE LOCATIONS SHOWN ARE APPROXIMATE AND HAVE NOT BEEN SURVEYED.

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PLAZA CLEANER SITE, OU-1
TOWN OF NORTH HEMPSTEAD, NEW YORK

ALTERNATIVE 3 - IN-SITU CHEMICAL OXIDATION AND
ALTERNATIVE 4 - ENHANCED BIOREMEDIATION
LAYOUT WITH OPTIMIZED SVE
SCALE: AS SHOWN

JUNE 2014

FIGURE 7

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Appendix A

Remedial Alternatives Opinions of Probable Costs

Table A-1
Remedial Alternative Opinion of Probable Cost

Alternative 1
Baseline/Continued Action

OPINION OF PROBABLE COST SUMMARY

Site:	Former Plaza Cleaners OU#1
Location:	Port Washington, New York
Phase:	Feasibility Study (-30% to +50%)
Base Year:	2014
Date:	September 24, 2014

Description: Alternative 1 consists of continued operation of the existing air sparge/soil vapor extraction (AS/SVE) system and common elements defined in Table 6-1. Capital costs and first year O&M costs occur in Year 1. Annual O&M costs occur in Years 1-30 (assumes 30 years of monitoring required).

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Report Preparation					
Site Management Plan	200	hours	$100.00	$20,000	
Soil Management Plan	20	hours	$100.00	$2,000	
SUBTOTAL				$22,000	
Site Management Survey	1	LS	$10,000	$10,000	
Monitoring Well Installation	3	EA	$6,000	$18,000	Two new intermediate and one new shallow monitoring wel
SUBTOTAL				$50,000	
Contingency	25%			$12,500	10% scope + 15% Bid
SUBTOTAL				$62,500	
Project Management*	10%			$6,250	Planning, reporting, and administration.
Remedial Design*	0%			$0	Design analysis, plans, specs, costing, and scheduling.
Construction Management*	20%			$12,500	Submittal review, design modifications, construction oversight.
First year operation and maintenance	1	lump sum		$46,071	See cost breakdown below
TOTAL CAPITAL COST				$127,000	

OPERATION & MAINTENANCE COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
SVE System O&M (Years 1 to 5)					
Electric	7.5	HP	$1,314	$9,855	85% motor efficiency; $0.17/kwh; 100% up time
Vapor Samples	4	samples	$450	$1,800	
System O&M	40	hours	$100	$4,000	Quarterly O&M visits for maintenance/sample collection.
Activated Carbon	0	lbs	$3	$0	Assumes no carbon needed for existing configuration.
Project Management	10%		$15,655	$1,566	
Technical Support	10%		$15,655	$1,566	
SUBTOTAL				$18,786	
SSDS System O&M (Years 1 to 30)					
Electric	0.75	HP	$1,314	$986	85% motor efficiency; $0.17/kwh; 100% up time
Vapor Samples	1	samples	$450	$450	Annual sampling only
System O&M	8	hours	$100	$800	Annual O&M visit and 1 emergency visit for maintenance.
Project Management	10%		$1,436	$144	
Technical Support	10%		$1,436	$144	
SUBTOTAL				$2,523	
Site Monitoring (Years 1 to 30)					
Groundwater Sampling	48	hours	$80.00	$3,840	2 people, 2 days, 1 times/year
Passive Diffusion Bags and Weights	10	bags	$40.00	$400	10 wells once per year
Groundwater Laboratory Analysis	11	samples	$100.00	$1,100	VOC analysis: 10 samples+ trip blank annually
Data Validation	15	samples	$30.00	$450	Summa canister rental and analytical; assumes 2 samples annually
Data Compilation and Evaluation	30	hours	$100.00	$3,000	
Reporting and Annual Site Certification	50	hours	$100.00	$5,000	Site management plan certification/Periodic Review Report
Project Management	10%		$8,790	$879	
Technical Support	10%		$8,790	$879	
SUBTOTAL				$15,548	
SUBTOTAL (Years 1 to 5)				$36,857	
SUBTOTAL (Years 6 to 30)				$18,071	
Contingency (Years 1 to 5)	25%			$9,214.15	
Contingency (Years 6 to 30)	25%			$4,517.65	
SUBTOTAL (Years 1 to 5)				$46,071	
SUBTOTAL (Years 6 to 30)				$22,588	
TOTAL ANNUAL O&M COST (Years 1 to 5)				$46,071	
TOTAL ANNUAL O&M COST (Years 6 to 30)				$22,588	

Table A-1
Remedial Alternative Opinion of Probable Cost

Alternative 1
Baseline/Continued Action

OPINION OF PROBABLE COST SUMMARY

PERIODIC COSTS IN YEARS 10, 20 and 30:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Fan Replacement					
Fan Replacement	9	fan	$150.00	$1,350	
Subcontractor Installation	1	lump sum	$1,000.00	$1,000	
Installation Oversight	72	hours	$85.00	$6,120	
SUBTOTAL				$8,470	
Contingency	25%			$2,117.50	10% scope + 15% Bid
SUBTOTAL				$10,588	
Project Management*	10%			$1,058.75	
Technical Support*	10%			$1,059	
TOTAL PERIODIC COST FOR FAN REPLACEMENT				$12,700	
Well Abandonment and System Dismantling					
Drilling Subcontractor	800	linear feet	$8.00	$6,400	
System Dismantling and Disposal	1	lump sum	$10,000.00	$10,000	
Installation Oversight	60	hours	$85.00	$5,100	
SUBTOTAL				$21,500	
Contingency	25%			$5,375.00	10% scope + 15% Bid
TOTAL PERIODIC COST FOR WELL ABANDONMENT AND SYSTEM DISMANTLINC				$26,875	

Note:
Expected life of a fan is 5 to 15 years.
Assume fan is replaced every 10 years.
Replace fans in nine systems at year 10 and year 20 to get usable fans to year 30.
Well abandonment and system dismantling takes place in year 30

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	PRESENT VALUE	NOTES
Capital	1	$127,000	$127,000	$127,000	
Periodic Cost	10	$12,700	$12,700	$8,187	
Periodic Cost	20	$12,700	$12,700	$5,026	
Periodic Cost	30	$26,875	$26,875	$6,529	
Annual O&M	2 to 5	$184,283	$46,071	$163,365	
Annual O&M	6 to 30	$564,706	$22,588	$249,441	
		$928,264		$559,548	30 years, 5 %
TOTAL PRESENT VALUE OF ALTERNATIVE FOR THIRTY YEARS				$560,000	

** Per USEPA 540-R-00-002, "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study". July 2000.*

PRESENT VALUE ANALYSIS ASSUMING 5% RATE AND THE SAME ANNUAL O&M COSTS EACH YEAR:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	PRESENT VALUE	NOTES
Capital	1	$127,000	$127,000	$127,000	
Annual O&M	1 to 30	$846,000	$28,200	$433,503	
		$973,000		$560,503	30 years, 5 %
TOTAL PRESENT VALUE OF ALTERNATIVE FOR THIRTY YEARS				$561,000	

Table A-2
Remedial Alternative Opinion of Probable Cost

Alternative 2
Optimized Air Sparge/Soil Vapor Extraction

OPINION OF PROBABLE COST SUMMARY

Site:	Former Plaza Cleaners OU#1
Location:	Port Washington, New York
Phase:	Feasibility Study (-30% to +50%)
Base Year:	2014
Date:	September 24, 2014

Description: Alternative 2 consists of continued operation of the existing SVE system with expansion to address areas outside of the building for soil treatment and vapor mitigation. Installation and operation of a new, properly constructed AS system for site groundwater plus implementation of the common elements defined in Table6-1. Capital costs and first year O&M costs occur in Year 1. Annual O&M costs occur in Years 1-10 (assumes 10 years of monitoring required).

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Report Preparation					
Site Management Plan	200	hours	$100.00	$20,000	
Soil Management Plan	20	hours	$100.00	$2,000	
SUBTOTAL				$22,000	
Site Management Survey	1	LS	$10,000	$10,000	
Monitoring Well Installation	3	EA	$6,000	$18,000	2 new intermediate and one new shallow monitoring well
AS/SVE System Installation					
AS Well Installation	16	EA	$4,000.0	$64,000	1-inch pre-packed wells to 50 feet bls
SVE Well Installation	5	EA	$3,600.00	$18,000	4-inch wells to 30 feet bls. Assumes 1 existing well reused.
Well Vault Installation	21	EA	$300.00	$6,300	
Trenching and Below Grade Piping	1	LS	$62,400.00	$62,400	
Mechanical Upgrades/Manifolds	1	LS	$15,000.00	$15,000	Includes utility scan, trenching, and piping, and trench restoration.
New AS Blower	1	LS	$15,000.00	$15,000	10 HP reciprocating compressor
Electrical/Control Upgrades	1	LS	$15,000.00	$15,000	
Granular Activated Carbon	2	EA	$5,000.00	$10,000	
System Startup/Shakedown	1	LS	$10,000.00	$10,000	
SUBTOTAL				$215,700	
Contingency	25%			$66,425	10% scope + 15% Bid
SUBTOTAL				$332,125	
Project Management*	10%			$33,213	Planning, reporting, and administration.
Remedial Design*	15%			$49,819	Design analysis, plans, specs, costing, and scheduling.
Construction Management*	20%			$66,425	Submittal review, design modifications, construction oversight.
First year operation and maintenance	1	lump sum		$100,000	See cost breakdown below
TOTAL CAPITAL COST				$582,000	

OPERATION & MAINTENANCE COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
AS/SVE System O&M (Years 1 to 5)					
Electric	17.5	HP	$1,314	$22,995	85% motor efficiency; $0.17/kwh; 100% up time
Vapor Samples	8	samples	$450	$3,600	
System O&M	40	hours	$100	$4,000	Quarterly O&M visits for maintenance/sample collection.
Activated Carbon	5,000	lbs	$3	$12,500	Assumes 5,000 lbs carbon used per year
Remedy Specific Groundwater Monitoring	1	EA	$7,710	$7,710	Semi-annual sampling for AS monitoring
Project Management	10%		$43,095	$4,310	
Technical Support	10%		$43,095	$4,310	
SUBTOTAL				$59,424	
SSDS System O&M (Years 1 to 10)					
Electric	0.75	HP	$1,314	$986	85% motor efficiency; $0.17/kwh; 100% up time
Vapor Samples	1	samples	$450	$450	Annual sampling only
System O&M	8	hours	$100	$800	Annual O&M visit and 1 emergency visit for maintenance.
Project Management	10%		$2,236	$224	
Technical Support	10%		$2,236	$224	
SUBTOTAL				$2,683	
Site Monitoring (Years 1 to 10)					
Groundwater Sampling	48	hours	$80.00	$3,840	2 people, 2 days, 1 times/year
Passive Diffusion Bags and Weights	10	bags	$40.00	$400	10 wells once per year
Groundwater Laboratory Analysis	11	samples	$100.00	$1,100	VOC analysis: 10 samples+ trip blank annually
Data Validation	19	samples	$30.00	$570	Summa canister rental and analytical; assumes 2 samples annually
Data Compilation and Evaluation	38	hours	$100.00	$3,800	
Reporting and Annual Site Certification	50	hours	$100.00	$5,000	Site management plan certification/Periodic Review Report
Project Management	10%		$14,710	$1,471	
Technical Support	10%		$14,710	$1,471	
SUBTOTAL				$17,652	
SUBTOTAL (Years 1 to 5)				$79,759	
SUBTOTAL (Years 6 to 10)				$20,335	
Contingency (Years 1 to 5)	25%			$19,939.65	
Contingency (Years 6 to 10)	25%			$5,083.65	
SUBTOTAL (Years 1 to 5)				$99,698	
SUBTOTAL (Years 6 to 10)				$25,418	
TOTAL ANNUAL O&M COST (Years 1 to 5)				$100,000	
TOTAL ANNUAL O&M COST (Years 6 to 10)				$25,418	

Table A-2
Remedial Alternative Opinion of Probable Cost

Alternative 2
Optimized Air Sparge/Soil Vapor Extraction

OPINION OF PROBABLE COST SUMMARY

PERIODIC COST IN YEAR 10

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Well Abandonment and System Dismantling					
Drilling Subcontractor	1,750	linear feet	$8.00	$14,000	
System Dismantling and Disposal	1	lump sum	$15,000.00	$15,000	
Installation Oversight	84	hours	$85.00	$7,119	
SUBTOTAL				$36,119	
Contingency	25%			$9,029.69	10% scope + 15% Bid
TOTAL PERIODIC COST FOR WELL ABANDONMENT AND SYSTEM DISMANTLING				$45,148	

Note:
Well abandonment and system dismantling takes place in year 10

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	PRESENT VALUE	NOTES
Capital	1	$582,000	$582,000	$582,000	
Periodic Cost	10	$45,148	$45,148	$29,103	
Annual O&M	2 to 5	$400,000	$100,000	$354,595	
Annual O&M	6 to 10	$127,091	$25,418	$86,225	
		$1,154,240		$1,051,923	10 years, 5 %
TOTAL PRESENT VALUE OF ALTERNATIVE FOR TEN YEARS				$1,052,000	

** Per USEPA 540-R-00-002, "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study". July 2000.*

PRESENT VALUE ANALYSIS ASSUMING 5% RATE AND THE SAME ANNUAL O&M COSTS EACH YEAR:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	PRESENT VALUE	NOTES
Capital	1	$582,000	$582,000	$582,000	
Annual O&M	1 to 30	$918,000	$30,600	$470,397	
		$1,500,000		$1,052,397	30 years, 5 %
TOTAL PRESENT VALUE OF ALTERNATIVE FOR THIRTY YEARS				$1,052,000	

Table A-3
Remedial Alternative Opinion of Probable Cost

Alternative 3
In-Situ Chemical Oxidation Using Persulfate with Soil Vapor Extraction

OPINION OF PROBABLE COST SUMMARY

Site: Former Plaza Cleaners OU#1
Location: Port Washington, New York
Phase: Feasibility Study (-30% to +50%)
Base Year: 2014
Date: September 24, 2014

Description: Alternative 3 consists of continued operation of the existing SVE system for soil remediation and vapor mitigation, in-situ chemical oxidation (ISCO) using persulfate for groundwater, plus implementation of the common elements defined in Table 6-1. Capital costs and first year O&M costs occur in Year 1. Annual O&M costs occur in Years 1-10 (assumes 10 years of monitoring required).

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Report Preparation					
Site Management Plan	200	hours	$100.00	$20,000	
Soil Management Plan	20	hours	$100.00	$2,000	
SUBTOTAL				$22,000	
Site Management Survey	1	LS	$10,000	$10,000	
Monitoring Well Installation	3	EA	$6,000	$18,000	Two new intermediate and one new shallow monitoring well
SVE and ISCO System Installation					
ISCO Injection Wells	16	EA	$7,200.0	$115,200	2-inch diameter wells with stainless wire-wrapped screens.
SVE Well Installation	5	EA	$3,600.00	$18,000	4-inch wells to 30 feet bls. Assumes one existing well reused.
Well Vault Installation	21	EA	$300.00	$6,300	
Trenching and Below Grade Piping	1	LS	$39,600.00	$39,600	
Mechanical Upgrades/Manifolds	1	LS	$5,000.00	$5,000	Includes utility scan, trenching, and piping, and trench restoration.
Electrical/Control Upgrades	1	LS	$10,000.00	$10,000	
Granular Activated Carbon	2	EA	$5,000.00	$10,000	
System Startup/Shakedown	1	LS	$10,000.00	$10,000	
SUBTOTAL				$214,100	
ISCO Injections (assumes two injections required)					
Reagents	2	LS	$161,387.2	$322,774	Sodium persulfate, iron activator, and citric acid for 2 injections.
Injection Labor	2	LS	$30,240.00	$60,480	Injection labor - two staff - 28 man-days total
Equipment Rental and Expenses	2	EA	$7,000.00	$14,000	Equipment/trailer rental and oversight expenses
Injection Data Evaluation and Reporting	100	hours	$100.00	$10,000	Data evaluations and summary reports
Injection Specific Groundwater Monitoring	2	LS	$10,444.00	$20,888	Post-injection groundwater monitoring and reporting
SUBTOTAL				$428,142	
Contingency	25%			$173,060.61	10% scope + 15% Bid
SUBTOTAL				$865,303	
Project Management*	10%			$86,530	Planning, reporting, and administration.
Injection Work Plan	1	lump sum	$20,000	$20,000	Design analysis, plans, specs, costing, and scheduling.
Construction Management*	20%			$42,820	220% of system construction cost only
Injection/Pilot Test	1	lump sum	$30,000	$30,000	
First year operation and maintenance	1	lump sum		$62,000	See cost breakdown below
TOTAL CAPITAL COST				$1,107,000	

OPERATION & MAINTENANCE COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
SVE System O&M (Years 1 to 5)					
Electric	7.5	HP	$1,314	$9,855	85% motor efficiency; $0.17/kwh; 100% up time
Vapor Samples	4	samples	$450	$1,800	
System O&M	40	hours	$100	$4,000	Quarterly O&M visits for maintenance/sample collection.
Activated Carbon	5,000	lbs	$3	$12,500	Assumes average of 5,000 lbs required per year
Project Management	10%		$15,655	$1,566	
Technical Support	10%		$15,655	$1,566	
SUBTOTAL				$31,286	
SSDS System O&M (Years 1 to 10)					
Electric	0.75	HP	$1,314	$986	85% motor efficiency; $0.17/kwh; 100% up time
Vapor Samples	1	samples	$450	$450	Annual sampling only
System O&M	8	hours	$100	$800	Annual O&M visit and 1 emergency visit for maintenance.
Project Management	10%		$2,236	$224	
Technical Support	10%		$2,236	$224	
SUBTOTAL				$2,683	
Site Monitoring (Years 1 to 10)					
Groundwater Sampling	48	hours	$80.00	$3,840	2 people, 2 days, 1 times/year
Passive Diffusion Bags and Weights	10	bags	$40.00	$400	10 wells once per year
Groundwater Laboratory Analysis	11	samples	$100.00	$1,100	VOC analysis: 10 samples+ trip blank annually
Data Validation	11	samples	$30.00	$330	Summa canister rental and analytical; assumes 2 samples
Data Compilation and Evaluation	22	hours	$100.00	$2,200	
Reporting and Annual Site Certification	50	hours	$100.00	$5,000	Site management plan certification/Periodic Review Report
Project Management	10%		$12,870	$1,287	
Technical Support	10%		$12,870	$1,287	
SUBTOTAL				$15,444	
SUBTOTAL (Years 1 to 5)				$49,413	
SUBTOTAL (Years 6 to 10)				$18,127	
Contingency (Years 1 to 5)	25%			$12,353.15	
Contingency (Years 6 to 10)	25%			$4,531.65	
SUBTOTAL (Years 1 to 5)				$61,766	
SUBTOTAL (Years 6 to 10)				$22,658	
TOTAL ANNUAL O&M COST (Years 1 to 5)				$62,000	
TOTAL ANNUAL O&M COST (Years 6 to 10)				$23,000	

Table A-3
Remedial Alternative Opinion of Probable Cost

Alternative 3
In-Situ Chemical Oxidation Using Persulfate with Soil Vapor Extraction

OPINION OF PROBABLE COST SUMMARY

PERIODIC COST IN YEAR 10

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Well Abandonment and System Dismantling					
Drilling Subcontractor	1,750	linear feet	$8.00	$14,000	
System Dismantling and Disposal	1	lump sum	$12,500.00	$12,500	
Installation Oversight	84	hours	$85.00	$7,119	
SUBTOTAL				$33,619	
Contingency	25%			$8,404.69	10% scope + 15% Bid
TOTAL PERIODIC COST FOR WELL ABANDONMENT AND SYSTEM DISMANTLING				$42,023	

Note:
Well abandonment and system dismantling takes place in year 10

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	PRESENT VALUE	NOTES
Capital	1	$1,107,000	$1,107,000	$1,107,000	
Periodic Cost	10	$42,023	$42,023	$27,089	
Annual O&M	2 to 5	$248,000	$62,000	$219,849	
Annual O&M	6 to 10	$115,000	$23,000	$78,022	
		$1,512,023		$1,431,960	10 years, 5 %
TOTAL PRESENT VALUE OF ALTERNATIVE FOR TEN YEARS				$1,432,000	

** Per USEPA 540-R-00-002, "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study". July 2000.*

PRESENT VALUE ANALYSIS ASSUMING 5% RATE AND THE SAME ANNUAL O&M COSTS EACH YEAR:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	PRESENT VALUE	NOTES
Capital	1	$1,107,000	$1,107,000	$1,107,000	
Annual O&M	1 to 30	$636,000	$21,200	$325,896	
		$1,743,000		$1,432,896	30 years, 5 %
TOTAL PRESENT VALUE OF ALTERNATIVE FOR THIRTY YEARS				$1,433,000	

Table A-4
Remedial Alternative Opinion of Probable Cost

Alternative 4
Enhanced Bioremediation with Soil Vapor Extraction

OPINION OF PROBABLE COST SUMMARY

Site: Former Plaza Cleaners OU#1
Location: Port Washington, New York
Phase: Feasibility Study (-30% to +50%)
Base Year: 2014
Date: September 24, 2014

Description: Alternative 4 consists of continued operation of the existing SVE system for soil remediation and vapor mitigation, enhanced bioremediation using emulsified vegetable oil for groundwater, plus implementation of common elements defined in Table 6-1. Capital costs and first year O&M costs occur in Year 1. Annual O&M costs occur in Years 1-10 (assumes 10 years of monitoring required).

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Report Preparation					
Site Management Plan	200	hours	$100.00	$20,000	
Soil Management Plan	20	hours	$100.00	$2,000	
SUBTOTAL				$22,000	
Site Management Survey	1	LS	$10,000	$10,000	
Monitoring Well Installation	3	EA	$6,000	$18,000	2 new intermediate and one new shallow monitoring well
SVE and Enhanced Bio Injection System Installation					
Carbon Injection Wells	16	EA	$7,200.0	$115,200	2-inch diameter wells with stainless wire-wrapped screens.
SVE Well Installation	5	EA	$3,600.00	$18,000	4-inch wells to 30 feet bls. Assumes 1 existing well reused.
Well Vault Installation	21	EA	$300.00	$6,300	
Trenching and Below Grade Piping	1	LS	$39,600.00	$39,600	Includes utility scan, trenching, and piping, and trench
Mechanical Upgrades/Manifolds	1	LS	$5,000.00	$5,000	restoration.
Electrical/Control Upgrades	1	LS	$10,000.00	$10,000	
Granular Activated Carbon	2	EA	$5,000.00	$10,000	
System Startup/Shakedown	1	LS	$10,000.00	$10,000	
SUBTOTAL				$214,100	
Contingency	25%			$66,025	10% scope + 15% Bid
SUBTOTAL				$330,125	
Project Management*	10%			$33,013	Planning, reporting, and administration.
Injection Work Plan	1	lump sum	$20,000	$20,000	Design analysis, plans, specs, costing, and scheduling.
Remedial Design*	15%			$49,519	Design analysis, plans, specs, costing, and scheduling.
Injection/Pilot Test	1	lump sum	$30,000	$30,000	
Construction Management*	20%			$66,025	Submittal review, design modifications, construction oversight.
First year operation and maintenance	1	lump sum		$206,000	See cost breakdown below
TOTAL CAPITAL COST				$735,000	

OPERATION & MAINTENANCE COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Enhanced Bio System O&M (Years 1 through 5) - Assumes injections required every other year for 5 years					
EVO	31,260	lbs	$2	$62,520	EVO
Injection Labor	17	man-day	$1,000	$16,800	
Injection Expenses	1	ls	$4,200	$4,200	Quarterly O&M visits for maintenance/sample collection.
Injection Data Evaluation and Reporting	50	hours	$100	$5,000	Data evaluations and summary reports
Injection Specific Groundwater Monitoring	1	each	$6,266	$6,266	Post-injection groundwater monitoring
Project Management	10%		$88,520	$8,852	
Technical Support	10%		$94,786	$9,479	
SUBTOTAL				$113,117	
SVE System O&M (Years 1 through 5)					
Electric	7.5	HP	$1,314	$9,855	85% motor efficiency; $0.17/kwh; 100% up time
Vapor Samples	4	samples	$450	$1,800	
System O&M	40	hours	$100	$4,000	Quarterly O&M visits for maintenance/sample collection.
Activated Carbon	5,000	lbs	$3	$12,500	Assumes average of 5,000 lbs required per year.
Project Management	10%		$28,155	$2,816	
Technical Support	10%		$28,155	$2,816	
SUBTOTAL				$33,786	
SSDS System O&M (Years 1 to 10)					
Electric	0.75	HP	$1,314	$986	85% motor efficiency; $0.17/kwh; 100% up time
Vapor Samples	1	samples	$450	$450	Annual sampling only
System O&M	8	hours	$100	$800	Annual O&M visit and 1 emergency visit for maintenance.
Project Management	10%		$2,236	$224	
Technical Support	10%		$2,236	$224	
SUBTOTAL				$2,683	
Site Monitoring (Years 1 through 10)					
Groundwater Sampling	48	hours	$80.00	$3,840	2 people, 2 days, 1 times/year
Passive Diffusion Bags and Weights	10	bags	$40.00	$400	10 wells once per year
Groundwater Laboratory Analysis	11	samples	$100.00	$1,100	VOC analysis: 10 samples+ trip blank annually
Data Validation	11	samples	$30.00	$330	Summa canister rental and analytical; assumes 2 samples
Data Compilation and Evaluation	22	hours	$100.00	$2,200	
Reporting and Annual Site Certification	50	hours	$100.00	$5,000	Site management plan certification/Periodic Review Report
Project Management	10%		$12,870	$1,287	
Technical Support	10%		$12,870	$1,287	
SUBTOTAL				$15,444	
SUBTOTAL (Years 1 through 5)				$165,030	
SUBTOTAL (Years 6 through 10)				$18,127	
Contingency (Years 1 through 5)	25%			$41,257.41	
Contingency (Years 6 through 10)	25%			$4,531.65	
SUBTOTAL (Years 1 through 5)				$206,287	
SUBTOTAL (Years 6 through 10)				$22,658	
TOTAL ANNUAL O&M COST (Years 1 through 5)				$206,000	
TOTAL ANNUAL O&M COST (Years 6 through 10)				$22,658	

Table A-4
Remedial Alternative Opinion of Probable Cost

Alternative 4
Enhanced Bioremediation with Soil Vapor Extraction

OPINION OF PROBABLE COST SUMMARY

PERIODIC COST IN YEAR 10

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Well Abandonment and System Dismantling					
Drilling Subcontractor	1,750	linear feet	$8.00	$14,000	
System Dismantling and Disposal	1	lump sum	$12,500.00	$12,500	
Installation Oversight	84	hours	$85.00	$7,119	
SUBTOTAL				$33,619	
Contingency	25%			$8,404.69	10% scope + 15% Bid
TOTAL PERIODIC COST FOR WELL ABANDONMENT AND SYSTEM DISMANTLING				$42,023	

Note:
Well abandonment and system dismantling takes place in year 10

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	PRESENT VALUE	NOTES
Capital	1	$735,000	$735,000	$735,000	
Periodic Cost	10	$42,023	$42,023	$27,089	
Annual O&M	2 to 5	$824,000	$206,000	$730,466	
Annual O&M	6 to 10	$113,291	$22,658	$76,863	
		$1,714,315		$1,569,417	10 years, 5 %
TOTAL PRESENT VALUE OF ALTERNATIVE FOR TEN YEARS				$1,569,000	

** Per USEPA 540-R-00-002, "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study". July 2000.*

PRESENT VALUE ANALYSIS ASSUMING 5% RATE AND THE SAME ANNUAL O&M COSTS EACH YEAR:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	PRESENT VALUE	NOTES
Capital	1	$735,000	$735,000	$735,000	
Annual O&M	1 to 30	$1,629,000	$54,300	$834,724	
		$2,364,000		$1,569,724	30 years, 5 %
TOTAL PRESENT VALUE OF ALTERNATIVE FOR THIRTY YEARS				$1,570,000	

Table A-5
Remedial Alternatives Opinion of Probable Cost Summary

OPINION OF PROBABLE COST SUMMARY

Site: Former Plaza Cleaners OU#1
Location: Port Washington, New York
Phase: Feasibility Study (-30% to +50%)
Base Year: 2014
Date: September 24, 2014

Alternative	Description	Capital Costs	Annual O&M	Present Value O&M	Total Present Value
Alternative 1	Baseline/Continued Action	$127,000	$28,200	$433,000	$560,000
Alternative 2	Optimized Air Sparge/Soil Vapor Extraction	$582,000	$30,600	$470,000	$1,052,000
Alternative 3	In-Situ Chemical Oxidation Using Persulfate with Soil Vapor Extraction	$1,107,000	$21,200	$325,000	$1,432,000
Alternative 4	Enhanced Bioremediation with Soil Vapor Extraction	$735,000	$54,300	$834,000	$1,569,000

Notes:
Total Present Value costs assume implementation of each alternative for 30 years and O&M costs assume a 5% discount rate.
The annual O&M is a weighted average annual cost.