FEASIBILITY STUDY REPORT

FORMER ALUMINUM LOUVRE CORPORATION

(NYSDEC Site Number 130195)

ON-SITE CONTAMINATION (OPERABLE UNIT 1)

NYSDEC STANDBY ENGINEERING CONTRACT

Work Assignment #D006129-10

PREPARED FOR

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

625 BROADWAY

ALBANY, NEW YORK 12233

Prepared by

HDR

One Blue Hill Plaza
Pearl River, NY 10965

February 2013

Table of Contents

Table of Contents (continued)

List of Tables

List of Figures (following tables)

List of Figures (continued)

List of Acronyms

AOCs	Areas of Concern
AS	Air Sparging
AS/SVE	Air Sparging/Soil Vapor Extraction
AST	Aboveground Storage Tank
BGS	Below Ground Surface
CVOCs	Chlorinated Volatile Organic Compounds
DCE	Cis-1,2-dichloroethene
ECL	Environmental Conservation Law
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
FT	Feet
GAC	Granulated Activated Carbon
GPM	Gallons Per Minute
GRA	General Response Actions
GWQS	Groundwater Quality Standards
HDR	Henningson, Durham, and Richardson Architecture and Engineering P.C.
ISCO	In-Situ Chemical Oxidation
ISTT	In-Situ Thermal Treatment
LTM	Long Term Monitoring
MNA	Monitored Natural Attenuation
NCDH	Nassau County Department of Heath
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
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
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethylene also known as Perchloroethylene
POGW	Protection of Groundwater
POTW	Publicly-owned Treatment Works
RAOs	Remedial Action Objectives
RI	Remedial Investigation
ROD	Record of Decision
SCG	Standards, criteria and guidance
S/S	Solidification/Stabilization
SSF	State Superfund Program
SARA	Superfund Amendments and Reauthorization Act
SCO	Soil Cleanup Objective
SSDS	Subslab Depressurization System
SVOCs	Semi-Volatile Organic Compounds
1,1,1-TCA	1,1,1-Trichloroethane
TCE	Trichloroethylene
TCLP	Toxicity characteristic leaching procedure
TOC	Total Organic Carbon

List of Acronyms (continued)

TSDF	Treatment, storage and disposal facility
URU	Unrestricted Use
URU/ POGW	Unrestricted Use and Protection of Groundwater Soil Cleanup Objectives
UV	Ultraviolet
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION

Henningson, Durham, and Richardson Architecture and Engineering P.C. (HDR) was retained by the New York State Department of Environmental Conservation (NYSDEC) to conduct a Remedial Investigation (RI) and Feasibility Study (FS) of the Former Aluminum Louvre Site (NYSDEC Site #130195), located at 161 Bethpage-Sweethollow Road and 301 Winding Road in the Hamlet of Old Bethpage, Town of Oyster Bay, Nassau County, New York.

HDR conducted the RI from January 2011 through August 2012. The 2011 Phase 1 RI field sampling focused on the identification and the initial delineation of Areas of Concern (AOCs) and further delineation of impacted soil and groundwater. Phase 1 consisted of a geophysical survey to mark underground utilities and subsurface features, followed by the installation and sampling of direct-push soil borings, sub-slab soil vapor and co-located indoor air samples, temporary piezometers in January and March 2011, and the installation and sampling of multi-level monitoring wells at six locations around the Site in April through August 2011. During monitoring well installation, between two and four soil samples were collected per well.

Based on the results of the Phase 1 RI field sampling activities and subsequent to discussion of the results and scope development with the NYSDEC, additional Phase 2 RI activities were conducted in 2012. Phase 2 consisted of utility clearance, soil borings, sub-slab soil vapor/indoor air sampling, temporary piezometers, and permanent multi-level monitoring wells. For Phase 2, six of the nine additional temporary piezometers and four additional permanent multi-level wells were installed off-Site and one single-depth deep well was installed in the source area in the eastern portion of the 301 Winding Road property.

HDR has prepared this FS in general conformance with Section 4 of the *Technical Guidance for Site Investigation and Remediation (DER-10)* (NYSDEC Division of Environmental Remediation, May 3, 2010). This FS report covers Operable Unit 1 - on-site contamination. Operable Unit 2 covers off-site contamination and will be addressed separately. The FS identifies technologies and evaluates alternatives which are capable of achieving cleanup to pre-disposal or unrestricted conditions, or those that may achieve a cleanup appropriate for the identified use of the Site. The primary objective of the FS is to ensure that appropriate remedial alternatives are identified and evaluated such that relevant information concerning potential remedial actions at the Site can be presented and an appropriate remedy selected.

2.0 SITE DESCRIPTION AND HISTORY

2.1 General Site Description

The Former Aluminum Louvre Corporation Site is located at the southeast corner of Bethpage-Sweethollow Road and Winding Road in the Hamlet of Old Bethpage, Town of Oyster Bay, Nassau County, New York (Figure 1). The Site is approximately 3.36 acres in size and consists of two tax parcels with the respective addresses of 161 Bethpage-Sweethollow Road (tax parcel 47-A-265, approximately 2.14 acres) and 301 Winding Road (tax parcel 47-A-263, approximately 1.22 acres) (Figure 2). The 301 Winding Road property was previously known as 310 Winding Road, and is identified as such in some of the previous environmental reports.

Each of the two lots contains one commercial/industrial building. The building at 161 Bethpage-Sweethollow Road is currently occupied by three tenants: a paving company that uses the Site for office space, outdoor storage of equipment and supplies, and vehicle maintenance; the Automobile Association of America (AAA) of New York for office space and storage; and a general contracting company, also for office space and storage. The building at 301 Winding Road is currently occupied by Intelligen Power which provides a service that separates solids from used vegetable oil that will be used for the off-Site production of biodiesel. The surrounding properties to the north, east and south are used for commercial and light industrial purposes. To the west and southwest are an inactive municipal waste incinerator and the former Old Bethpage Landfill.

2.2 Physical Setting

The Site lies at an elevation of between approximately 127 and 135 feet above sea level. The general area around the Site and the Site itself slope towards the southeast. The two tax lots that comprise the Site are mostly level; however, they are separated by an approximately 3-4 foot high retaining wall between the higher 161 Bethpage-Sweethollow Road property and the lower 301 Winding Road property. Within the 161 Bethpage-Sweethollow Road property, the lower western portion of the parking lot on the north side of the building (facing Bethpage-Sweethollow Road) is separated from the higher eastern portion by an approximately 3-foot high retaining wall. The eastern portion of the 161 Bethpage-Sweethollow Road parking lot represents the overall highest portion of the Site. The storage yard on the east side of this property is also slightly lower than the parking lot and Bethpage-Sweethollow Road.

The 301 Winding Road property is one to two feet lower on the western and southern sides compared with the northern and eastern sides. Overall, it is approximately three feet lower than 161 Bethpage-Sweethollow Road.

With the exceptions of narrow strips of grass between the parking areas and the adjoining roadways, the Site is entirely paved and built over and has no surface water features. There are no natural water bodies within one mile of the Site. The nearest man-made water body is Nassau County Stormwater Recharge Basin No. 528 to the northwest of the intersection of Winding Road and Bethpage-Sweethollow Road. Stormwater drains towards drywells on Site.

Depth to groundwater ranges from 60 to 70 feet below ground surface and flow direction is generally to the southeast (Figure 3). The upper glacial aquifer deposits are mostly absent in the area and the Magothy formation is the uppermost geologic unit (approximately 750 feet thick in the area) and stratigraphic unit of concern.

2.3 History

The Site is named after the Aluminum Louvre Corporation, a former owner of 161 Bethpage-Sweethollow Road. Aluminum Louvre also owned or leased the 301 Winding Road property and used it for manufacturing operations.

<u>161 Bethpage-Sweethollow Road</u>

The building at 161 Bethpage-Sweethollow Road was erected in 1966 as a warehouse/light industrial use facility and was expanded in 1986. The property was occupied by New Dimensions Research from 1966 to 1985, by Aluminum Louvre Corporation from 1986 to 1994, and by a waste management company (Allen Waste) from an unknown time after 1994 until approximately 2004. Allen Waste used the property as a transfer station for plastic and glass recycling.

301 Winding Road

The building at 301 Winding Road was erected in 1965 as a manufacturing/processing facility. It was occupied by New Dimensions Research from 1966 to 1985 and by Aluminum Louvre Corporation from 1986 to approximately 1994, when it was used to manufacture louvers, including the stamping, cutting, and shaping of steel and aluminum stock, degreasing and painting. The former owners of Aluminum Louvre Corporation bought the 301 Winding Road property through a tax sale under a new company name (Mel Frank Realty Corporation) at an unknown time after 1994 and entered into a Voluntary Cleanup Agreement (VCA) with NYSDEC in 1996. Global Pottery, Inc. purchased the property from Mel Frank Realty under the name 310 Winding Road Realty Corporation for use as a warehouse for the storage and distribution of pottery and decorative flower pots. At the start of the RI, Global Pottery had discontinued its operations at the property and the building was vacant.

Nassau County records indicate that Aluminum Louvre used PCE, TCE, and 1,1,1-TCA at the Site from 1986-1994, and generated halogenated solvent waste and oily wastes during this time.

In 1996, a contaminated stormwater drywell, DW-9, at the rear of 301 Winding Road was remediated subsequent to being sampled in 2004 as part of a Site Investigation conducted on behalf of the property owner at the time as part of a Voluntary Cleanup Agreement with NYSDEC. Activities included the removal and off-Site disposal of 3,000 gallons of contaminated liquid and 21 feet of contaminated soil from the bottom of the drywell at 10 feet below ground surface (bgs) to a depth of 31 feet bgs. The pre-excavation soil sample, collected from 14 feet bgs, contained TCE at 10,300 ppm, PCE at 408 ppm, and 1,1,1-TCA at 60 ppm. These VOCs were not detected in the post-excavation sample collected from 31 feet bgs.

A more detailed Site history and descriptions of prior investigations are provided in the RI report.

3.0 REMEDIAL INVESTIGATION AND EXPOSURE ASSESSMENT SUMMARY

3.1 Remedial Investigation Summary

3.1.1 Site Characterization Criteria

The Remedial Investigation/Feasibility Study (RI/FS) must characterize the Site and identify and evaluate alternatives which are capable of achieving the goal, which is cleanup to pre-disposal or unrestricted Site conditions. However, the FS may also evaluate alternatives to achieve a cleanup necessary to meet an identified use of the Site. In the case of soil contamination, the applicable criteria are the 6NYCRR Part 375 Soil Cleanup Objectives (Part 375 SCOs). Part 375 provides SCOs for unrestricted use, which would equate to pre-disposal conditions, protection of groundwater, protection of ecological resources, and four protection of public health categories: residential, restricted-residential, commercial and industrial. For the Aluminum Louvre Site, the applicable SCOs are unrestricted for the pre-disposal cleanup goal, protection of groundwater because Long Island is a sole-source aquifer, and commercial given the Site's zoning and current uses (zoned industrial, but used for commercial purposes). In the case of volatile organic compounds (VOCs) detected on the Site, the unrestricted use (URU) and protection of groundwater (POGW) SCOs are the same with the exception of xylene.

3.1.2 Soil Contamination

The RI included the installation of soil borings and field screening and analysis of soil samples both on- and off-Site. The soil investigation identified an area of subsurface soil contamination to the northeast of the building at 301 Winding Road. This area extends underneath the southeastern portion of the 161 Bethpage-Sweethollow Road building and to the west between the buildings on the two properties (Figure 4). Soil in this area is impacted with VOCs above NYSDEC URU/POGW SCOs. Contamination within the locus of this area exceeds commercial SCOs. Detected compounds were primarily TCE, PCE, DCE, 1,1,1-TCA, toluene, and xylene (Figures 5). TCE and PCE were the most frequently detected compounds and also exceeded the SCOs by the largest factors. Only TCE exceeds the commercial SCO. The highest contaminant concentrations were detected on the 301 Winding Road property just south of the 161 Bethpage-Sweethollow Road building. The contaminated subsurface soil appeared to be largely confined to a layer of silty clay, in which the highest VOC concentrations were consistently detected from between 14 and 18 feet bgs. In addition, a small area of soil impacted with three pesticides above the URU SCOs and with PCBs above the commercial SCOs was identified near drywell DW-9 east of the 301 Winding Road building. The areas to the west of the two Site buildings, to the north of 161 Bethpage-Sweethollow Road, and off-Site areas did not have soil contamination above URU/POGW SCOs. The ranges of detected contaminant concentrations in RI soil samples are provided in Tables 1 through 4.

3.1.3 Vapor Intrusion

A total of six subslab soil vapor points with co-located indoor air and one exterior location were included in the vapor intrusion investigation (Figure 6). Subslab soil vapor concentrations of TCE, PCE and 1,1,1-TCA are present at both buildings warranting further monitoring for 1,1,1-TCA and mitigation for TCE and PCE. The determination of the need to mitigate is based on the NYSDOH vapor intrusion guidance decision matrices for these compounds as well as consultation with the NYSDOH. Concentrations of PCE and TCE at co-located indoor air sample locations were below the corresponding NYSDOH air guideline values with the exception of PCE at one location. One indoor air sample collected in 2011 from the southeastern portion of 161 Bethpage-Sweethollow Road was considered compromised because it had been collected in an area where a car and trailer were being painted during or immediately preceding sample collection. Therefore, the significantly elevated indoor air concentration of PCE of 3,200 $\mu g/m^3$ was considered not to be representative of indoor air concentrations.

NYSDOH has not established an air guideline value for 1,1,1-TCA. The ranges of VOC concentrations in subslab soil vapor and indoor air samples are provided in Tables 5 and 6, respectively.

3.1.4 Groundwater Contamination

The RI included both temporary and permanent groundwater monitoring wells (Figures 7a through 7e). A cluster of four permanent wells (water table, intermediate [85-95 ft], deep [115-125 ft], and very deep [173-183 ft]) was installed within the soil source area at 301 Winding Road. Two triplet well clusters (water table, intermediate, and deep) were installed at 161 Bethpage-Sweethollow Road and one on the west side of 301 Winding Road. Two new pairs of wells (intermediate and deep) were installed alongside previously existing adjacent water table wells at the south side of 301 Winding Road. Five temporary monitoring wells (using a

Geoprobe®) were installed and sampled at AOCs on both properties, three upgradient of the Site, one inside the building at 161 Bethpage-Sweethollow Road, and three along the eastern boundary of 161 Bethpage-Sweethollow Road. Permanent wells installed as part of the RI were sampled a minimum of two times.

Analytical results indicate that groundwater at both the 161 Bethpage-Sweethollow Road and 301 Winding Road properties is impacted with chlorinated VOCs above applicable standards, most notably TCE, PCE, DCE, and 1,1,1-TCA, and less widespread, toluene and xylene (see results on Figures 7a through 7e). The contamination originates mostly at the soil source area in the northeastern portion of the 301 Winding Road property and extends from the water table to 125 feet bgs on-Site. The highest concentrations of TCE, the main contaminant in groundwater at the Site, were found at the water table in the soil source area in the eastern portion of the 301 Winding Road property, and in the intermediate depths intervals to the east and southeast of the main source area, both on-Site and off-Site. With increasing distance from the source area, the highest concentrations of TCE and other chlorinated VOCs are found in the deeper sampling intervals of the multi-level wells. This is typical of groundwater plumes comprised of contaminants such as TCE and PCE with densities greater than water. These plumes tend to "dive" as they migrate away from the source area. Tables 7 and 8 depict the ranges of concentrations of detected VOCs and SVOCs in groundwater. Two SVOCs were detected, but neither exceeded the groundwater quality standards.

Groundwater flow, as determined during the RI (shown on Figure 3), is generally to the southeast, which is consistent with previous investigations and regional groundwater flow maps. At the Site itself, the flow direction at the water table has a more easterly component, which can be explained with local groundwater mounding that is due to the Nassau County Recharge Basin No. 528, located to the northwest of the intersection of Winding Road and Bethpage-Sweethollow Road.

3.2 Nature and Extent of Contamination

Major conclusions related to the nature and extent of contamination at the Site includes the following:

Subsurface Soil:

- TCE and PCE are the most pervasive VOCs present in subsurface soil with concentrations above the URU/POGW SCOs. While other VOCs also exceed URU/POGW SCOs, the largest number of exceedances and magnitude of exceedances were generally observed for TCE and PCE.
- As shown on Figure 5, subsurface soil impacted with TCE/PCE above the URU/POGW SCOs (470 µg/kg and 1,300 µg/kg for TCE and PCE, respectively) is limited to the northeast of the building at 301 Winding Road and the area underneath the southeastern portion of the building at 161 Bethpage-Sweethollow Road. Elevated contaminant concentrations with VOCs above the Commercial Use SCO (200,000 µg/kg) for TCE were detected in the area to the northeast of the building at 301 Winding Road. TCE concentrations above the Commercial Use SCO were not observed in the area underneath the building 161 Bethpage-Sweethollow Road.
- The limit of the nature and extent of soil contamination as shown on Figure 4 was estimated based on the next available (horizontal and vertical) clean RI soil sample with a TCE concentration less than the URU/POGW SCO. The analytical results of investigation samples are discussed in the RI report.
- An approximately 3,000 square foot area is characterized as subsurface soil with TCE contamination with depth varying from 24 to 38 feet bgs. Within this area, an approximately three to seven feet thick layer of silty clay between 11 and 16 feet bgs was observed during the installation of soil borings and monitoring wells for the RI. This layer of silty clay exhibited the highest observed concentrations of TCE in soil.
- Of the 3,000 square foot area, approximately 1,000 square feet are located underneath the building at 161 Bethpage-Sweethollow Road and TCE concentrations are above the URU/POGW SCO but below the Commercial Use SCO.
- An approximately 12 feet long by 12 feet wide by 12 feet deep area with soil impacted with pesticides at concentrations above the URU SCOs and PCBs above

the Commercial Use SCO was identified near drywell DW-9 east of the 301 Winding Road building. POGW SCOs were not exceeded for pesticides or PCBs. It should be noted that the boundaries of this area were determined by clean samples. Only one sample within this area, DB-DW9N, at a depth of 10 feet bgs, had concentrations of pesticides and PCBs exceeding any of the criteria. Further, the depth of this soil contamination is well below the surface at 10 feet preventing any exposure through direct contact, and there is a distance of roughly 50 vertical feet separating it from the water table. Neither pesticides nor PCBs have impacted groundwater on Site. Therefore, the sole pesticide/PCB-contaminated sample is considered to be anomalous.

- The areas to the west and north of the two Site buildings as well as off-Site areas did not have soil contamination above URU/POGW SCOs.

On-Site Groundwater:

- The RI identified groundwater contamination above the NYSDEC Class GA Groundwater Quality Standards (Class GA GWQS) within the on-Site area including the 161 Bethpage-Sweethollow Road and 301 Winding Road properties as well as off-Site. The detected contamination consisted of CVOCs, predominately TCE, PCE and low levels of other VOCs. The on-Site groundwater contamination was detected in shallow, 55 to 95 bgs, and deep, 95 to 125 feet bgs, zones. An approximately 10 foot thick silty clay layer bisects the shallow and deep zone across the Site; therefore, the shallow and deep zones are identified to facilitate evaluation of remedial alternatives based on the respective nature and extent of groundwater contamination.
- As shown in Figure 8, the extent of groundwater impacts are estimated based on available groundwater samples at TCE and PCE concentrations greater than the NYSDEC Class GA GWQS (5 µg/l for PCE and TCE).
- As shown on Figure 8, the shallow groundwater remediation area (55 to 95 feet bgs) is approximately 250 feet wide by 200 feet long and extends to the eastern and southeastern limits of the property boundary.

- The deep groundwater remediation area (95 to 135 feet bgs) is approximately 200 feet wide by 190 feet long and extends to the eastern on-Site property boundary.

Vapor Intrusion:

- Sub-slab soil vapor concentrations of TCE, PCE and 1,1,1-TCA are present at both buildings; however, concentrations of PCE and TCE at co-located indoor air sample locations were below the corresponding NYSDOH air guideline values with the exception of one location which was determined to be a result of indoor use of the contaminant. Sub-slab depressurization systems for the buildings located at 161 Bethpage-Sweethollow Road and 301 Winding Road are included in the evaluation of remedial alternatives for soil contamination.

3.3 Exposure Assessment

The most significant potential exposure route is the infiltration of vapor-phase chlorinated VOCs from contaminated groundwater and soil into overlying structures at the Site. Direct contact and ingestion were not identified as exposure routes for reasons provided in Table 9.

4.0 REMEDIAL GOALS AND REMEDIAL ACTION OBJECTIVES

4.1 Remedial Goals

The remedial action goals for remedial actions undertaken pursuant to the New York State Inactive Hazardous Waste Disposal Site Remedial Program (State Superfund Program or SSF), are defined by ECL, Article 27, Title 13. The goal of the SSF program is complete cleanup of the Site through the elimination of the significant threat to the environment posed by the disposal of hazardous wastes at the Site and of the imminent danger of irreversible or irreparable damage to the environment caused by such disposal.[1]

4.2 Remedial Action Objectives

RAOs are developed for a Site to determine the levels to what Site specific concerns must be addressed to protect human health and the environment. The RAOs for the Former Aluminum Louvre Site are presented below.

Groundwater RAOs for Public Health Protection

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of volatiles, from contaminated groundwater.

Groundwater RAOs for Environmental Protection

- Restore groundwater to pre-disposal/pre-release conditions, to the extent practicable.
- Reduce the concentrations of VOCs in groundwater at the Site.
- Limit off-Site migration of VOCs in groundwater at concentrations greater than the Class GA GWQS ambient water standards.
- Reduce or remove the source of groundwater contamination, to the extent practicable.

---

[1] Environmental Conservation Law, Article 27, Title 13, §27-1313 Remedial Programs.

Chapter X - Division of Water, Part 703: Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations, contains promulgated water quality standards and groundwater effluent limitations for discharges to Class GA waters to be used for the restoration of the groundwater aquifer to pre-disposal/pre-release conditions. VOCs have been detected in the groundwater at the Site at concentrations greater than the groundwater Class GA ambient water quality standards.

Groundwater is not used for potable or production purposes at the property since the Site and vicinity are serviced by a municipal water system. Therefore, there is no direct exposure to contaminants in groundwater.

Soil RAOs for Public Health Protection

- Prevent ingestion/direct contact with contaminated soil.
- Prevent inhalation of or exposure from contaminants volatilizing from contaminants in soil.

Soil RAOs for Environmental Protection

- Prevent migration of contaminants that would result in groundwater contamination.

Soil Vapor RAOs for Public Health Protection

- Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at a Site.

Applicable SCG for soil are contained in 6 NYCRR Part 375 – Environmental Remediation Programs, Section 6.8. This section sets forth soil cleanup objectives that will satisfy the RAO's for soil at the Site (i.e. protection of public health and the environment). Soil cleanup objectives have been developed for unrestricted and restricted uses. The types of restricted use soil cleanup objectives include: residential; restricted-residential; commercial use; industrial use; protection of groundwater; and protection of ecological resources. The unrestricted soil cleanup objectives represent the most conservative of the values and “pre-disposal” conditions.

The ultimate goal of Site remediation is to restore the Site to “pre-disposal” conditions and as such the URU/POGW SCOs are considered for the FS. An unrestricted use scenario remedy will be evaluated in this FS for purposes of comparison. However, since the current and anticipated future use of the Site is commercial/industrial, the NYSDEC commercial restricted use soil cleanup objectives (commercial SCOs) are also considered. Protection of groundwater SCOs are also applicable at restricted use Sites where contamination has been identified in on-Site soil and groundwater standards have been, or are threatened to be, contravened. Further, Long Island is a sole source aquifer.

VOCs, pesticides, and PCBs have been detected in the soils at the Site at concentrations greater than the SCOs outlined in Part 375 Section 6.8 as follows:

- VOCs exceed URU, POGW and commercial use SCOs
- Pesticides exceed URU SCOs
- PCBs exceed URU and commercial SCOs

New York State does not currently have any SCGs for subsurface vapors; however, the matrices in Section 3.4.2 of the Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, October 2006 were used to determine the most appropriate actions given the concentrations of TCE, PCE and 1,1,1-TCA in subslab soil vapor on Site. NYSDOH Air Guideline Values of 100 $\mu g/m^3$ for PCE and 5 $\mu g/m^3$ for TCE are used for indoor air sample results. There is currently no Air Guideline Value for 1,1,1-TCA.

5.0 GENERAL RESPONSE ACTIONS

As described in Section 4, both the soil and groundwater have been impacted at the Site. VOCs, pesticides, and PCBs have been detected in soil; and VOCs in groundwater at concentrations exceeding SCGs. General Response Actions (GRAs) are broad categories of remedial alternatives and include non-technology specific types such as treatment, containment, excavation, extraction, disposal, institutional controls or various combinations. Table 10 lists the GRAs for soil and groundwater. Information for each type of General GRA includes an estimate of the areas and volumes of contaminated media to be addressed and remediated; the medium being addressed; the identified use of that area of the Site; and whether or not it the GRA category includes a Presumptive Remedy.

6.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

6.1 Introduction

In this section, specific technologies associated with the GRAs are further assessed. The technologies are grouped by medium (soil, groundwater) and screened to identify those that appear to be most appropriate to the Site-specific conditions and Site contamination, technically implementable, and capable of achieving the Site's RAOs. Further, presumptive remedies are given preference. Presumptive remedies include technologies that are proven and appropriate for the specific sets of Site conditions which, based on experience gained at remediated Sites and NYSDEC's scientific and engineering evaluation of performance data, can be used to streamline the remedy selection process (DER-15, p 1).

Site specific conditions, including contamination type, concentration, location (aerial extent and depth), geology/hydrogeology and estimated quantity were considered during the initial screening process. Estimated dimensions / quantity of contaminated soil are provided on Table 10. The initial screening was also based on the effectiveness for treating the contaminants present at the Site, implementability given Site-specific conditions, and relative cost.

Remedial technologies that were deemed to be not technically appropriate or cost prohibited were dropped from further consideration. Tables 11 and 12 summarize the technology identification and screening process for soil and groundwater, respectively. The tables are grouped by the GRA (i.e., in-situ treatment, ex-situ treatment, containment, and reduction). Technologies that may be appropriate for addressing the contaminants at the Site and that were thus retained for further evaluation are identified on the second to last columns of Tables 11 and 12. Technologies that were screened out and not retained for further analysis are designated as "no" in the second to last columns of Tables 11 and 12.

The most promising technologies were combined into remedial alternatives, which are described in the development of alternatives section of this report.

6.2 Identification and Screening of Technology for Soil and Soil Vapor Intrusion

As discussed in Section 3, VOCs, pesticides and PCBs have been detected in on-Site soil at concentrations greater than the 6 NYCRR Part 375 soil cleanup objectives. Based on the investigation analytical results, the targeted soil remediation zone is approximately 3,000 square feet contaminated with VOCs, and 144 square feet contaminated with pesticides/PCBs.

In consultation with NYSDEC DER, soil vapor intrusion will be addressed through mitigation. The most common mitigation method recommended by the NYSDOH is the use of subslab depressurization systems (SSDS), a presumptive remedy which includes a network of vapor collection points or horizontal pipes under a building. These systems are designed to collect vapor from below floor slabs and prevent accumulation of contaminated vapor and subsequent infiltration in the work area of a building or structure. The network of collection points or horizontal pipes is connected to a blower designed to maintain a continuous flow of air under the building or structure. Based on the contaminant concentrations, the vapor is either treated and discharged to the atmosphere or discharged without treatment. SSDS for the on-Site buildings is included with all soil alternatives retained for further analysis with the exception of the No Action alternative.

The GRAs for impacted on-Site soils include no action, institutional controls, containment, treatment, and removal. Remedial technologies are grouped by GRA and discussed in detail in the following sections. A summary of the soil screening process is provided in Table 11.

6.2.1 Containment

The in-place containment of contaminated soils will be accomplished through capping, enhancement of existing capping or surface sealing. These containment technologies would eliminate or reduce stormwater infiltration to contaminated areas, thereby reducing a mechanism for contaminant migration from soil to groundwater or surface water. These technologies are effective at minimizing human exposures to impacted soils and other media. Capping does not lessen toxicity, mobility, or volume of contaminated soil, but does mitigate migration and exposure pathways. Capping systems are most effective where most of the underlying contaminated soil is above the water table. The technology requires long-term inspection and maintenance.

The on-Site remediation area is already capped with buildings, concrete and asphalt pavement. However, capping does not lessen toxicity, mobility, or volume of contaminated soil therefore, as a standalone technology; it does not meet the RAOs. Existing capping can be effective in combination with institutional controls and environmental easements to prevent exposure to the contaminants. Therefore, capping has been retained and will be evaluated further with other technologies.

6.2.2 In-Situ Biological Treatment

In-situ biological treatment such as bioventing, enhanced bioremediation, and phytoremediation is a process in which indigenous or inoculated microorganisms degrade (metabolize) organic contaminants found in soil and/or groundwater, converting the contaminants to innocuous end products. In-situ biological treatments are most effective for remediating residual organic contamination in conjunction with source removal. Implementation of in-situ biological treatments does not require the excavation of contaminated media therefore, minimizing potential worker exposure to contaminants. In-situ biological treatment is generally applied at the Site where a sign of natural biodegradation is present at some degree or conditions are favorable for natural biodegradation. It requires a longer period of time to meet remedial objectives and can result in high operation and maintenance requirements compared to ex-situ technologies.

Biological treatment is less proven than other technologies for CVOCs and pesticides/PCBs and is a presumptive remedy only for petroleum hydrocarbons. Analytical results from the RI indicate an absence of natural biodegradation on Site. Therefore, in-situ biological treatment has been screened out and will not be evaluated further.

6.2.3 In-Situ Physical/Chemical Treatment

In-situ physical/chemical treatment includes various treatment processes that occur in the subsurface to physically/chemically convert contaminants to less toxic compounds. In-situ physical/chemical treatment includes the following:

- Chemical Oxidation: In-situ chemical oxidation (ISCO) is a process where powerful oxidizing chemicals are injected into the subsurface to chemically convert contaminants to less toxic compounds. ISCO is a viable remediation technology for mass reduction of organic contaminants in source areas, has a relatively rapid treatment time, and can be implemented with readily available equipment. This technology is widely used for soil and groundwater treatment in the saturated zone; however, there are limitations associated with achieving effective distribution and retention in the unsaturated zone. The soil remediation zone for the Site is mostly in the unsaturated zone and because of its limitations to be less effective in the unsaturated zone ISCO has been screened out and will not be evaluated further.

- Electrokinetic Separation: The electrokinetic separation process consists of the application of a low-intensity direct current through the soil via ceramic electrodes installed in and around soil contamination areas. The induced current mobilizes charged contaminants toward the polarized electrodes to concentrate the contaminants for subsequent removal and ex-situ treatment/disposal. The electrokinetic separation process is generally used to remove inorganics not organics. Based on the organic nature of the soil contamination at the Site, this technology has been screened out and will not be evaluated further.
- Soil Flushing: Soil flushing is a process where contaminants are extracted from the soil by passing uncontaminated water or water containing an additive to enhance contaminant solubility, through in-place soils. Contaminants are leached into the water, which is then extracted and treated. By applying soil flushing, there is a potential for contaminant migration if contaminants are flushed beyond the capture zone. In addition, ex-situ treatment costs for recovered fluids can add significantly to the remedial costs associated with this process. Due to the concerns raised above, this technology has not been retained for further analysis.
- Soil Vapor Extraction (SVE): SVE is an in-situ unsaturated (vadose) zone soil remediation technology where a vacuum is applied to the subsurface soil to induce air flow through the soil medium and remove VOCs and some SVOCs. Contaminants captured in the extracted soil vapor are typically treated above grade, via activated carbon or other process. SVE will be an effective remediation technology for the Site because of its effectiveness in removing VOCs. In addition, the existing buildings and pavement that provide a cap at the Site will enhance the SVE system effectiveness. The cap will prevent the

infiltration of ambient air near the SVE system and short circuit the air flow pathway. SVE has been retained for further evaluation.

- Solidification/Stabilization (in-situ): Solidification/stabilization (S/S) reduces the mobility of hazardous substances and contaminants in the environment through both physical and chemical means. During solidification, contaminants are physically bound or enclosed within a solidified mass, or during stabilization, chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility. These systems have limited effectiveness for SVOCs and limited or no effectiveness for VOCs. Based on the organic nature of soil contamination, this technology has been screened out and will not be evaluated further.

6.2.4 In-Situ Thermal Treatment

In-situ thermal treatment involves steam/hot air injection or heating via electrical resistance, fiber optics, radio frequency, or other means that can be utilized to increase the volatilization rate of VOCs and SVOCs and facilitate extraction. The process is otherwise similar to conventional SVE but requires heat resistant extraction wells. Thermal treatment heats soil to enhance SVE in the followings ways: VOC and SVOC volatility are increased by heating; the soil permeability is increased by drying; water vapor converted to steam can facilitate stripping of volatile contaminants in the overburden; and heating may cause a decrease in contaminant viscosity which improves contaminant mobility. In-situ thermal has been used for treating surface contamination using heating blankets and for treating subsurface contamination using heater/vacuum wells. Because of its effectiveness in treating VOC-contaminated soil in place, in-situ thermal treatment technology is retained for further evaluation.

6.2.5 Ex-Situ Biological/Physical/Chemical and Thermal Treatment

All the ex-situ treatment technologies involve controlled staging of excavated soils and any type of treatment including any biological, physical, chemical and thermal at the Site. Implementation of ex-situ technologies requires a portion of the Site to be dedicated for a moderate to long-term timeframe to the treatment and monitoring of excavated soils. Based on the commercial use of the Site, small size of 3.36 acres including buildings, and very limited exterior area available, ex-situ technologies do not appear to be compatible for the Site. Therefore, ex-situ technologies have been screen out and will not be evaluated further.

6.2.6 Removal

Removal of all or a portion of soil containing elevated contaminant concentrations and transportation to permitted off-Site treatment and/or disposal facilities is a commonly used technology for soil remediation. Soil excavation may be accomplished using conventional earthmoving equipment. Limitations that may affect the applicability and effectiveness of excavation at a Site include: proximity to structures of sub-standard condition, potential generation of fugitive emissions requiring monitoring and suppression; exposure of subsurface contaminants to workers; and depth and composition of the soil requiring excavation. Excavation at this Site can be implemented in a relatively short time frame and has no long-term monitoring and maintenance considerations. The applicability and cost-effectiveness of off-Site disposal may be limited by the distance from the subject Site to the nearest disposal facility. Excavation and off-Site disposal has been retained for further analysis.

6.3 Identification and Screening of Technology for Groundwater

As discussed in Section 3, VOCs have been detected in groundwater at concentrations greater than the NYS Class GA standards. The shallow groundwater contamination is approximately 250 feet wide by 200 feet long and in the depth horizon of 55 to 95 feet bgs. This contamination extends to the eastern and southeastern limits of the property. In addition, deep contamination, considered to be between 95 to 125 feet bgs, is approximately 200 feet wide by 190 feet long and also extends to the eastern and southeastern limits of the property. A summary of the type and range of groundwater contamination at the Site is provided in Table 7.

The GRAs for impacted on-Site groundwater include no action, monitored natural attenuation, containment, treatment, and removal. Remedial technologies are grouped by GRA and discussed in detail in the following sections. A summary of the groundwater screening process is provided in Table 12.

6.3.1 Containment

Containment involves remediation technologies such as physical barriers to slow groundwater flow and minimize migration of contaminated groundwater off-Site. Subsurface physical barriers generally consist of vertically excavated trenches filled with slurry and often are used where the waste mass is too large for treatment and where soluble and mobile constituents pose an imminent threat to a sensitive receptor. Also, physical barriers are more effective when geologic conditions allow for connection to a low permeability layer to enhance the containment.

Groundwater contamination at the Site is as deep as 125 feet bgs and not suitable for installing a physical barrier. Also, there are no known continuous low permeability layers in the area to enhance the containment. Therefore, based on the Site geology and depth of contamination, containment has been screened out from further evaluation.

6.3.2 In Situ Biological Treatment

- Enhanced Bioremediation: Enhanced bioremediation is a process that attempts to accelerate the natural biodegradation process by introducing nutrients, electron acceptors, and/or competent contaminant-degrading microorganisms to the subsurface. The rate of bioremediation can be enhanced by increasing the concentration of oxygen for aerobic degradation or adding a carbon substrate to support anaerobic degradation. Biological treatment is less proven than other technologies for CVOCs and pesticides/PCBs and is a presumptive remedy only for petroleum hydrocarbons. Analytical results from the RI indicate an absence of natural biodegradation on Site. Therefore, in-situ biological treatment has been screened out and will not be evaluated further.
- Monitored Natural Attenuation (MNA): MNA is a process where natural subsurface processes such as dilution, volatilization, biodegradation, adsorption, and chemical reactions with subsurface materials are allowed to reduce contaminant concentrations to acceptable levels. Regulatory approval of this option usually requires modeling and evaluation of contaminant degradation rates and pathways, and predicting contaminant concentration at potential down gradient receptor points. The primary objective of Site modeling is to demonstrate

that natural processes of contaminant degradation will reduce contaminant concentrations below regulatory standards or risk-based levels before potential exposure pathways are completed. In addition, long term monitoring must be conducted throughout the process to confirm that degradation is proceeding at rates consistent with meeting cleanup objectives. MNA can be implemented with other active remediation technologies and has been retained for further evaluation for the Site.

- Phytoremediation: Phytoremediation is a set of processes that uses plants to remove, transfer, stabilize and destroy organic/inorganic contamination in groundwater. Phytoremediation processes are limited to shallow groundwater and are not implementable given the depth to groundwater at this Site. Therefore, phytoremediation technology for groundwater remediation will not be considered further.

6.3.3 In-Situ Physical/Chemical Treatment

- Air Sparging: Air sparging is an in-situ technology and presumptive remedy in which clean air is injected into a contaminated aquifer. Injected air traverses horizontally and vertically in channels through the soil column, creating a subsurface "air stripper" that removes contaminants by volatilization. The injected air helps to flush the contaminants upward into the unsaturated zone where a vapor extraction system is usually implemented in conjunction with air sparging to remove the generated vapor phase contamination. Air sparging is very effective for high permeability aquifers such as those found on Long Island and VOCs are effectively remediated via air sparging. Based on Site-specific geology/hydrogeology, as well as its effectiveness for VOCs, air sparging has been retained for further evaluation.
- In-Situ Chemical Oxidation: ISCO chemically converts contaminants to less toxic compounds that are more stable, less mobile, and/or inert. The oxidizing agents most commonly used are ozone, hydrogen peroxide, potassium permanganate, persulfate, hypochlorites, chlorine, and chlorine dioxide. Matching the oxidant and in-situ delivery system to the contaminants of concern and the Site conditions

is the key to successful implementation and achieving performance goals. ISCO is a presumptive remedy that is a viable remediation technology for mass reduction of organic contaminants in groundwater. Chemical oxidation can have a relatively rapid treatment time, and can be implemented with readily available equipment. Limitations associated with chemical oxidation include: requirements for handling and administering large quantities of hazardous oxidizing chemicals; and naturally occurring organic material in the formation can consume large quantities of oxidant. Because of its effectiveness in reducing VOCs in rapid treatment time, ISCO has been retained for further analysis.

- Directional Wells: Drilling techniques can be modified to position wells horizontally, or at an angle, to reach contaminants not accessible by direct vertical drilling. Directional drilling may be used to enhance other in-situ or in-well technologies such as groundwater pumping, SVE, soil flushing, and in-well air stripping. Based on Site conditions, directional wells do not appear to be an applicable technology. Therefore, this technology will not be retained for further evaluation.
- Thermal Treatment: In this technology, steam is forced into an aquifer through injection wells to vaporize VOCs and SVOCs. Vaporized components rise to the unsaturated zone where they are removed by vacuum extraction and the off-gases are treated. Groundwater contamination at the Site is as deep as 125 feet bgs and not suitable for implementing thermal treatment that deep. Therefore, based on the Site geology, thermal treatment has not been retained for further evaluation.
- In-Well Air Stripping: With in-well air stripping technology, air is injected into a vertical well that has been screened at two depths. The lower screen is set in the groundwater saturated zone, and the upper screen is set in the unsaturated zone. Pressurized air is injected into the well below the water table, aerating the water. The aerated water rises in the well and flows out of the system at the upper screen, inducing localized movement of groundwater into and up the well as contaminated groundwater is drawn into the system at the lower screen. VOCs vaporize within the well at the top of the water table. The contaminated vapors

accumulating in the wells are collected via vapor extraction contained within the well. Vapor phase treatment typically occurs above grade. The partially treated groundwater is never brought to the surface; it is forced into the unsaturated zone, and the process is repeated as water follows a hydraulic circulation pattern or cell that allows continuous cycling of groundwater. As groundwater circulates through the treatment system in-situ, and vapor is extracted, contaminant concentrations are gradually reduced.

  Although in-well air stripping is a presumptive remedy, there are a limited number of vendors that are available to design and construct the remedy (DER-15, p. 7) making it difficult to obtain competitive bids and evaluate it against other technologies for cost effectiveness. Therefore, in-well air stripping has not been retained for further evaluation.

- Passive/Reactive Treatment Walls: Treatment walls or, treatment barriers allow the passage of impacted groundwater while causing the degradation or removal of contaminants. Passive/reactive treatment walls do not appear to be an efficient/effective technology for addressing groundwater contaminants given the physical characteristics of the Site and concentrations, configuration and depth of the groundwater plume. Therefore, passive/reactive treatment walls have been screened out and will not be evaluated further.

6.3.4 Ex-Situ Biological Treatment

Ex-situ biological treatment involves the pumping of impacted groundwater at the Site and implementing biological treatments such as bioreactors and constructed wetlands. Ex-situ biological treatment requires a portion of the Site dedicated for treatment for a moderate to long term timeframe. Given the physical characteristics, limited space and active commercial use of the Site, ex-situ biological treatments have been screened out and not retained for further evaluation.

6.3.5 Ex-Situ Physical/Chemical Treatment

Ex-situ physical/chemical treatment involves the pumping of impacted groundwater at the Site and implementing physical/chemical treatment such as adsorption, advanced oxidation process, air stripping, ion exchange, precipitation/coagulation/flocculation, separation, and sprinkler irrigation.

- Adsorption: The adsorption process consists of passing contaminated groundwater through a sorbent media. Contaminants are adsorbed onto the media, reducing their concentration in the bulk liquid phase. The most common adsorbent is granular activated carbon (GAC) which is also a presumptive remedy. Adsorption is a viable technology for VOC treatment of extracted groundwater and vapors. Therefore adsorption via GAC has been retained for further evaluation.
- Advanced Oxidation Processes: Advanced oxidation processes including ultraviolet (UV) radiation, ozone, and/or hydrogen peroxide are used to destroy organic contaminants as impacted water is pumped into a treatment vessel. If ozone is used as the oxidizer, an ozone destruction unit(s) may be required to treat off-gases from the treatment tank and where ozone gas may accumulate or escape. Advance oxidation technology is associated with high energy requirements. Therefore, advanced oxidation process technology has been screened out and will not be retained for further analysis.
- Air Stripping: Air stripping is a presumptive remedy that involves the mass transfer of volatile contaminants from water to air. VOCs are separated from extracted groundwater by exposing the contaminated water to a flow of air. Air stripping configurations include packed towers, diffused aeration, tray aeration, and spray aeration. Given the large size of the plume, flow rates of a pump and treat system are likely to be in a range where air stripping will be more cost-effective. Treatment of the air stripper effluent air stream with vapor phase GAC would be required with this process option. This is a well-established technology that can be effective in reducing contaminant toxicity, mobility and concentration through the use of treatment equipment that is readily available, although it is likely to have an extended remedial timeframe and relatively high capital and operational costs. Air stripping has been retained for further analysis.

- Groundwater Pumping/Pump and Treat: Pump and treat is a presumptive remedy. Groundwater pumping consists of pumping groundwater from an aquifer to remove dissolved phase contaminants and/or achieve hydraulic containment of contaminated groundwater to prevent migration. Processes typically evaluated or used in Pump and Treat systems include ex-situ physical and chemical treatments. Generally, treatment and monitoring of extracted groundwater is required. A multiple treatment train may be required for groundwater with multiple types of contaminants. A groundwater monitoring program is a component of any groundwater extraction system to verify its effectiveness. Potentially long time periods are required for groundwater pumping to achieve remediation goals. Operation and maintenance considerations associated with treatment systems may be more extensive than other treatment technologies. Groundwater pumping has been retained for further analysis due to its proven and long track record as a remediation technology.

6.3.6 Discharge/Disposal

Groundwater that has undergone treatment must ultimately be disposed of or discharged. Groundwater treated by the above technologies can be discharged to the sanitary sewer, surface water or re-injected to groundwater. Discharge options including those utilizing surface water, the sanitary sewer and POTW have been retained. Air emissions and GAC adsorption media will also require discharge, disposal or regeneration.

6.4 Evaluation of Technologies and Selection of Representative Technologies

As listed in Table 11, soil remedial technologies under each type of GRAs were screened for potential applicability, effectiveness, and implementation at the Site. In addition to No Action, the following soil and soil vapor technologies, respectively, pass the screening process:

- Existing Capping and SSDS
- SVE and SSDS
- ISTT and SSDS
- Excavation and Off-Site Disposal and SSDS

In consultation with NYSDEC, SSDSs for the on-Site buildings is included as a soil vapor technology with all soil technologies retained for further analysis

As listed in Table 12, groundwater remedial technologies under each type of GRAs were screened for potential applicability, effectiveness, and implementation at the Site. In addition to No Action, the following technologies pass the screening process:

- LTM
- ISCO
- AS/SVE
- Adsorption
- Air Stripping
- Pump and Treat
- Disposal/Discharge

7.0 DEVELOPMENT AND ANALYSIS OF ALTERNATIVES

7.1 Alternative Development

In accordance with NYSDEC's *DER-10 Technical Guidance for Site Investigation and Remediation*, May 3, 2010 and DER-15: *Presumptive /Proven Remedial Technologies for New York State's Remedial Programs*, February 27, 2007, remedial alternatives for a Site are developed by combining the remedial technologies that have successfully passed the screening stage into a range of alternatives.

NYSDEC's *DER-10* requires a No-Action alternative and an alternative that would restore the Site to "pre-disposal conditions". Other alternatives are to be included based on:

- Current, intended, and reasonably anticipated future use of the Site;
- Removal of source areas of contamination; and
- Containment of contamination.

7.1.1 Soil and Soil Vapor Intrusion Alternative Development

The soil and soil vapor intrusion remedial technologies retained for further analysis include

- Existing Capping and SSDS
- SVE and SSDS
- ISTT and SSDS
- Excavation and Off-Site Disposal and SSDS

SSDS are paired with each of the soil remedial technologies to mitigate vapor intrusion into on-Site buildings. Although not retained as separate remedial technologies, institutional controls such as environmental easements will be included as being used in conjunction with, or as enhancements, contingency or alternative remedies to the other remedial technologies. Institutional controls will not reduce the mass of contamination at the Site but are effective at reducing access and exposure to the Site contaminants. Future land use must be restricted via legal restrictions that require continued implementation to remain effective. Any restrictions must be consistent with the current Site use.

Four remedial alternatives were developed, based on the retained remedial technologies and Site-specific conditions, and are described in the following sections. Except for the no action alternative, each of the three alternatives includes the common element of the SSDS for the on-Site buildings.

<u>Subslab Depressurization System (SSDS):</u>

SSDS uses a fan-powered vent and piping to draw vapor from the soil beneath the building's slab (i.e., essentially creating a small negative pressure beneath the slab) and discharge the vapors to the atmosphere. This results in lower sub-slab air pressure relative to indoor air pressure, which prevents the infiltration of contaminated subslab soil vapors into the building. The depressurization approach needs to be determined on a building-specific basis due to building-specific features that may be conductive to a specific depressurization approach. A pilot test will be performed at both buildings to measure the ability of a pressure field and air flow to extend through the material beneath the slab. This test is commonly conducted by applying suction on a centrally located penetration drilled through the concrete slab and simultaneously measuring the vacuum at various locations across the slab using a digital micromanometer or comparable instrument. Depending on test results, multiple slab penetration points may be needed to achieve the desired effectiveness of the system. The system design will be based on the results of the pilot test and may be different for each building.

For the purpose of this FS, SSDS system installation includes one system for each of the buildings located on 161 Bethpage-Sweethollow Road and 301 Winding Road. The building located on 161 Bethpage-Sweethollow Road is approximately 270 feet long by 90 feet wide and the building located on 301 Winding Road is approximately 170 feet long by 120 feet wide. As shown in Figure 9, approximately 10 extraction points for each building will be connected to the fan designed to maintain a continuous flow of air. Based on the contaminant concentrations, the vapor will be either treated through GAC and discharged to the atmosphere or discharged without treatment. All the piping required for the SSDS is assumed to be co-located with other utility conduit runs.

7.1.1.1 Alternative S1 – No Action

The "no action" option is included as a basis for comparison with active soil remediation technologies in accordance with Section 4.2 of DER-10. If no remedial action is taken, contaminants already present in the soil will remain in place or continue to impact the underlying groundwater. Contaminants, particularly chlorinated VOCs, may transform to form other compounds over time. In the absence of active soil remediation, any decreases in the contaminant mass will occur as a result of natural attenuation processes.

7.1.1.2 Alternative S2 – SSDS, PCB/Pesticides Area Excavation and SVE System

Alternative S2 represents the treatment and removal GRA. Alternative S2 consists of three remedial technologies including a SSDS system for vapor intrusion for on-Site buildings, limited excavation of PCB/Pesticides contaminated soil, and implementing soil vapor extraction system (SVE) to remediate the VOCs contaminated soil at the Site. With the exception of some planters in front of the buildings and open grate stormwater drywells, the entire Site is covered with asphalt and concrete pavement and slab on-grade buildings which combined act as a cap over the contaminated soil area. The existing pavement and buildings cap will improve the effectiveness of the SVE system by minimizing short circuiting of air flow from the ground surface.

The SVE system will be sized to maintain a vacuum over the 3,000 square feet of area as shown on Figure 10. Because of the three to seven feet thick layer of silty clay observed between 11 and 16 feet bgs within this area, the SVE system consists of two vacuum extractions wells in the sand layer and seven vacuum extraction wells in clay layer as shown in Figure 10. One of the vacuum extraction wells in the sand layer is placed inside the building at 161 Bethpage-Sweethollow Road and the other in the vicinity of DW-7 where elevated TCE concentrations were observed. Each vacuum extraction well will be flush mounted with the existing ground surface and installed to a depth of approximately 38 feet bgs. Each well will be 3 inches in diameter, and constructed of schedule 40 PVC. The sand layer extraction wells will have an approximately 20 foot screen length at 15 to 35 feet bgs; and the clay layer extraction wells screen lengths will depend on the thickness of the clay at any particular location but on average will have 3 to 5 feet of screen at approximately 1 foot below the top of the clay layer. Based on the Site geology, each well in the sand layer and clay/silt layer is expected to have a radius of influence of approximately 35 and 15 feet, respectively. However, pilot testing and field measurements in the pre-design phase of the work will determine the number of vacuum extraction points, placement, and depth of each well. A liquid ring pump with a total system suction flow rate of approximately 105 scfm will be used for the SVE system. Overhead piping will be used for the vacuum extraction well located in the building and subsurface piping will be used to connect the wells to a centrally located blower/treatment system. A vacuum will be generated by a liquid ring pump, and collected vapor will by treated via GAC units.

Components of the SVE system include a vacuum pump, filters, moisture separator, vapor-phase GAC units, piping and control system. A schematic of a typical SVE system is show in Figure 11. A temporary building will be constructed to house the treatment equipment. A part-time operator will be needed to maintain and operate the system. Operation and maintenance costs include electricity to operate the system; periodic repair and replacement of system parts and components; routine inspection; system monitoring; replacement of GAC units; and performance and compliance sampling.

The time for soil remediation of VOCs by SVE is estimated at five years based on a review of Site contaminant levels and geology. Replacement of the GAC will be required several times depending on actual mass removal rates achieved. Air emissions must meet the substantive requirements of the Department's air emissions regulations. After five years, the SVE system can be shut off temporarily and confirmatory soil sampling will be necessary to determine if the RAOs are achieved. Soil samples can be collected from the area of highest TCE contamination and from the perimeter of the contaminated area.

This alternative will eventually achieve soil VOC concentrations less than the URU/POGW SCOs.

Approximately 65 cubic yards of soil impacted with pesticides concentrations above the URU SCOs and a PCB concentration in one sample above the Commercial Use SCO were identified near drywell DW-9 east of the 301 Winding Road building. Excavation and off-Site disposal of these 65 cubic yards of soil is included in this soil alternative. PCB/Pesticides contaminated soil will be permanently removed from the Site and this treatment option will meet all of the RAOs for PCB/Pesticides containing soil and return the Site to pre-release conditions by removing soil that poses health risks at the Site.

7.1.1.3 Alternative S3 – SSDS and In-Situ Thermal Treatment

Alternative S3 represents the treatment GRA. Alternative S3 consists of two remedial technologies including a SSDS system for vapor intrusion for on-Site buildings and installing a low temperature In-Situ Thermal Treatment (ISTT) system to remediate the VOC-contaminated soil at the Site.

ISTT is basically the combination of two processes: thermal conductive low temperature heating and vacuum extraction (i.e. SVE). With the ISTT application, heat from the combustion of natural gas or propane is routed through heating wells into the subsurface. The heating wells are a closed loop system, and no gases are injected into the subsurface. Instead, the direct contact between soil particles and the heating wells conducts heat throughout the treatment area. Heat and vacuum are applied simultaneously to the soil. The application of vacuum accelerates the evaporation of contaminants from the soil, and controls the migration pathway of contaminants. The existing pavement and buildings cap will assist in controlling the vapor generated through the ISTT system. Both volatile and semi-volatile organic contaminants in the soil are vaporized or destroyed through means of: 1) evaporation, 2) steam stripping, 3) hydrolysis, 4) oxidation, and 5) pyrolysis. Vaporized water and contaminants are extracted from vacuum extraction wells, which are co-located with the heating wells.

Heating is relatively uniform in its vertical and horizontal heat transfer throughout the treatment zone. The transfer of heat into the soil by heating wells is uniform over each heater's length, and each heating well is individually controllable for horizontal heat flux control. Thermal conductivity values vary over a very narrow range between most soil types, resulting in a predictable rate of heat flux throughout the treatment zone. Uniform heating is achieved when the heat fluxes created by the heating wells begin to overlap, resulting in attainment of a predetermined target temperature throughout the treatment zone. A thermocouple well placed at the midpoint between the heating wells is usually used to determine the soil temperature away from the heating well. Temperatures close to 100°C are achieved for the treatment of chlorinated solvents.

For the purpose of this FS, approximately 46 heating wells collocated with 46 vacuum extraction wells are estimated to be necessary to address removal of VOCs in approximately 3,000 square feet of VOC-contaminated soil area. The three to seven feet thick layer of silty clay observed between 11 and 16 feet bgs within this area is not expected to affect the rate of heat flux throughout the treatment zone as thermal conductivity value does not vary much between most soil types. The proposed heating/vacuum extraction wells placed at approximately 8 feet apart at an average depth of 33 feet bgs will be sufficient to achieve temperatures close to 100°C throughout the treatment zone. A conceptual layout of the heating wells and vacuum wells for the ISTT system is shown on Figure 12. Pilot testing during the pre-design phase of the work will determine the exact number, placement, and depth of each heating and vacuum extraction well.

A vacuum blower with a total system suction flow rate of approximately 500 scfm would be used for the vacuum extraction system. Overhead piping would be used for the vacuum extraction well located in the building and surface piping would be used to connect the wells to a centrally located blower/treatment system. A vacuum would be generated by a blower, and collected vapor would by treated via GAC units. A schematic of a typical ISTT system with vacuum extraction is shown in Figure 13. A temporary building will be constructed to house the treatment equipment. A full time operator will be needed to operate and maintain the ISTT/vacuum extraction system. Operation and maintenance costs include propane and/or natural gas to operate the system, repair and replacement of system parts/components, routine inspection, system monitoring, performance monitoring, compliance sampling and replacement of GAC units.

ISTT treatment periods are generally measured in months. Most VOCs including chlorinated solvents can be treated with ISTT in two to three months. After the treatment duration, the ISTT system will be shut off temporarily and confirmatory soil sampling will be necessary to determine if the RAOs are achieved. Soil samples can be collected from the area of highest TCE contamination and from the perimeter of the contaminated area.

This alternative is likely to achieve soil VOC concentrations less than the URU/POGW SCOs. The POGW SCOs are not exceeded for pesticides or PCBs.

The remedial technologies in combination with institutional controls and environmental easements will prevent exposure to the contaminants through restrictions or limitations of Site uses. An environmental easement limits or prohibits certain uses or development of the Site and serves to notify prospective owners of the existence of remaining contamination at the Site. Alternative S4 – SSDS and VOCs and PCB/Pesticides Area Excavation and Off-Site Disposal, Existing Foundation as Cap

Alternative S4 represents the removal GRA. Alternative S4 consists of two remedial technologies including a SSDS system for vapor intrusion for on-Site buildings and excavation of PCB/Pesticides contaminated soil, and excavation of VOCs contaminated soil located outside of the building footprint. An approximately 3,000 square foot area is characterized as subsurface soil with VOC contamination with depth varying from 24 to 38 feet bgs. Of this 3,000 square foot area, approximately 1,000 square feet are located underneath the building at 161 Bethpage-Sweethollow Road. As part of Alternative S4, approximately 2,000 square feet of the area (shown in Figure 14) located outside of the building footprint is included for excavation and off-Site disposal. Approximately 2,600 cubic yards of VOC-contaminated soil and 65 cubic yards of PCBs/Pesticides-contaminated soil will be excavated and disposed of off-Site to a permitted landfill.

The time to complete the remediation of the VOC, pesticide and PCB impacted soil is relatively short (less than 2 months). Implementation of this alternative would involve significant disruption of the Site for approximately 1-2 months making portions of the Site unavailable for current commercial uses.

Because both buildings adjoin the proposed excavation area and the depth of excavation would be as deep as 38 feet, a system for excavation protection will be required to stabilize the walls of the excavation. Excavated soil will be appropriately characterized and transported to an approved off-Site facility for disposal. The excavation area will be backfilled with clean fill.

The limited extent of impacted soil underneath the building will not be included as part of this excavation. The depth of contamination under the building makes it nearly impossible to excavate the building without removing that portion of the building. Therefore, excavation underneath the building was not included as part of this alternative. The building foundation in this area will function as a cap to prevent contact with underlying impacted soil and to prevent stormwater infiltration through the contaminated soil.

Because soil contamination greater than the URU/POGW SCOs but less than commercial SCOs will likely remain at the Site underneath the building, institutional controls (environmental easements, Site Management Plan) will be required for the Site. The existing cap can be effective in combination with institutional controls and environmental easements to prevent exposure to the contaminants through restrictions or limitations of Site uses. An environmental easement limits or prohibits certain uses or development of the Site and serves to notify prospective owners of the existence of remaining contamination at the Site.

The POGW SCOs may not be applicable when the criteria in 6 NYCRR Part 375-6.5, Soil cleanup objectives for the projection of groundwater, are met:

1. <u>The groundwater standard contravention is the result of an on-site source which is addressed by the remedial program</u>. Alternative S4 addresses the on-site source.
2. <u>An environmental easement will be put in place which provides for a groundwater use restriction on the site</u>. Alternative S4 includes an environmental easement.
3. <u>The Department determines that contaminated groundwater at the site is migrating off site; however, the remedy includes controls or treatment to address off-site migration</u>. Off-site groundwater data collected as part of the RI indicate that contaminated groundwater has migrated off-site. Groundwater remedial alternatives including controls and treatments to address off-site migration are evaluated in this report.
4. <u>The Department determines the groundwater quality will improve over time</u>. Groundwater remedial alternatives that will result in the improvement of groundwater quality over time are evaluated in this report.

Groundwater alternatives when selected in conjunction with soil Alternative S4 that meet the criteria to address off-site migration of contaminated groundwater are shown on Table 15.

7.1.2 Groundwater Alternative Development

VOCs were detected in on- and off-Site groundwater at concentrations greater than the NYSDEC Class GA groundwater standards to a depth of up to 125 feet bgs. Groundwater flow is easterly to southeasterly. TCE that appears to have originated on-Site has migrated vertically downward and horizontally in the direction of groundwater flow. The shallow groundwater remediation area (55 to 95 feet bgs) is approximately 250 feet wide by 200 feet long and extends to the eastern and southeastern limits of the property boundary. The deep groundwater remediation area (95 to 135 feet bgs) is approximately 200 feet wide by 190 feet long and extends to the eastern on-Site property boundary. Due to the presence of an approximately 10 foot thick silty clay layer between the shallow and deep groundwater zones, treatment components for both shallow and deep zones are identified in each remedial alternative.

The groundwater remedial technologies retained for further analysis include:

- LTM
- ISCO
- AS/SVE
- Adsorption (Vapor Phase)
- Air Stripping
- Pump and Treat
- Disposal/Discharge

LTM and institutional controls will not be included as an individual alternative but they will be used in conjunction with, or as enhancements to the other remedial technologies. LTM would consist of a network of wells located within and downgradient of the Site boundary. It is assumed that this well network will generally include the existing and newly installed monitoring wells located outside and downgradient of the on-Site plume area. The selection of specific wells will depend on the layout of the remedial technologies and can be adjusted during the treatability, remedial design and implementation phases of the project. LTM will be used to monitor any diluted residual plume that may result after the active remedial actions.

In addition to the GRAs, alternatives were assembled to address on-Site areas and/or provide containment to mitigate further migration of contaminated groundwater. Based on the retained remedial technologies and Site-specific conditions, groundwater remedial alternatives were developed, and are described in the following sections.

The SCGs for groundwater are the New York State Ambient Water Quality Standards. There are limitations in achieving the groundwater SCGs on Site because of upgradient, off-Site groundwater concentrations of the same contaminants that contravene the SCGs. For example, upgradient TCE concentrations ranging from 11 to 68 μg/L were detected at 148 and 160 Bethpage-Sweethollow Road to the north-northwest (upgradient) of 161 Bethpage-Sweethollow Road (Malcolm Pirnie, 2009). Even if one or more of the groundwater alternatives could achieve the groundwater standard of 5 μg/L for TCE, the resulting TCE groundwater concentrations on Site would still be influenced by the upgradient TCE concentrations. Thus, there are technical limitations to achieving the TCE groundwater standard of 5 μg/L.

7.1.2.1 Alternative G1 – No Action

The "no action" option is included as a basis for comparison with active groundwater remediation technologies in accordance with Section 4.2 of NYSDEC DER-10. If no remedial action is taken, contaminants already present in the groundwater will remain in place and/or move downgradient in the direction of groundwater flow. Contaminants, particularly chlorinated VOCs, will possible degrade via natural processes and transform to form other compounds over time. The "no action" alternative is retained for further evaluation. It is assumed that land and groundwater resource use will not change over time and that existing institutional controls will remain in place and enforced by other regulatory programs.

7.1.2.2 Alternative G2 – ISCO

Alternative G2 consists of ISCO with LTM for the remediation of VOCs in groundwater. This alternative would include the installation of shallow (55 to 95 feet bgs) and deep (95 to 135 feet bgs) injection wells throughout the groundwater remediation area to inject the chemical oxidation solution. Chemical oxidation would consist of the injection of a chemical /reagent such as liquid peroxide (H_2O_2), permanganate ($KMnO_4$) or Modified Fenton's Reagent® into the subsurface to degrade the organic contaminants.

The chemical oxidant used for cost estimating purposes was Modified Fenton's Reagent® (MFR) from Isotec. Fenton's Reagent is very effective at destroying organic contamination through co-existing chemical oxidation and reduction; however its shortcomings include incomplete treatment, explosive reactions, organic vapor generation and contaminant migration. MFR was selected because it is equally as effective as Fenton's Reagent but its catalysts allow reagents at background neutral pH conditions to be effectively distributed within the aquifer, destroying contaminants in groundwater without generating organic vapors or high temperatures.

A conceptual design includes approximately 230 shallow and 185 deep permanent injection wells and is shown in Figure 15. The injection wells are placed approximately 15 feet apart with assumed radius of influence of 12 feet based on Site geology. Pilot testing and field measurement during the pre-design phase of the work will determine the exact number, placement, and depth of injection wells as well as the bench testing will determine the most appropriate type of reagent and dosage. The groundwater remediation area will likely require multiple injection phases. Pressurized injection can also be employed to obtain better lateral transport (increase in radius of influence) using higher oxidant solutions, resulting in fewer injection points.

The time for remediation may be relatively short, on the order of months, depending on the need for reapplications. Groundwater monitoring will occur subsequent to chemical oxidation events to confirm that VOC concentrations are being effectively reduced. Although a significant portion of the contaminant mass is reduced using ISCO, it is frequently subject to re-bound with concentrations returning to near pre-treatment levels in source areas. Based on the monitoring data, additional chemical oxidation injection events may be required.

For cost estimating, it was assumed that LTM will be conducted quarterly for the first 2 years beyond the injections, twice a year for years 3 and 4, and possibly reduced to annual sampling for year 5. Under this alternative, institutional controls (environmental easement, Site Management Plan) will be required. Environmental easements are intended to prevent human contact with contaminated media through restrictions or limitations of Site uses.

7.1.2.3 Alternative G3 – AS/SVE System

Alternative G3 consists of the installation of an AS/SVE system to remediate shallow as well as deep groundwater contamination at the Site. Off-gas treatment and LTM are also implemented as part of this alternative.

AS/SVE is an in-situ physical/chemical treatment alternative for remediating contaminated groundwater which includes two remedial technologies as one system. For the AS/SVE system, an air compressor or blower will be used to deliver a stream of air under pressure to the subsurface via the sparging well, and vacuum pumps or blowers are utilized for the removal of contaminants in the vapor phase through the vacuum extraction well. The aboveground AS/SVE system components will also include a vapor treatment system and a process control system to monitor and adjust air delivery and the vapor extraction system for maximum remediation efficiency.

For the purpose of this FS, a preliminary assessment of the AS/SVE system configuration, radius of influence, and air flow rates have been made based on a typical application and available Site geology and hydrogeology data. A conceptual design includes 53 shallow AS wells and 45 deep AS wells and is shown in Figure 16. The AS wells are placed in the saturated zone at approximately 45 feet apart. The total number of air sparging wells was determined based on a total plume area of approximately 50,300 square feet and radius of influence of approximately 20 feet in each sparge well. An air compressor unit capable of producing a flow rate of approximately 500 scfm will be used to operate the AS system. Pilot testing and field measurements in the pre-design phase of the work will more accurately determine the exact number and placement of each of the air sparging wells.

As shown in Figure 16, approximately 53 vacuum extraction wells are estimated to be necessary to address removal of VOCs transported through the unsaturated zone. The vacuum extraction wells are collocated with AS wells in the unsaturated zone at approximately 45 feet apart. Pilot testing and field measurements in the pre-design phase of the work will determine the exact number, placement and depth of each vacuum extraction well. VOCs in the vapor phase are collected from each vacuum extraction well and pumped with a vacuum extraction blower to a granular activated carbon (GAC) treatment system. This structure will house the blowers, vacuum pumps, controls, and GAC vapor treatment units for the vapor extraction wells. The exact location of the treatment building will be confirmed with the Site owner during the design stage. The overall vapor phase flow rate for the shallow contaminated plume is expected to be approximately 500 scfm. At the treatment area, the collected vapors containing VOCs are passed through the GAC medium, adsorbed, and the clean air is vented to the atmosphere. When the GAC is spent (i.e., saturated with VOCs), will be transported off-Site and replaced with fresh material. The ultimate configuration of the entire vapor recovery/treatment system, including GAC usage rates over time, should be based on the results from the pilot study. Air monitoring and inspection of the vapor treatment system after startup may also determine system requirements. A typical AS/SVE Process Schematic is shown on Figure 17.

For cost estimating purposes, GAC was the assumed vapor phase treatment option for the AS/SVE alternative. High relative humidity of the treated vapor (i.e., above about 50%) reduces the adsorption efficiency of the GAC. In addition, moisture and condensate can accumulate within the vapor extraction piping. To address these issues, vacuum extraction blowers will be specified so that sufficient heat is imparted to the vapor stream and the relative humidity is maintained within satisfactory limits. Any condensate that is created in the system will be collected and periodically disposed of at an approved off-Site facility.

It is estimated that approximately 185 cubic yards of uncontaminated, nonhazardous soil will require off-Site disposal from the installation of the AS/SVE system. In addition approximately 5,000 square feet of asphalt will also be excavated and require off-Site disposal. It is conservatively estimated that approximately 100 gallons per month of condensate will accumulate aboveground in the vapor extraction treatment area. As noted, condensate will be treated on Site or periodically collected and disposed of at an approved off-Site facility. Analytical sampling of the condensate and any other materials generated during remedial activities will be conducted to characterize the wastes and identify disposal options.

To confirm that the AS/SVE system is achieving RAOs, groundwater samples will be collected for system performance monitoring and analyzed for VOCs. The results of these analyses will be used to determine whether remedial action objectives are being satisfied, and whether changes in the system design, configuration, and operation are required.

The time for remediation may be relatively on the order of 3 to 5 years. For cost estimating purposes, it is assumed that the RAOs for the shallow and deep groundwater contaminants at the Site will be met in five years.

Because contamination greater than the Class GA GWQS may remain at the Site under this alternative because of contributing upgradient contamination, LTM, institutional controls (environmental easement, Site Management Plan) will be required. LTM will be conducted on a periodic basis to determine if remedial objectives are being met. For cost estimating, it was assumed that LTM will be conducted twice per year for 10 years (initial 5 years beyond remediation system startup and 5 years after the system shut down), and possibly reduced to annual sampling for year 11. Environmental easements are intended to prevent human contact with contaminated media through restrictions or limitations of Site uses. Environmental easements limit or prohibit certain uses or development of the Site and serve to notify prospective owners of the existence of remaining contamination at the Site.

7.1.2.4 Alternative G4 – Pump and Treat

Alternative G4 consists of a groundwater extraction system to capture the shallow as well as deep VOC-contaminated groundwater and treat it at the surface by implementing remedial technologies such as air stripping, vapor phase GAC system, and finally discharge/disposal of treated groundwater. This alternative of extraction and treatment of groundwater will remove contaminant mass from the groundwater at the source area and establish hydraulic control of the aquifer to minimize off-Site migration of the groundwater plume.

Conceptually, groundwater pumping wells as shown in Figure 18 will be installed at the Site to draw contaminated groundwater into the pumping well's zone of capture. The pumping well flow rate is adjusted until the capture zone radius is estimated to be greater than the lateral dimensions of the groundwater treatment area. The pumping wells are also placed sufficiently downgradient of the highest contaminated point in the plume so that the majority of the contaminated groundwater will naturally flow into the capture zone. A pump test in the pre-design phase of the work will more accurately determine the adequate well spacing, capture zone, flow rates, and remediation time. For the purpose of the FS, a hydraulic conductivity of 8 feet per day derived using slug test data was used to determine the number of wells, and pumping rates.

Alternative G4 includes installation of four shallow extraction wells and three deep extraction wells as shown in Figure 18. The shallow extraction wells will be installed to approximately 95 feet bgs and have a screened length of about 40 feet. One shallow extraction well will be placed near the location MW-301-1S/I to address removal of contaminant mass in the source area and three shallow extraction wells will be placed near the eastern, southeastern, and southern property boundaries to establish hydraulic control of the aquifer to minimize off-Site migration of the groundwater plume. Similarly, one deep extraction well installed to approximately 135 feet bgs with a screen length of about 40 feet will be co-located with the shallow extraction well to address removal of contaminant mass in the source area and two will be placed near the eastern and southeastern boundaries to establish control of the aquifer to minimize off-Site migration of the groundwater plume.

The pumping rate for each of the shallow and deep extraction wells is estimated to be about 25 gpm to affect a capture zone of approximately 100 feet in diameter based on the Site geology and hydraulic conductivity of 8 feet per day. The results of the slug test conducted on the shallow monitoring wells during the RI indicated that the hydraulic conductivity varies from 2 to 14 feet per day for the Site. The noted range of hydraulic conductivity is partly due to the presence of clay/silt lenses that are present in the available soil boring logs. The actual remedial pumping rates for the extraction wells should be optimized based on the results of the pump test and a comprehensive groundwater flow model of the Site. The contaminated groundwater from each extraction well will be pumped to the on-Site groundwater treatment system.

For this alternative, a total peak flow of approximately 200 gpm is estimated from the extraction well network. The components of the treatment system are sized based on a peak flow rate of approximately 200 gpm to allow flexibility in the event that one or more of the wells will need to be pumped at a higher flow rate to hydraulically control the contamination plume. An approximately 2000- square foot groundwater treatment plant is proposed as shown on Figure 18; however, the actual location will be confirmed with the Site owner during the design phase. After the pumped groundwater has been metered inside the treatment plant, it will enter a media filter to remove dissolved solids. Then the water will be fed into a tray air stripper for treatment. The vapor phase emitted from the air stripper will be treated by passing through a vapor phase GAC network. The liquid effluent from the air stripper will be passed through a liquid phase GAC network. The treated effluent water will be discharged into re-injection dry wells located near the northern and western boundaries of the building at 161 Bethpage-Sweethollow Road. A schematic of the proposed process treatment of the system is shown in Figure 19. Pilot testing and field measurements in the pre-design phase of the work will be required to determine if any type of pre-treatment of the groundwater is required prior to passing through the air stripper. A pre-treatment for iron removal via manganese greensand is included in the cost estimate. The requirement to pre-treat for iron was determined from review of existing data of iron concentrations in groundwater included in the report "Site Characterization Report Old Bethpage Industrial Area Plume Trackdown", Malcolm Pirnie, Inc., February 2010. Iron concentrations in groundwater within the Old Bethpage Industrial Area frequently exceeded the Class GA GWQS for iron of 300 µg/l ranging from a marginal exceedance of 485 µg/l to over 21,000 µg/l.

The discharged effluent is subject to the New York State groundwater effluent limitations – Class GA and will be detailed in a State Pollutant Discharge Elimination System (SPDES) permit as issued by the NYSDEC.

To confirm that the groundwater pump and treat system is achieving remedial objectives, groundwater samples will be collected from piezometers installed for system performance monitoring and analyzed for VOCs. The results of these analyses will be used to determine whether remedial action objectives are being satisfied, and whether changes in the system design, configuration, and operation are required.

The time for remediation may be relatively on the order of 20 to 30 years. For cost estimating purposes, it is assumed that the RAOs for the shallow and deep groundwater contaminants at the Site will be met in 30 years.

Because contamination greater than the Class GA groundwater standards may remain at the Site under this alternative because of contributing upgradient contamination, LTM, institutional controls (environmental easement, Site Management Plan) will be required. LTM will be conducted on a periodic basis to determine if remedial objectives are being met. For cost estimating, it was assumed that LTM will be conducted twice per year for 30 years beyond remediation system startup. The continued need for monitoring can be re-evaluated and possibly reduced to annual sampling after the initial 5-year period. Environmental easements are intended to prevent human contact with contaminated media through restrictions or limitations of Site uses. Environmental easements limit or prohibit certain uses or development of the Site and serve to notify prospective owners of the existence of remaining contamination at the Site.

7.2 Evaluation of Alternatives

7.2.1 Introduction

This Section presents the detailed evaluation of the remedial alternatives described in Section 7.1. The purpose of the evaluation is to identify the advantages and disadvantages of each alternative as well as key trade-offs among the alternatives. The evaluation was based on criteria established under NYSDEC's *DER-10 Technical Guidance for Site Investigation and Remediation*, Section 4.2. The evaluation criteria are as follows:

- **Overall protection of human health and the environment:** This criterion is an evaluation of the alternative's ability to protect public health and the environment, assessing how risks posed through each existing or potential pathway of exposure are eliminated, reduced or controlled through removal, treatment, engineering controls or institutional controls. The alternative's ability to achieve each of the RAOs is evaluated.
- **Compliance with Standards, Criteria and Guidance (SCGs):** This criterion evaluates the compliance of the alternative with all identified SCGs. All SCGs for the Site will be listed along with a discussion of whether or not the remedy will achieve compliance.
- **Long term effectiveness and permanence**: Each alternative is evaluated for its long-term effectiveness after implementation. If wastes or treated residuals remain on-Site after the selected remedy has been implemented, the following items are evaluated:
    - The magnitude of the remaining risks (i.e. will there be any significant threats, exposure pathways, or risks to the community and environment from the remaining wastes or treated residuals?);

    - The adequacy of the engineering and institutional controls intended to limit the risk;
    - The reliability of these controls, and;
    - The ability of the remedy to continue to meet RAOs in the future.

- **Reduction of toxicity, mobility, or volume of contamination through treatment:** The alternative's ability to reduce the toxicity, mobility or volume of Site contamination is evaluated. Preference should be given to remedies that permanently and significantly reduce the toxicity, mobility, or volume of the wastes at the Site.

- **Short term impacts and effectiveness:** The potential short-term adverse impacts and risks of the remedy upon the community, the workers, and the environment during the construction and/or implementation are evaluated. A discussion of how the identified potential adverse impacts to the community or workers at the Site will be controlled, and the effectiveness of the controls, should be presented. Provide a discussion of engineering controls that will be used to mitigate short term impacts (i.e., dust control measures). The length of time needed to achieve the remedial objectives is also estimated.

- **Implementability:** The technical and administrative feasibility of implementing each alternative is evaluated for this criterion. Technical feasibility includes the difficulties associated with the construction and the ability to monitor the effectiveness of the remedy. For administrative feasibility, the availability of the necessary personnel and material is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, etc.

- **Cost Effectiveness:** This criterion is an evaluation of the overall cost effectiveness of an alternative or remedy. This criterion evaluates the estimated capital, operations, maintenance, and monitoring costs. Costs are estimated and presented on a present worth basis.

- **Land Use:** This criterion evaluates the current, intended and reasonably anticipated future use of the Site and its surroundings, as it relates to an alternative or remedy, when unrestricted levels would not be achieved.

7.2.2 Soil Alternative Evaluation

The four soil alternatives that were identified and pre-screened for evaluation include:

- Alternative S1 - No Action
- Alternative S2 - SSDS, PCB/Pesticides Area Excavation and SVE System
- Alternative S3 – SSDS and ISTT
- Alternative S4 - SSDS and VOCs and PCB/Pesticides Area Excavation and Off-Site Disposal, Existing Foundation as Cap

An individual analysis of the soil alternative against the criteria outlined above was conducted and is presented below. A summary of the evaluation is provided in Table 13.

7.2.2.1 Alternative S1 - No Action

The "no action" option is included as a basis for comparison with active soil remediation technologies in accordance with Section 4.2 of DER-10. If no remedial action is taken, contaminants already present in the soil will remain in place or continue to impact the underlying groundwater.

- **Overall protection of human health and the environment:** Alternative S1 provides no control of exposure to contaminated soil and no reduction in risk to human health posed by contaminated soil. The alternative allows for the potential for migration of contaminated soil and potential for impact to groundwater from contaminated soil.
- **Compliance with SCGs:** Alternative S1 does not comply with any of the SCGs. Contaminated soil at the Site will continue to exhibit concentrations above the URU/POGW SCOs.
- **Long term effectiveness and permanence**: Alternative S1 does not provide a degree of long-term effectiveness and permanence. No long term management or controls for exposure are included in this alternative. Long term potential risks would remain unchanged under this alternative.

- **Reduction of toxicity, mobility, or volume of contamination through treatment:** Alternative S1 does not provide reduction in toxicity, mobility, or volume of the contaminated soil.
- **Short term impacts and effectiveness:** This alternative does not result in disruption of the Site and therefore no additional risks are posed to the community, workers, or the environment as no remedial actions will occur at the Site. Remedial objectives are not achieved so no remedial time frame is associated with this alternative.
- **Implementability:** There are no implementability concerns posed by this remedy as no remedial actions are being implemented.
- **Cost Effectiveness:** Because this is a no action alternative, the capital, operations and maintenance, and net present value costs are estimated to be $0. Therefore, no cost estimate is provided.
- **Land Use:** The no action alternative would result in soil contaminants exceeding commercial SCOs remaining in place. This is not sufficient for the current, intended and reasonably anticipated future use of the Site which is commercial use.

7.2.2.2 Alternative S2 - SSDS, PCB/Pesticides Area Excavation and SVE System

Alternative S2 consists of three remedial technologies including SSDS system for vapor intrusion for on-Site buildings, limited excavation of PCB/Pesticides contaminated soil, and implementing SVE to remediate the VOCs contaminated soil at the Site.

- **Overall protection of human health and the environment:** Alternative S2 provides overall protection of human health and the environment through remediation of contaminants in the soil by removing PCB/Pesticides contaminated soil through excavation, by mitigating vapor beneath the two buildings on-Site and therefore preventing vapors from entering the work zone of the buildings, and by actively reducing VOCs contaminant levels in soils through a SVE system. Also, Alternative S2 will prevent impact to groundwater because it will remove the contamination from the soils and will prevent further downward migration of contamination to groundwater.

- **Compliance with SCGs:** Alternative S2 will achieve compliance with chemical specific SCGs for the Site, including URU/POGW SCOs. Excavation and off-Site disposal of PCB/Pesticides contaminated soil will achieve compliance with URU SCOs for PCBs and Pesticides (POGW SCOs for pesticides and PCBs have not been exceeded). Remedial activities for VOCs contaminated soil will continue until the URU/POGW SCOs for VOCs are met.
- **Long term effectiveness and permanence**: Alternative S2 provides a high degree of long-term effectiveness and permanence. The PCB/Pesticides contamination will be permanently removed from the Site. Remedial activities for VOCs contaminated soil will continue until no wastes or treatment residuals will remain on Site. Long term potential risks will be removed.
- **Reduction of toxicity, mobility, or volume of contamination through treatment:** Alternative S2 will provide reduction in toxicity, mobility, and volume of the both PCB/Pesticides and VOC contamination in soils. PCB/Pesticides contamination will be removed by excavation and VOC contamination will be extracted through the SVE system therefore eliminating the toxicity, mobility and volume of the contamination at the Site.
- **Short term impacts and effectiveness:** Alternative S2 will result in some disruption of the Site and additional risks will be imposed to the community, workers, and the environment. The additional risks will be generated from the excavation of the PCB/Pesticide contaminated soils, drilling activities to install the SVE wells and the construction of the SVE system. These risks will be mitigated by the development and implementation of a Remedial Action Work Plan including a Health and Safety Plan. This plan will provide measures to prevent exposure of workers to the contamination, air sampling to protect the workers and the surrounding population, protection of workers from construction activities, create exclusion zones to protect the public from entering work areas and noise mitigation to prevent impacting the surrounding businesses. Also,

standard industry protocols will be used to prevent dust generation during excavations and to provide for traffic control for all equipment on-Site and off-Site. Alternative S2 will achieve SCGs in approximately 5 years.

- **Implementability:** Alternative S2 is implementable with easily available equipment and material. The excavation of PCB/Pesticides contaminated soil is a commonly used remedial technology. The SVE technology is widely used and there is sufficient trained staff to perform the installation, operation and maintenance. The existing clay/silt layer present within the remediation area may reduce the effectiveness of the SVE system; however, the placement of extraction wells into the clay/silt layer would be sufficient to remediate elevated levels of VOCs in the area. The extraction wells placed in the clay/silt layer will dry out the surrounding clay/silt which will eventually desiccate and promote higher air flow. The existing dry wells may interfere with the SVE system by short circuiting the air flow, therefore, reducing the effectiveness of the remedial technology. Corrective measures will need to be implemented during the design phase of the SVE treatment system.
- **Cost Effectiveness:** Alternative S2 cost is approximately $2.04M which is low compared to the cost of other alternatives (not including S1 - no action). This alternative also includes O&M for the SVE system; the cost can vary based on the number of years of operation. The estimated cost for Alternative S2 is summarized in Table 16.
- **Land Use:** Alternative S2 will achieve URU/POWG SCOs and will prevent contaminated soil vapor from entering the on-site buildings. Alternative S2 is therefore sufficient for the current, intended and reasonably anticipated future use of the site which is commercial.

7.2.2.3 Alternative S3 – SSDS and In-Situ Thermal Treatment

Alternative S3 consists of two remedial technologies including a SSDS system for vapor intrusion for on-Site buildings and implementing in-situ thermal treatment with a vacuum extraction system to remediate the VOCs contaminated soil at the Site.

- **Overall protection of human health and the environment:** Alternative S3 provides overall protection of human health and the environment through remediation of contaminants in the soil by eliminating vapor beneath the two buildings on-Site and therefore preventing vapors from entering the work zone of the buildings, and by actively reducing VOC contaminant levels in soils through in-situ thermal treatment. Also, Alternative S3 will prevent impact to groundwater because it will remove the VOC contamination from the soils and will prevent further downward migration of VOC contamination to groundwater.
- **Compliance with SCGs:** Alternative S3 will achieve compliance with chemical specific SCGs for VOCs, specifically URU/POGW SCOs. ISTT for VOC contaminated soil will continue until the URU/POGW SCOs for VOCs are met. POGW SCOs for pesticides and PCBs have not been exceeded.
- **Long term effectiveness and permanence**: Alternative S3 provides a high degree of long-term effectiveness and permanence. Remedial activities for VOC contaminated soil will continue until no wastes or treatment residuals will remain on Site. Long term potential risks will be removed.
- **Reduction of toxicity, mobility, or volume of contamination through treatment:** Alternative S3 will provide reduction in toxicity, mobility, and volume of VOC contamination in soils. VOC contamination will be extracted through the SVE system therefore eliminating the toxicity, mobility and volume of the VOC contamination at the Site.
- **Short term impacts and effectiveness:** Implementation of Alternative S3 will result in some disruption of the Site and additional risks will be imposed to the community, workers, and the environment. The additional risks will be generated from drilling activities to install the heating well/vacuum extraction wells and construction of the treatment system. These risks will be mitigated by the development and implementation of a Remedial Action Work Plan including a Health and Safety Plan and Community Air Monitoring Plan. These plans will provide measures to prevent exposure of workers to the contamination, air sampling to protect the workers and the surrounding community, protection of

workers from construction activities, create exclusion zones to protect the public from entering work areas and noise mitigation to prevent impacting the surrounding businesses. Also, standard industry protocols will be used to prevent dust generation during intrusive work and to provide for traffic control for all equipment on-Site and off-Site. During the in-situ thermal treatment implementation, regular business activities may be disrupted for a short amount of time. Alternative S3 will achieve SCGs in less than 6 months.

The underground heating is not anticipated to result in short term impacts to subsurface utilities or structures because the temperature will not reach 100º C and will also be monitored in case of temperature rise near utilities. A thermal insulating blanket will prevent contact with heat generated by the system at the ground surface.

- **Implementability:** Alternative S3 is implementable with easily available equipment and material. In-situ thermal treatment is implemented on a number of field remediation projects; however, additional measures will need to be implemented while installing heating wells near the building and underground utilities such as dry wells and any piping connections from these dry wells. Usually, heating sensors can be installed near the utilities to monitor the temperature rise near the utilities which can automatically shut off the heating input for the heating wells nearby. The existing clay/silt layer present within the remediation area is not expected to affect the rate of heat flux throughout the treatment zone as thermal conductivity value does not vary much between most soil types. The vapor extraction system components of the in-situ thermal technology are more widely used and there is sufficient trained staff to perform the installation, operation and maintenance.
- **Cost Effectiveness:** Alternative S3 cost is approximately $2.06M which is only slightly higher than the lowest cost alternative – S2 (not including S1 – no action). This alternative does not have any O&M cost associated with the in-situ thermal system since this technology will be implemented within 6 months. The O & M

costs associated with the SSDS system for vapor intrusion are included in the cost estimate provided in Table 17.

- **Land Use:** Alternative S3 will achieve URU/POWG SCOs for VOCs and will prevent contaminated soil vapor from entering the on-site buildings. The POGW SCOs for pesticides and PCBs are not exceeded. Alternative S3 is therefore sufficient for the current, intended and reasonably anticipated future use of the site which is commercial.

7.2.2.4 Alternative S4 - SSDS and VOCs and PCB/Pesticides Area Excavation and Off-Site Disposal, Existing Foundation as Cap

Alternative S4 consists of two remedial technologies including a SSDS system for vapor intrusion for on-Site buildings and excavation of PCB/Pesticides contaminated soil, and excavation of VOC contaminated soil located outside of the building footprint at the Site. A portion of the existing building foundation at 161 Bethpage-Sweethollow Road will function as a cap over the remaining VOC contaminated soil.

- **Overall protection of human health and the environment:** Alternative S4 provides overall protection of human health and the environment through soil excavation by removing PCB/Pesticides contaminated soil and removing VOC contaminated soil located outside of the building footprint and by eliminating vapor beneath the two buildings on-Site and therefore preventing vapors from entering the buildings. Alternative S3 will prevent impact to groundwater because it will remove the contamination from the soils and will prevent further downward migration of contamination to groundwater. The existing impermeable cap consisting of a slab on-grade foundation in combination with institutional controls and environmental easements will prevent exposure to the contaminants through restrictions and limitations of Site uses.
- **Compliance with SCGs:** Alternative S4 will partially achieve compliance with chemical specific SCGs for the Site. Excavation and off-Site disposal of PCB/Pesticides contaminated soil and VOC contaminated soil located outside of the building footprint will achieve compliance with URU/POGW SCOs for PCBs, Pesticides, and VOCs. Remaining soil underneath the building footprint will

achieve compliance with the Restricted Commercial Use SCOs; however, it will not meet the URU/POGW SCOs.

- **Long term effectiveness and permanence**: Alternative S4 provides a limited degree of long-term effectiveness and permanence. The PCB/Pesticides and limited VOC contamination will be permanently removed from the Site. Since contaminated soils will remain under the building, the existing impermeable cap consisting of a slab on-grade foundation in combination with institutional controls and environmental easements will provide long term effectiveness but not permanence.
- **Reduction of toxicity, mobility, or volume of contamination through treatment:** Alternative S4 will provide reduction in toxicity, mobility, and volume of the both PCB/Pesticides and VOC contamination for soils outside the footprint of the building on 161 at Bethpage-Sweethollow Road. The existing cap over the remaining VOC contaminated soil will not reduce toxicity, or volume of contamination. The mobility of the contamination will be reduced by preventing stormwater infiltration through that area and removing the downward contaminant transport mechanism.
- **Short term impacts and effectiveness:** Implementation of Alternative S4 will result in significant disruption of the Site and additional risks will be imposed to the community, workers, and the environment. The additional risks will be generated from the excavation of the PCB/Pesticide and VOC contaminated soils. These risks will be mitigated by the development and implementation of a Remedial Action Work Plan including a Health and Safety Plan and Community Air Monitoring Plan. These plans will provide measures to prevent exposure of workers to the contamination, air sampling to protect the workers and the surrounding community, protection of workers from construction activities, create exclusion zones to protect the public from entering work areas and noise mitigation to prevent impacting the surrounding businesses. Also, standard industry protocols will be used to prevent dust generation during excavations and to provide for traffic control for all equipment on-Site and off-Site. During the

excavation, regular business activities will be disrupted. Alternative S4 will achieve SCGs in less than 6 months.

- **Implementability:** Alternative S4 is implementable with readily available equipment and material. The excavation of PCB/Pesticides and VOC contaminated soil is a commonly used remedial technology. Additional protection measures such as building foundation support will be implemented while excavating near the buildings.
- **Cost Effectiveness:** Alternative S4 cost is approximately $2.8M which is high compared to the cost of other alternatives. This alternative does not have any O&M cost associated with the excavation but includes O & M costs associated with the SSDS system for vapor intrusion. The estimated cost for Alternative S4 is summarized in Table 18.
- **Land Use:** Alternative S4 will achieve URU/POWG SCOs for pesticides/PCBs and will prevent contaminated soil vapor from entering the on-site buildings. Commercial SCOs will be achieved for VOCs. Alternative S4 is therefore sufficient for the current, intended and reasonably anticipated future use of the site which is commercial.

7.2.3 Groundwater Alternative Evaluation

The four groundwater alternatives that were identified and pre-screened for evaluation include:

- Alternative G1 – No Action
- Alternative G2 – ISCO
- Alternative G3 – AS/SVE System
- Alternative G4 – Pump and Treat

An individual analysis of the groundwater alternatives against the criteria outlined in section 7.2.1 was conducted and is presented below. A summary of the evaluation is provided in Table 14.

7.2.3.1 Alternative G1 – No Action

The “no action” option is included as a basis for comparison with active groundwater remediation technologies in accordance with Section 4.2 of DER-10. If no remedial action is taken, contaminants already present in the groundwater will remain in place.

- **Overall protection of human health and the environment:** Alternative G1 provides no control of exposure to contaminated groundwater and no reduction in risk to human health posed by contaminated groundwater. The No Action alternative does not attain the groundwater RAOs (e.g., restoration of the resource) and does not enhance the protection of human health. The alternative allows for the continued migration of contaminated groundwater off-Site.
- **Compliance with SCGs:** Alternative G1 does not comply with any of the SCGs. Contaminated groundwater at the Site will continue to exhibit concentrations above the Class GA GWQS in the on-Site area being considered for active groundwater remediation.
- **Long term effectiveness and permanence**: Alternative G1 does not provide a degree of long-term effectiveness and permanence. Existing groundwater contamination at the Site poses potential unacceptable human health risks under current and likely future groundwater use scenarios. No long term management or controls for exposure are included in this alternative. Under the No Action alternative, these risks would remain unchanged over the long- term for expected groundwater uses.
- **Reduction of toxicity, mobility, or volume of contamination through treatment:** Alternative S1 will not provide reduction in toxicity, mobility, or volume of the contaminated groundwater.
- **Short term impacts and effectiveness:** This alternative does not result in disruption of the Site and therefore no additional risks are posed to the community, workers, or the environment as no remedial actions will occur at the Site. No remedial timeframe is associated with this alternative.

- **Implementability:** There are no implementability concerns posed by this remedy as no remedial actions are being implemented.
- **Cost Effectiveness:** Because this is a no action alternative, the capital, operations and maintenance, and net present value costs are estimated to be $0.
- **Land Use:** The no action alternative would result in groundwater contaminants exceeding standards remaining on-site. No environmental easement would be put in place. This is not sufficient for the current, intended and reasonably anticipated future use of the Site which is commercial use.

7.2.3.2 Alternative G2 – ISCO

Alternative G2 consists of ISCO with LTM for the remediation of VOCs in groundwater. This alternative would include the installation of shallow (55 to 95 feet bgs) and deep (95 to 135 feet bgs) permanent injection wells throughout the groundwater remediation area to inject the chemical oxidation solution to degrade the organic contaminants. LTM would consist of a network of wells located within and downgradient of the Site boundary

- **Overall protection of human health and the environment:** Alternative G2 would protect human health and the environment at the Site through a combination of ISCO implementation throughout the active remediation area including underneath the building, institutional controls, and LTM. Existing institutional controls would remain in place to restrict local groundwater use. LTM would be implemented outside of any active remediation areas and as a contingency to monitor the contaminants concentrations in groundwater if needed after ISCO treatment.
- **Compliance with SCGs:** Alternative G2 is expected to achieve compliance with SCGs including Class GA GWQS for the active remedial area.
- **Long term effectiveness and permanence**: ISCO treatment has been demonstrated to be effective and reliable at numerous Sites for groundwater treatment for VOCs and is expected to be effective at this Site. ISCO treatment will significantly degrade VOCs in contaminated areas. However, groundwater concentrations may rebound depending of the effectiveness of the initial

treatments. Multiple injection of ISCO treatment may be required to address rebounding. Institutional controls and LTM will provide adequate protection of human health from a diluted residual plume if properly implemented and maintained.

- **Reduction of toxicity, mobility, or volume of contamination through treatment:** ISCO treatment uses chemical processes to degrade contaminants in groundwater to less harmful compounds. ISCO will reduce the toxicity, mobility and volume of contaminants in groundwater. LTM that will be used for a diluted residual plume provides minimal reduction in the toxicity, mobility or volume of contaminants, and will likely require long periods to reach RAOs through natural processes alone.
- **Short term impacts and effectiveness:** Implementation of Alternative G2 will result in considerable disruption to the Site and additional risks will be imposed to the community, workers, and the environment. The additional risks will be generated from the potential administrative difficulties and potential safety concerns involved with handling hazardous material during its implementation. Hydraulic short circuiting and/or preferential pathways may result from migration of the oxidant into non-target off-Site areas. These risks will be mitigated by the development of a design and operational guidelines and implementation of a Remedial Action Work Plan including a Health and Safety Plan. The remedial timeframe for Alternative G2 is 5 years.
- **Implementability:** ISCO is a well-established technology and the equipment and services to install and operate the treatment injection system and to sample groundwater monitoring wells are commercially available. Additional measures will need to be implemented while handling oxidant and injecting within the building. The existing clay/silt layer present between the shallow and deep remediation area may contain soil with higher total organic carbon (TOC) content which can result in high oxidant consumption due to competition provided by TOC. Additional pre-design investigation and pilot testing would be necessary to

determine optimal well placement, oxidant demand, flow rates and additional injection(s) that may be necessary.

- **Cost Effectiveness:** Alternative G2 cost is approximately $11.1M which is high compared to the cost of other alternatives. This alternative does not have any O&M cost associated with the ISCO treatment but includes O & M costs associated with the LTM program. The estimated cost for Alternative G2 is summarized in Table 19. For purposes of developing a cost estimate for comparison purposes, the following assumptions were made:
  - Short-Duration Remedy (with remedial timeframes 1 to 2 years for shallow and deep remediation areas);
  - Two rounds of injection in the first year and one contingency round in the following year after two monitoring events;
  - LTM quarterly for the first 2 years, twice a year for years 3 and 4, and possibly reduced to annual sampling for year 5.
- Land Use: Alternative G2 will achieve compliance with Class GA GWQS which is sufficient for the current, intended and reasonably anticipated future use of the site which is commercial.

7.2.3.3 Alternative G3 – AS/SVE System

Alternative G3 consists of the installation of an AS/SVE system to remediate shallow as well as deep groundwater contamination at the Site. Off-gas treatment and LTM are also implemented as part of this alternative. For the AS/SVE, air will be delivered to the subsurface via the sparging well, and vacuum pumps or blowers are utilized for the removal of contaminants in the vapor phase through the vacuum extraction well.

- **Overall protection of human health and the environment:** Alternative G3 will protect human health and the environment at the Site through a combination of AS/SVE system implementation throughout the remediation area, institutional controls, and LTM for any diluted residual plume that may remain after AS/SVE. Existing institutional controls would remain in place to restrict local groundwater use. LTM would be implemented outside of any active remediation areas and as a contingency if needed after the AS/SVE system is no longer active. Alternative G3 will control further spread of the contaminant plume.

- **Compliance with SCGs:** Alternative G3 is expected to achieve compliance with SCGs including the NYSDEC Class GA GWQS for the remediation area. Remedial activities for Alternative G3 will be continued until the NYSDEC Class GA GWQS are met. Small areas with diluted residual plume after the AS/SVE is no longer active will be monitored by LTM until SCGs are met.

- **Long term effectiveness and permanence**: AS/SVE has been demonstrated to be effective and reliable at numerous Sites for groundwater treatment for VOCs and is expected to be effective at this Site. An AS/SVE system will significantly reduce VOCs in contaminated areas. If needed, institutional controls and LTM, if properly implemented and maintained, could provide adequate protection of human health from a residual diluted plume.

- **Reduction of toxicity, mobility, or volume of contamination through treatment:** AS/SVE system will reduce the volume of contamination present by injecting air into sparging wells, volatilizing VOCs from the groundwater to the unsaturated zone, and extracting the volatilized contaminants for vapor phase GAC treatment. Extraction of VOCs from the contaminated groundwater will effectively reduce their mobility, toxicity, and volume in the underlying aquifer. LTM provides minimal reduction in the toxicity, mobility or volume of contaminants, and will likely require long periods to reach RAOs through natural processes alone.

- **Short term impacts and effectiveness:** Implementation of Alternative G3 will result in minimal impacts to human health or the environment. However, normal Site operations may temporarily be impacted during installation and startup, and increased traffic and noise during well installation is expected. The remedial timeframe for Alternative G3 is approximately 11 years.

- **Implementability:** An AS/SVE system is a well-established technology and the equipment and services to install and operate the SVE system and to sample groundwater monitoring wells are commercially available. Based on the available subsurface information, it is not clear if the existing clay/silt layer between the shallow and deep remediation area is continuous. This clay/silt layer is expected to affect the performance of the AS/SVE system if it is continuous throughout the area. Extracted vapor from the air sparging could be trapped within the deep remediation area if the clay/silt layer is continuous. Additional pre-design investigation and pilot testing will be necessary to determine the effect of the clay/silt layer, optimal well placement, flow rates and additional treatment that may be necessary.

- **Cost Effectiveness:** Alternative G3 cost is approximately $6M which is medium compared to the cost of other alternatives. This alternative includes the O&M cost associated with the operation of the SVE system, and implementing the LTM program. The estimated cost for Alternative G3 is summarized in Table 20. For purposes of developing a cost estimate for comparison purposes, the following assumptions were made:
  - Short-Duration Remedy (with remedial timeframes 5 years for shallow and deep remediation areas);
  - LTM to continue for a period of 11 years.
- **Land Use:** Alternative G3 will achieve compliance with Class GA GWQS which is sufficient for the current, intended and reasonably anticipated future use of the site which is commercial.

7.2.3.4 Alternative G4 – Pump and Treat

Alternative G4 consists of a groundwater extraction system to capture the shallow as well as deep VOC-contaminated groundwater and treat it at the surface by implementing remedial technologies such as air stripping, a vapor phase GAC system, and finally discharge/disposal of treated groundwater. Alternative G4 also includes LTM with institutional controls.

- **Overall protection of human health and the environment:** Alternative G4 will protect human health and the environment at the Site through a combination of pump and treat system implementation throughout the active remediation area, institutional controls, and LTM. Existing institutional controls will remain in place to restrict local groundwater use. LTM will be used to monitor the remediation progress throughout the operational years of the Pump and Treat system. This alternative will remove contaminant mass from the groundwater at the source area and establish hydraulic control of the aquifer to minimize off-Site migration of the groundwater plume.

- **Compliance with SCGs:** Alternative G4 is expected to achieve compliance with SCGs including the NYSDEC Class GA GWQS for the remediation area. Remedial activities for Alternative G4 will be continued until the NYSDEC Class GA GWQS are met. Treated effluent from groundwater treatment system will meet the New York State groundwater effluent limitations prior to being discharged to on-Site dry wells.
- **Long term effectiveness and permanence**: Groundwater pump and treat systems have been demonstrated to be effective and reliable at numerous Sites for groundwater treatment for VOCs and it is expected to be effective at this Site. Pump and treat would significantly reduce VOCs in contaminated areas. Institutional controls and LTM could provide adequate protection of human health if properly implemented and maintained. However, they do not reduce contamination in the subsurface or promote restoration of the resource, and they also require continuous oversight to maintain their effectiveness.
- **Reduction of toxicity, mobility, or volume of contamination through treatment:** The Pump and treat system will reduce the volume of contamination by extracting groundwater from the shallow and deep remediation area and treating it above ground. Extraction of VOCs from the contaminated groundwater will effectively reduce the mobility, toxicity, and volume of VOCs in the underlying aquifer.
- **Short term impacts and effectiveness:** Implementation of Alternative G4 will result in minimal impacts to human health or the environment. However, normal Site operations may temporarily be impacted during installation and startup, and increased traffic and noise during well installation is expected. The remedial timeframe for Alternative G4 is 30 years.
- **Implementability:** Pump and treat is a well-established technology and the equipment and services to install and operate the treatment system and to sample groundwater monitoring wells are commercially available. Shallow and deep

extraction wells are identified to remediate both areas separated by the existing clay/silt layer. Additional pre-design investigation and pilot testing would be necessary to determine optimal well placement, flow rates and additional pre-treatment that may be necessary.

- **Cost Effectiveness:** Alternative G4 cost is approximately $22.8M which is high compared to the cost of other alternatives. This alternative includes the O&M cost associated with the operation of the extraction and treatment system, and implementing the LTM program. The estimated cost for Alternative G4 is summarized in Table 21. For purposes of developing a cost estimate for comparison purposes, the following assumptions were made:
  - Long-Duration Remedy (with remedial timeframes of 30 years for shallow and deep remediation areas);
  - LTM conducted twice per year for 30 years beyond remediation system startup.
- **Land Use:** Alternative G4 will achieve compliance with Class GA GWQS which is sufficient for the current, intended and reasonably anticipated future use of the site which is commercial.

7.3 Comparative Analysis of Alternatives

In the previous sections, each of the remedial alternatives for soil and groundwater were individually evaluated with respect to the eight evaluation criteria. In this section, a comparative analysis was completed where the alternatives were evaluated in relation to each other for each of the evaluation criteria. The purpose of this analysis is to identify the relative advantages and disadvantages of each alternative.

7.3.1 Soil Alternative Comparative Evaluation

7.3.1.1 Overall Protectiveness of the Public Health and the Environment

All of the alternatives, except the no action Alternative S1, provide protection of human health and the environment. Risks from direct contact, inhalation, and migration of soil contaminants including impacts to groundwater are addressed by soil Alternatives S2, S3 and S4. Exposure risks are slightly higher under Alternatives S3 and S4 compared to Alternative S2 due to the VOC contamination which will remain underneath the building under Alternative S4 (exceeding

URU/POGW SCOs) and the PCB/Pesticides contamination which will remain under Alternative S3 (exceeding URU and Commercial SCOs, but not POGW SCOs). Alternative S2 will effectively restore the entire Site to pre-disposal conditions and achieve URU/POGW SCOs for all contaminants. Given the anticipated future use of the Site as commercial, Alternatives S3 and S4 in conjunction with institutional controls, will meet the direct contact RAO and the RAO associated with inhalation of volatilized contamination. Alternatives S2, S3 and S4 will minimize or eliminate the risk of vapor intrusion for Site occupants.

7.3.1.2 Compliance with SCGs

Alternative S2 will achieve the SCGs established for the Site including URU/POGW SCOs. Alternative S3 will remove VOC contaminants and meet the URU/POGW SCOs for VOCs sooner than Alternative S2. However, Alternative S3 will not meet URU or Commercial Use SCOs for PCBs/Pesticides, but it is compliant with the POGW SCOs. Alternative S1 will not meet the SCGs established for the Site. Alternative S4 will achieve URU/POGW SCOs for the soil remediation area outside the building footprint; however, only Commercial Use SCOs will be achieved for the soil remaining underneath the 161 Bethpage-Sweethollow Road building. Given the anticipated future use of the Site and groundwater use in the area, Alternatives S3 and S4 in conjunction with institutional controls should not result in impacts to groundwater that will present a significant risk to public or private water supply users. Alternatives S2, S3 and S4 will achieve applicable indoor air guideline values.

7.3.1.3 Long Term Effectiveness and Permanence

Alternatives S2 and S4 provide the highest degree of long term effectiveness and permanence for PCB/Pesticides contaminated soil because the impacted soil is permanently removed from the Site. All alternatives except for Alternative S1 will provide long term effectiveness and permanence for vapor intrusion inside both buildings located on-Site. For VOC contaminated soil, Alternatives S2 and S3 provide the highest degree of long term effectiveness and permanence because the impacted soil is treated in-situ and VOCs contamination is permanently reduced at the Site. Alternative S1 will result in contaminants remaining in the environment and will have no long-term effect. Alternative S4 will permanently remove 2,600 cubic yards of VOC impacted soil and approximately 1,200 cubic yards of VOC impacted soil will remain underneath the building. Therefore, Alternative S4 relies on an existing cap to control infiltration, direct contact exposure and migration of VOC impacted soil. The existing cap, (concrete floor of the building) is a reliable technology if properly maintained. Although capping is effective and reliable for reducing VOC exposure risk, it is less reliable in the long term compared to treatment (Alternatives S2 and S3).

7.3.1.4 Reduction of Toxicity, Mobility or Volume with Treatment

Alternative S1 will not reduce toxicity, mobility or volume of Site contaminants. Alternatives S2 and S4 will reduce toxicity, mobility or volume of PCB/Pesticides contaminated soil by excavation and transportation to a permitted landfill for disposal. Alternatives S2 and S3 will reduce the mass of VOCs in soil by transferring contaminants to the vapor phase and treating ex-situ. Alternative S4 will reduce the volume of VOC impacted soils which will reduce contaminated soil vapors.

7.3.1.5 Short Term Impact and Effectiveness

Alternative S1 can be implemented without any disruption to the Site operations. In comparison to the Alternative S3 ISTT system, Alternative S2 will be implemented with less disruption for installation of the SVE system. Alternative S2 and S3 will involve temporary disruption for construction of the VOC treatment systems along with limited excavation of the pesticide and PCB contaminated soil for Alternative S2. Alternative S4 will result in considerable temporary disruption because of the large scale excavation. Alternatives S2 and S3 will result in some traffic and noise during construction while Alternative S4 will result in having the most traffic and noise and for the longest duration. Alternative S4 has a relatively greater exposure risk to workers because contaminants are excavated and handled at the surface prior to off-Site disposal. Alternative S1 has no associated remediation time frame. Alternative S2 would take approximately 5 years. Alternatives S3 and S4 are substantially shorter and would take less than 6 months.

7.3.1.6 Implementability

All of the alternatives are expected to be technically and administratively implementable. The silty clay layer found in the remediation area will pose some implementation challenges for which remedies will have to be engineered. In comparison to Alternative S3, Alternative S2 will be easier to implement than Alternative S3 since less piping will be installed for the SVE system than the in-situ thermal treatment system. Also, Alternative S3 will need additional precautions for installing heating wells near the utilities. Excavations near the existing structures for Alternative S4 will require additional shoring and bracing to complete.

7.3.1.7 Cost Effectiveness

Cost evaluation of each alternative includes an estimation of construction/capital costs and O&M costs. Tables 16 through 18 include conceptual cost analyses (and assumptions) for the soil/soil vapor alternatives being considered for the Site. The costing was based on conceptual remedy assumptions and the information developed for this FS (e.g., Site geology, contaminant levels). The costs are presented in present worth basis for comparison purposes. Table 13 provides a summary of the remedial costs developed for the soil/soil vapor alternatives.

No cost is associated with the No Action Alternative (S1) because no activities are implemented. Alternative S2 has the lowest capital cost (just under $1.1M) of the active soil alternatives. Capital costs for Alternative S3 ($1.5M) is less than Alternative S4 ($2.3M). Alternative S4 has the highest capital cost ($2.3M) of the soil alternatives. Soil alternatives S2, S3 and S4 include annual operations and maintenance costs for the SSDS systems. Alternative S4 has the highest overall present worth value of the soil Alternatives ($2.8M).

7.3.1.8 Land Use

The Site is presently zoned for industrial use. Commercial uses are also permitted. Alternative S2 would achieve URU/POGW SCOs; however current zoning would limit such use to commercial or industrial so that there would be no change. No alternatives would necessitate a change in the current land use.

7.3.2 Groundwater Alternative Comparative Evaluation

7.3.2.1 Overall Protectiveness of Public Health and the Environment

Alternative G1 provides no additional protection of human health and the environment. Alternatives G2 and G3 are protective of human health and the environment, and are expected to achieve groundwater RAOs throughout the remediation area. Protectiveness under Alternatives G2 and G3 requires a combination of reducing contaminant concentrations in groundwater and limiting exposure to residual contaminants that may result from upgradient sources through maintenance of existing, and implementation of additional institutional controls, as well as LTM. Protectiveness under Alternative G4 is achieved through reducing contaminant concentrations via extraction and treatment of groundwater. Alternative G4 also protects against the further migration of contaminated groundwater, as the extraction functions as a hydraulic plume containment mechanism. The NYSDEC Class GA GWQS is achieved in a shorter timeframe with the ISCO treatment in Alternative G2 than with AS/SVE in Alternative G3. Alternative G4 requires the longest remedial timeframe to achieve protection of human health and the environment.

Vapor releases under Alternatives G3 and G4 could have potential impact to human health and the environment due to air discharges during treatment. However, these would be minimal, as any vapor discharge will be subject to effective treatment technology such as GAC adsorption.

7.3.2.2 Compliance with SCGs

Alternatives G1 will not achieve compliance with SCGs. Alternatives G2 and G3 may result in a stabilized contamination plume that should meet SCGs at the property boundary. Alternative G4 should meet SCGs at the property boundary and will provide hydraulic control.

7.3.2.3 Long Term Effectiveness and Permanence

Alternative G1 provides no active reduction in contaminant levels or risk therefore does not provide any long term effectiveness.

ISCO treatment under Alternative G2 is a reliable method for reducing contaminant concentrations in groundwater. AS/SVE under Alternative G3, and pump & treat under Alternative G4 are considered effective technologies for treatment and/or containment of contaminated groundwater. Alternative G2 and Alternative G3 are known to provide significant mass removal of contaminants and are expected to achieve RAOs in the remediation area. Some residual risk for levels above the SCGs remains in contaminated groundwater in Alternatives G2 and G3 and these alternatives will rely on institutional controls and LTM for protection. Residual risk under Alternative G4 is likely reduced below the SCGs over a longer-term remedial timeframe as contaminant removal from groundwater is slower.

7.3.2.4 Reduction of Toxicity, Mobility or Volume with Treatment

Alternative G1 will not reduce toxicity, mobility or volume of groundwater contamination. Alternatives G2, G3 and G4 will reduce the mass of VOC contamination in groundwater. Alternative G2 uses a chemical oxidation process to destroy contaminants and eliminate them from the aquifer. Alternative G3 permanently removes the contaminants from the aquifer, and provides treatment for the collected vapor-phase contamination. Alternative G4 provides hydraulic control and reduces the mobility of the contaminated groundwater, and includes extraction and treatment that removes contaminants from the aquifer. Contaminants are then collected for treatment. After treatment, Alternative G3 and G4 will generate residuals in a form of used GAC that will require regeneration, destruction or disposal.

7.3.2.5 Short Term Impacts and Effectiveness

Alternative G1 creates no short-term impacts to human health or the environment because no action is conducted. Alternatives G2, G3 and G4 will have short-term impacts to remediation workers, the public, and the environment during implementation. All these alternatives implement monitoring, that would provide the data needed for proper management of the remedial processes and a mechanism to address any potential impacts to the community, remediation workers, and the environment.

Alternatives G3 and G4 have aboveground treatment components and infrastructure that may create a minor noise nuisance and inconvenience for local business operations during construction and operation. The potential for remediation workers to have direct contact with contaminants in groundwater occurs when the wells are installed for alternatives G2, G3 and G4, and when the groundwater remediation system is operating under Alternative G4. Remedy-related construction/installation under Alternative G2 would require more disruptions in regular business operations for a short duration than Alternatives G3 and G4. Groundwater monitoring and on-Site discharge will have minimal impact on workers responsible for periodic sampling.

RAOs are achieved in Alternatives G2, G3 and G4 within short, medium and longer timeframes, respectively. ISCO is expected to achieve groundwater RAOs within one to two years under Alternative G2 with LTM for 5 years. AS/SVE is expected to achieve groundwater RAOs within five years under Alternative G3 with LTM for another 6 years, and pump & treat technology is expected to achieve groundwater RAOs in 30 or more years under Alternative G4.

7.3.2.6 Implementability

Alternative G1, No Action, is the easiest alternative to implement. Alternatives G2 and G3 are commercially available technologies/systems and are normally easy to install and operate. The silty clay layer found in the remediation area will pose some implementation challenges for which remedies will have to be engineered. However, Alternative G2 would be moderately difficult to install inside the building. Of Alternatives G2, G3, and G4, pump & treat under Alternative G4 is probably the easiest alternative to construct at this Site, as the necessary infrastructure requires less land and disruption, particularly if certain enhancements are implemented. Alternatives G3 and G4 would require routine effluent sampling, performance and administrative monitoring, and periodic O&M for the life of the treatment.

7.3.2.7 Cost

Cost evaluation of each alternative includes an estimation of construction/capital costs and O&M costs. Tables 19 through 21 include conceptual cost analyses (and assumptions) for the groundwater alternatives being considered for the Site. The costing was based on conceptual remedy assumptions and the information developed for this FS (e.g., Site geology; contaminant levels). The costs are presented in present worth basis for comparison purposes. Table 14 provides a summary of the remedial costs developed for the groundwater alternatives.

The relative costs of the alternatives presented is a \$0 cost to implement the No Action Alternative, G1; to \$11.1M to implement Alternative G2 (ISCO); approximately \$6M to implement Alternative G3, AS/SVE; and \$22.8M, for the pump and treat system, Alternative G4.

7.3.2.8 Land Use

The Site is presently zoned for industrial use. Commercial uses are also permitted. Alternatives G2, G3 and G4 will likely achieve Class GA GWQS over the treatment periods although upgradient sources may continue to cause a contravention. Current zoning would limit land use to commercial or industrial, so there would be no change in the current land use as a result of implementation of any of the alternatives. Groundwater use is already restricted at the Site as part of a declaration of restrictive covenants that prohibitions the use of groundwater without treatment.

8.0 CERTIFICATION

I Peter M. McGroddy certify that I am currently a NYS registered professional engineer and that this Feasibility Study Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) and that all activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.

____

Peter M. McGroddy, P.E.

9.0 REFERENCES

6 NYCRR Part 375, Environmental Remediation Programs, December 14, 2006.

40 CFR 300.430-National Oil and Hazardous Substances Pollution Contingency Plan

CDM, Nassau County DPW Firemen's Training Center Groundwater Model, April 2008.

Environmental Conservation Law, Article 27, Title 13, §27-1313 Remedial Programs

HDR, Former Aluminum Louvre Remedial Investigation Report, January 2013.

Malcolm Pirnie, Inc., Site Characterization Report Old Bethpage Industrial Area Plume, February 2010.

NYSDEC, DER-10 Technical Guidance For Site Investigation and Remediation, May 3, 2010.

NYSDEC, DER-15: Presumptive /Proven Remedial Technologies, February 27, 2007.

NYSDEC, Division of Water Technical and Operational Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations, June 1998.

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

USEPA, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, October 1988.

This page intentionally left blank.

Table 1 – Range of VOCs in Soil

Detected Constituents	Concentration Range Detected (ug/kg) Low - High	URUSCO/ POGWSCO (ug/kg)	Frequency Exceeding URUSCO and POGW SCOs/ Total # of Samples	Concentration Range Detected (ug/kg) Low - High	Commercial SCO (ug/kg)	Frequency Exceeding Commercial SCOs/Total # of Samples
Trichloroethene	ND - 1000000	470	13/114	ND - 1000000	200000	5/114
Tetrachloroethene	ND - 13000	1300	9/114	ND - 13000	150000	0/114
Toluene	ND - 4200	700	7/114	ND - 4200	500000	0/114
cis-1,2-Dichloroethene	ND - 1000	250	4/114	ND - 1000	500000	0/114
Acetone	ND - 66	50	3/114	ND - 66	500000	0/114
m,p-Xylene	ND - 1400	260/1600	3/114; 0/114	ND - 1400	500000	0/114
Xylene (Total)	ND - 1800	260/1600	3/114; 0/114	ND - 1800	500000	0/114
1,1,1-Trichloroethane	ND - 3000	680	1/114	ND - 3000	500000	0/114
o-Xylene	ND - 390	260/1600	1/114; 0/114	ND - 390	500000	0/114
1,2,4-Trimethylbenzene	ND - 350	3600	0/114	ND - 350	190000	0/114
1,2-Dichlorobenzene	ND - 360	1100	0/114	ND - 360	500000	0/114
1,3,5-Trimethylbenzene	ND - 150	8400	0/114	ND - 150	190000	0/114
2-Butanone	ND - 10	120	0/114	ND - 10	500000	0/114
2-Hexanone	ND - 1.4	NA	0/114	ND - 1.4	NA	0/114
Carbon disulfide	ND - 2.7	NA	0/114	ND - 2.7	NA	0/114
Chloroform	ND - 93	370	0/114	ND - 93	350000	0/114
Ethylbenzene	ND - 320	1000	0/114	ND - 320	390000	0/114
Methylene chloride	ND - 6	50	0/114	ND - 6	500000	0/114
Naphthalene	ND - 3.7	12000	0/114	ND - 3.7	500000	0/114
n-Propylbenzene	ND - 71	3900	0/114	ND - 71	500000	0/114
Styrene	ND - 150	NA	0/114	ND - 150	NA	0/114

Criteria: 6NYCRR Part 375 Soil Cleanup Objectives. URUSCO - unrestricted use soil cleanup objectives. POGWSCO - protection of groundwater soil cleanup objectives.
Commercial SCO - commercial soil cleanup objectives. POGW and URU SCOs are the same for all VOCs listed above except for the xylenes.
ND - not detected. NA – not applicable.

Table 2 – Range of SVOCs in Soil

Detected Constituents	Concentration Range Detected (ug/kg) Low - High	URUSCO/ POGWSCO (ug/kg)	Frequency Exceeding URUSCO and POGW SCOs/ Total # of Samples	Concentration Range Detected (ug/kg) Low - High	Commercial SCO (ug/kg)	Frequency Exceeding Commercial SCOs/Total # of Samples
Bis(2-ethylhexyl)phthalate	ND - 220	NA/NA	0/10; 0/10	ND - 220	NA	0/10
Di-n-butylphthalate	ND - 45	NA/NA	0/10; 0/10	ND - 45	NA	0/10

Criteria: 6NYCRR Part 375 Soil Cleanup Objectives. URUSCO - unrestricted use soil cleanup objectives. POGWSCO - protection of groundwater soil cleanup objectives.

Commercial SCO - commercial soil cleanup objectives.
ND - not detected. NA - not applicable.

Table 3 – Range of Pesticides in Soil

Detected Constituents	Concentration Range Detected (ug/kg) Low - High	URUSCO/ POGWSCO (ug/kg)	Frequency Exceeding URUSCO and POGW SCOs/ Total # of Samples	Concentration Range Detected (ug/kg) Low - High	Commercial SCO (ug/kg)	Frequency Exceeding Commercial SCOs/Total # of Samples
4,4´-DDD	ND - 55	3.3/14000	1/20; 0/20	ND - 55	92000	0/20
4,4´-DDE	ND - 52	3.3/17000	1/20; 0/20	ND - 52	62000	0/20
4,4´-DDT	ND - 120	3.3/136000	1/20; 0/20	ND - 120	47000	0/20
Dieldrin	ND - 38	5/100	1/20; 0/20	ND - 38	1400	0/20
alpha-Chlordane	ND - 2.1	94/2900	0/20; 0/20	ND - 2.1	24000	0/20
delta-BHC	ND - 5.4	40/250	0/20; 0/20	ND - 5.4	500000	0/20
Heptachlor epoxide	ND - 46	NA	0/20; 0/20	ND - 46	NA	0/20
Methoxychlor	ND - 38	NA	0/20; 0/20	ND - 38	NA	0/20

Criteria: 6NYCRR Part 375 Soil Cleanup Objectives. URUSCO - unrestricted use soil cleanup objectives. POGWSCO - protection of groundwater soil cleanup objectives.

Commercial SCO - commercial soil cleanup objectives.

ND - not detected. NA - not applicable.

Table 4 – Range of PCBs in Soil

Detected Constituents	Concentration Range Detected (ug/kg) Low - High	URUSCO/ POGWSCO (ug/kg)	Frequency Exceeding URUSCO and POGW SCOs/ Total # of Samples	Concentration Range Detected (ug/kg) Low - High	Commercial SCO (ug/kg)	Frequency Exceeding Commercial SCOs/Total # of Samples
Aroclor-1254	ND - 1600	100/3200	1/20; 0/20	ND - 1600	1000	1/20
Aroclor-1242	ND - 59	100/3200	0/20; 0/20	ND - 59	1000	0/20

Criteria: 6NYCRR Part 375 Soil Cleanup Objectives. URUSCO - unrestricted use soil cleanup objectives. POGWSCO - protection of groundwater soil cleanup objectives.

Commercial SCO - commercial soil cleanup objectives.

ND - not detected. NA - not applicable.

Table 5 – Range of VOCs in Subslab Soil Vapor

Detected Constituents	Concentration Range Detected (ug/m^3) Low - High	No Criteria Available for Subslab Soil Vapor	Frequency Exceeding Standard/Total # of Samples
Tetrachloroethene	ND - 8300	NA	0/13
1,1,1-Trichloroethane	ND - 560	NA	0/13
1,1,2,2-Tetrachloroethane	ND - 1	NA	0/13
1,1,2-Trichloroethane	ND - 22	NA	0/13
1,1-Dichloroethane	ND - 0.91	NA	0/13
1,1-Dichloroethene	ND - 13	NA	0/13
1,2,4-Trichlorobenzene	ND - 1.1	NA	0/13
1,2,4-Trimethylbenzene	ND - 28	NA	0/13
1,2-Dibromoethane	ND - 1.2	NA	0/13
1,2-Dichlorobenzene	ND - 0.92	NA	0/13
1,2-Dichloroethane	ND - 0.62	NA	0/13
1,2-Dichloropropane	ND - 0.7	NA	0/13
1,2-Dichlorotetrafluoroethane	ND - 1.1	NA	0/13
1,3,5-Trimethylbenzene	ND - 8	NA	0/13
1,3-Butadiene	ND - 0.34	NA	0/13
1,3-Dichlorobenzene	ND - 0.92	NA	0/13
1,4-Dichlorobenzene	ND - 0.92	NA	0/13
1,4-Dioxane	ND - 43	NA	0/13
2,2,4-Trimethylpentane	0.62 - 96	NA	0/13
2-Butanone	ND - 34	NA	0/13
2-Hexanone	ND - 1.2	NA	0/13
4-Ethyltoluene	ND - 8	NA	0/13
4-Methyl-2-pentanone	ND - 44000	NA	0/13
Acetone	3.5 - 470	NA	0/13
Allyl chloride	ND - 0.48	NA	0/13
Benzene	0.94 - 20	NA	0/13

Table 5 – Range of VOCs in Subslab Soil Vapor

Detected Constituents	Concentration Range Detected (ug/m^3) Low - High	No Criteria Available for Subslab Soil Vapor	Frequency Exceeding Standard/Total # of Samples
Benzyl chloride	ND - 0.88	NA	0/13
Bromodichloromethane	ND - 1	NA	0/13
Bromoethene	ND - 0.67	NA	0/13
Bromoform	ND - 1.6	NA	0/13
Bromomethane	ND - 0.59	NA	0/13
Carbon disulfide	ND - 2.8	NA	0/13
Carbon tetrachloride	ND - 0.96	NA	0/13
Chlorobenzene	ND - 0.7	NA	0/13
Chloroethane	ND - 0.4	NA	0/13
Chloroform	ND - 640	NA	0/13
Chloromethane	ND - 1.3	NA	0/13
cis-1,2-Dichloroethene	ND - 29	NA	0/13
cis-1,3-Dichloropropene	ND - 0.69	NA	0/13
Cyclohexane	ND - 17	NA	0/13
Dibromochloromethane	ND - 1.3	NA	0/13
Dichlorodifluoromethane	ND - 8.2	NA	0/13
Ethyl acetate	ND - 0.92	NA	0/13
Ethylbenzene	ND - 360	NA	0/13
Hexachlorobutadiene	ND - 1.6	NA	0/13
Isopropanol	ND - 29	NA	0/13
m,p-Xylene	1.3 - 1200	NA	0/13
Methyl tert-butyl ether	ND - 0.59	NA	0/13
Methylene chloride	ND - 15	NA	0/13
n-Heptane	ND - 16	NA	0/13
n-Hexane	ND - 29	NA	0/13
o-Xylene	ND - 610	NA	0/13

Table 5 – Range of VOCs in Subslab Soil Vapor

Detected Constituents	Concentration Range Detected (ug/m^3) Low - High	No Criteria Available for Subslab Soil Vapor	Frequency Exceeding Standard/Total # of Samples
Propylene	ND - 0.26	NA	0/13
Styrene	ND - 10	NA	0/13
Tetrahydrofuran	ND - 0.45	NA	0/13
Toluene	2.3 - 590	NA	0/13
trans-1,2-Dichloroethene	ND - 1.9	NA	0/13
trans-1,3-Dichloropropene	ND - 0.69	NA	0/13
Trichloroethene	ND - 23000	NA	0/13
Trichlorofluoromethane	1.6 - 54	NA	0/13
Trichlorotrifluoromethane	ND - 10	NA	0/13
Vinyl acetate	ND - 0.54	NA	0/13
Vinyl chloride	ND - 0.39	NA	0/13

Criteria: No criteria are available for subslab soil vapor.
ND - not detected. NA - not available.

Table 6 – Range of VOCs in Indoor (Ambient) Air

Detected Constituents	Concentration Range Detected (ug/m^3) Low - High	Indoor Air Guideline Value (ug/m^3)	Frequency Exceeding Standard/Total # of Samples
Tetrachloroethene	2.4 - 3200*	100	1/8
1,1,1-Trichloroethane	ND - 0.83	NA	0/8
1,1,2,2-Tetrachloroethane	ND - 1	NA	0/8
1,1,2-Trichloroethane	ND - 0.83	NA	0/8
1,1-Dichloroethane	ND - 0.62	NA	0/8
1,1-Dichloroethene	ND - 0.6	NA	0/8
1,2,4-Trichlorobenzene	ND - 1.1	NA	0/8
1,2,4-Trimethylbenzene	0.75 - 16	NA	0/8
1,2-Dibromoethane	ND - 1.2	NA	0/8
1,2-Dichlorobenzene	ND - 0.92	NA	0/8
1,2-Dichloroethane	ND - 0.62	NA	0/8
1,2-Dichloropropane	ND - 0.7	NA	0/8
1,2-Dichlorotetrafluoroethane	ND - 1.1	NA	0/8
1,3,5-Trimethylbenzene	ND - 9.9	NA	0/8
1,3-Butadiene	ND - 0.34	NA	0/8
1,3-Dichlorobenzene	ND - 0.92	NA	0/8
1,4-Dichlorobenzene	ND - 0.92	NA	0/8
1,4-Dioxane	ND - 1.1	NA	0/8
2,2,4-Trimethylpentane	0.71 - 100	NA	0/8
2-Butanone	ND - 31	NA	0/8
2-Hexanone	ND - 1.2	NA	0/8
4-Ethyltoluene	ND - 10	NA	0/8
4-Methyl-2-pentanone	ND - 13	NA	0/8
Acetone	ND - 91	NA	0/8
Allyl chloride	ND - 0.48	NA	0/8
Benzene	1.1 - 28	NA	0/8

Table 6 – Range of VOCs in Indoor (Ambient) Air

Detected Constituents	Concentration Range Detected (ug/m^3) Low - High	Indoor Air Guideline Value (ug/m^3)	Frequency Exceeding Standard/Total # of Samples
Benzyl chloride	ND - 0.88	NA	0/8
Bromodichloromethane	ND - 1	NA	0/8
Bromoethene	ND - 0.67	NA	0/8
Bromoform	ND - 1.6	NA	0/8
Bromomethane	ND - 0.59	NA	0/8
Carbon disulfide	ND - 0.47	NA	0/8
Carbon tetrachloride	0.26 - 0.83	NA	0/8
Chlorobenzene	ND - 0.7	NA	0/8
Chloroethane	ND - 0.4	NA	0/8
Chloroform	ND - 0.74	NA	0/8
Chloromethane	ND - 1.4	NA	0/8
cis-1,2-Dichloroethene	ND - 0.6	NA	0/8
cis-1,3-Dichloropropene	ND - 0.69	NA	0/8
Cyclohexane	ND - 10	NA	0/8
Dibromochloromethane	ND - 1.3	NA	0/8
Dichlorodifluoromethane	ND - 3.9	NA	0/8
Ethyl acetate	ND - 0.92	NA	0/8
Ethylbenzene	0.66 - 17	NA	0/8
Hexachlorobutadiene	ND - 1.6	NA	0/8
Isopropanol	ND - 170	NA	0/8
m,p-Xylene	1.3 - 57	NA	0/8
Methyl tert-butyl ether	ND - 0.55	NA	0/8
Methylene chloride	ND - 35	60	0/8
n-Heptane	ND - 23	NA	0/8
n-Hexane	ND - 32	NA	0/8
o-Xylene	0.66 - 20	NA	0/8

Table 6 – Range of VOCs in Indoor (Ambient) Air

Detected Constituents	Concentration Range Detected (ug/m^3) Low - High	Indoor Air Guideline Value (ug/m^3)	Frequency Exceeding Standard/Total # of Samples
Propylene	ND - 0.26	NA	0/8
Styrene	ND - 1.2	NA	0/8
Tetrahydrofuran	ND - 0.45	NA	0/8
Toluene	3.8 - 620	NA	0/8
trans-1,2-Dichloroethene	ND - 0.6	NA	0/8
trans-1,3-Dichloropropene	ND - 0.69	NA	0/8
Trichloroethene	0.49 - 3.8	5	0/8
Trichlorofluoromethane	1.5 - 28	NA	0/8
Trichlorotrifluoromethane	ND - 1.2	NA	0/8
Vinyl acetate	ND - 0.54	NA	0/8
Vinyl chloride	ND - 0.1	NA	0/8

Criteria: NYS Dept. of Health indoor air guideline values. Applies to indoor/ambient air samples only.

ND - not detected. NA - not available.

*Chemicals used indoors at this location assumed to have contributed to indoor air result.

Table 7 – Range of VOCs in Groundwater

Detected Constituents	Concentration Range Detected (ug/L) Low - High	Standard or Criteria (ug/L)	Frequency Exceeding Standard/Total # of Samples
Trichloroethene	ND - 2500	5	65/124
cis-1,2-Dichloroethene	ND - 110	5	20/124
Tetrachloroethene	ND - 39	5	15/124
1,1,1-Trichloroethane	ND - 57	5	13/124
1,1,2-Trichloroethane	ND - 2.9	1	7/124
1,1-Dichloroethene	ND - 42	5	6/124
1,1-Dichloroethane	ND - 8.8	5	5/124
Acetone	ND - 160	50	4/124
Benzene	ND - 1.9	1	2/124
Methyl tert-butyl ether	ND - 23	10	2/124
1,2,3-Trichloropropane	ND - 21	0.04	1/124
1,1,1,2-Tetrachloroethane	ND - 0.57	5	0/124
2-Butanone	ND - 11	50	0/124
Carbon disulfide	ND - 4.1	60	0/124
Chloroform	ND - 0.89	7	0/124
Chloromethane	ND - 1.1	5	0/124
Methylene chloride	ND - 1.5	5	0/124
Naphthalene	ND - 1.2	10	0/124
Toluene	ND - 1.2	5	0/124
Xylene (Total)	ND - 0.51	5	0/124
Criteria: Part 703: Surface Water and Groundwater Quality Standards (Class GA). ND - not detected.			

Table 8 – Range of SVOCs in Groundwater

Detected Constituents	Concentration Range Detected (ug/L) Low - High	Standard or Criteria (ug/L)	Frequency Exceeding Standard/Total # of Samples
Bis(2-ethylhexyl)phthalate	ND - 3	5	0/6
Di-n-butylphthalate	ND - 2.4	50	0/6
Criteria: Part 703: Surface Water and Groundwater Quality Standards (Class GA). ND - not detected.			

Table 9 – Summary of Qualitative Human Health Exposure Assessment

Environmental Media & Exposure Route	Human Exposure Assessment
Direct contact with surface soils (and incidental ingestion)	No surface soil contamination has been identified.
Direct contact with subsurface soils (and incidental ingestion)	People are not coming into contact because contaminated subsurface soils are covered with pavement and building foundations and contaminated soil is at least 10 ft bgs. People can come into contact if they complete ground-intrusive work or utility work at the site that requires excavation to 10 ft bgs.
Ingestion of groundwater	Contaminated groundwater is not being used for drinking water, as the area is served by the public water supply. There are no known potable or irrigation water supply wells in the area of groundwater contamination. Groundwater use at the site has already been deed restricted so private wells would not be installed on the property.
Direct contact with groundwater	Groundwater is greater than 50 feet bgs, so direct contact during ground-intrusive work is unlikely.
Inhalation of air (exposures related to soil vapor intrusion)	Exposures to contaminated soil vapor may occur if soil vapor migrates through cracks or other openings in the building floor or foundation. A soil vapor intrusion evaluation was conducted as part of the RI. Concentrations of PCE, TCE, and methylene chloride were below the applicable NYSDOH air guideline values in indoor air samples with the exception of one location where PCE had been used indoors. Periodic monitoring of indoor air quality should be conducted to make certain air guideline value concentrations are not exceeded or mitigation systems should be installed.

Table 10 – General Response Actions

General Response Actions	Media	Area /Volume		Identified Use of Area	Presumptive Remedy
No Action - included as a basis for comparison with the active soil remediation technologies. If no action is taken, the contaminants will remain in place and the RAOs will not be met.	Soil	3,144 square feet / 3,550 cubic yards		Commercial/ Industrial	No
Institutional Controls - Restricting the site to commercial use through institutional controls (deed restrictions, environmental easements) would likely not interfere with current site operations (zoned for industrial use) and would reduce the volume of soil requiring active remediation. However, because some contaminants were detected at concentrations greater than the commercial use SCOs, additional response action(s) will need to be employed in conjunction with institutional controls.	Soil	3,144 square feet / 3,550 cubic yards		Commercial/ Industrial	No
Containment – The in-place containment of contaminated soils may be accomplished through capping. The contaminated soil area is already capped by buildings, concrete and asphalt pavement. The cap prevents direct contact with impacted soils; however, it does not eliminate sources of groundwater contamination or address soil vapor intrusion.	Soil	3,144 square feet / 3,550 cubic yards		Commercial/ Industrial	No
Removal – Excavation and off-site disposal will permanently remove soil contaminants from the site. Soil excavation may be accomplished using conventional earthmoving equipment. Disposal options for excavated soils include disposal to an off-site landfill or treatment facility.	Soil	2,144 square feet / 2,665 cubic yards		Commercial/ Industrial	**Yes**
Treatment – Treatment of contaminants can be achieved either in-situ or ex-situ and includes several type of technologies that encompass biological, thermal, physical, and chemical treatment approaches.	Soil	3,144 square feet / 3,550 cubic yards		Commercial/ Industrial	**Yes (for thermal and physical only)**
		Shallow	Deep		
No Action – The no action option is included as a basis for comparison with the active groundwater remediation technologies.	Ground water	50,400 square feet/3.6 x 10^6 gallons	36,500 square feet /2.6 x 10^6 gallons	Commercial/ Industrial	No
Institutional Controls – Effective in insuring that on-site contaminated groundwater continues to not be used for a potable or process water uses. Groundwater use at the site has *already* been restricted through deed restrictions for both properties.	Ground water	50,400 square feet/3.6 x 10^6 gallons	36,500 square feet /2.6 x 10^6 gallons	Commercial/ Industrial	No
Containment – The contaminated groundwater area is already capped by buildings and pavement. Existing stormwater drywells currently provide a pathway of contaminant migration to groundwater so the cap is ineffective as a method of minimizing infiltration.	Ground water	50,400 square feet/3.6 x 10^6 gallons	36,500 square feet /2.6 x 10^6 gallons	Commercial/ Industrial	No

Table 10 – General Response Actions

General Response Actions	Media	Area /Volume		Identified Use of Area	Presumptive Remedy
Collection/Treatment/Disposal – Collection is an effective technology for hydraulic control and/or removal of groundwater contamination. Various technologies are available for treating organic contaminants in collected groundwater. On-site and off-site treatment/disposal options are available for the collected groundwater.	Ground water	50,400 square feet/3.6 x 10^6 gallons	36,500 square feet /2.6 x 10^6 gallons	Commercial/ Industrial	**Yes**
In-situ Treatment – Several types of technologies may be applicable for the in-situ treatment of groundwater, and include including biological, physical and chemical treatment.	Ground water	50,400 square feet/3.6 x 10^6 gallons	36,500 square feet /2.6 x 10^6 gallons	Commercial/ Industrial	**Yes (for thermal and physical only)**

Table 11 – Identification and Screening of Technologies – Soil

	Presumptive Remedy	Established Technology	Complexity	Overall Cost and Performance: O&M	Capital	Reliability/ Maintainability	Cost	Time	Availability	Treatment Effectiveness: VOCs	Product (NAPL)	CVOCs	SVOCs	Inorganics	Implementable at Site	Retained for Alternative Evaluation	Reason(s)
Containment																	
Capping System	No	Yes	Low	Medium	High	High	Low		High	Effective	Effective	Effective	Effective	Effective	Yes	**YES**	Most of the site is already capped with buildings, concrete and asphalt pavement. Capping does not lessen toxicity, mobility, or volume of hazardous wastes and does not meet the RAOs. However, capping has been retained and will be evaluated further in conjunction with other technologies.
Cap Enhancements/ Alternatives	No	Yes	Low-Medium	Medium-High	High	High	Low	Low but long-term inspection & maintenance	High	Effective	Effective	Effective	Effective	Effective	No	No	
In-Situ Biological Treatment																	
Bioventing	No	Yes	Low	Low	Low	High	Low	Medium	High	Effective	Limited	Limited	Limited	Not Effective	Yes	No	Biological treatment is less proven than other technologies for CVOCs. Data indicate the absence of natural biodegradation on site. *Bioremediation is a Presumptive Remedy only for petroleum hydrocarbons.
Enhanced Bioremediation	Yes*	Yes	Low	High	Medium	Medium	Low	Medium	High	Effective	Limited	Effective	Limited	Not Effective	Yes	No	
Phytoremediation	No	Yes	Low	Low	Low	Low	Low	High	Medium	Limited	Not Effective	Limited	Limited	Limited	No	No	
In-Situ Physical/Chemical Treatment																	SVE effectively treats soils in place at a relatively low cost. SVE physically removes contaminants from unsaturated zone soils by inducing air flow through the soil matrix, stripping VOCs from the soil and carrying them to extraction points. SVE is not effective for pesticide or PCB contamination. ISCO is a viable remediation technology for mass reduction of organic contaminants in source areas, has a relatively rapid treatment time, and can be implemented with readily available equipment. However, limitations include requirements to handle and administer large quantities of hazardous oxidizing chemicals and naturally occurring organic material in the formation can consume large quantities of oxidant. ISCO is not retained for soil because most of the contamination is in the unsaturated zone and the presence of a relatively thick silty clay layer within the source area.
Chemical Oxidation (ISCO)	No	Yes	Medium	Low	Medium	Medium	Medium	Low	High	Effective	Limited	Effective	Limited	Limited	Yes	No	
Electrokinetic Separation	No	Yes	High	High	Medium	Medium	High	Medium	Medium	Limited	Not Effective	Limited	Limited	Effective	No	No	
Fracturing	No	Yes	Medium	Medium	Low	Medium	Medium	Medium	High	Limited	Not Effective	Limited	Limited	Not Effective	No	No	
Soil Flushing	No	Yes	High	Low	Medium	Medium	Medium	Medium	High	Effective	Effective	Effective	Limited	Effective	No	No	
Soil Vapor Extraction	Yes	Yes	Medium	High	Medium	High	Low	Medium	High	Effective	Limited	Effective	Limited	Not Effective	Yes	**YES**	
Solidification/ Stabilization	No	Yes	High	Medium	Low-High	High	Low-High	Low	High	Limited	Not Effective	Limited	Limited	Effective	No	No	
In-Situ Thermal Treatment																	
ISTT	No	Yes	High	High	High	High	Medium	Low	Medium	Effective	Limited	Effective	Effective	Not Effective	Yes	**YES**	ISTD is a quick, effective remedy for the removal of CVOCs, pesticides and PCBs, and works in a wide range of soil types including silty clay. ISTD has been retained for evaluation.
Ex-Situ Biological Treatment (assuming removal by excavation)																	Implementation of ex situ technologies requires a portion of the site to be dedicated for a moderate to long-term timeframe to the treatment and monitoring of excavated soils. Based on the commercial use of the site, small size (3.36 acres including buildings), and very limited exterior area available, ex situ technologies do not appear to be compatible for the site. Therefore, ex situ technologies have been screen out and will not be evaluated further.
Biopiles	No	Yes	Low	Low	Low	High	Low	Medium-High	High	Effective	Limited	Effective	Limited	Limited	No	No	
Composting	No	Yes	Low	Low	Low	Medium	Low	Medium-High	High	Limited	Limited	Limited	Limited	Not Effective	No	No	
Landfarming	No	Yes	Low	Low-Medium	Low	High	Low	Medium-High	High	Limited	Limited	Limited	Effective	Not Effective	No	No	
Slurry Phase Biological Treatment	No	Yes	High	High	High	Medium	Medium	Medium	High	Limited	Limited	Effective	Effective	Limited	No	No	

Table 11 – Identification and Screening of Technologies – Soil (continued)

	Presumptive Remedy	Established Technology	Complexity	Overall Cost and Performance					Availability	Treatment Effectiveness					Implementable at Site	Retained for Alternative Evaluation	Reason(s)
				O&M	Capital	Reliability/ Maintainability	Cost	Time		VOCs	Product (NAPL)	CVOCs	SVOCs	Inorganics			
Ex-Situ Physical/Chemical Treatment (assuming excavation and/or treatment)																	Implementation of ex situ technologies requires a portion of the site to be dedicated for a moderate to long-term timeframe to the treatment and monitoring of excavated soils. Based on the commercial use of the site, small size (3.36 acres including buildings), and very limited exterior area available, ex situ technologies do not appear to be compatible for the site. Therefore, ex situ technologies have been screen out and will not be evaluated further.
Chemical Extraction	No	Yes	High	High	High	Medium	Medium	Medium	High	Limited	Limited	Limited	Effective	Effective	No	No	
Chemical Reduction /Oxidation	No	Yes	Medium	Medium	High	High	Medium	Low	High	Limited	Limited	Limited	Limited	Effective	No	No	
Adsorption (GAC)/Vinyl Chloride Control	No	Yes	Low	Medium-High	Medium	High	Low-Medium	Medium-High	High	Effective	Not Effective	Effective	Effective	Limited	No	No	
Dehalogenation	No	Yes	Medium	High	High	Low	High	Medium	Medium	Limited	Not Effective	Effective	Limited	Not Effective	No	No	
Separation	No	Yes	Medium	High	Medium	High	Medium	Low	High	Limited	Limited	Limited	Limited	Limited	No	No	
Soil Washing	No	Yes	High	High	High	High	Medium	Low	High	Limited	Limited	Limited	Limited	Limited	No	No	
Solidification/Stabilization	No	Yes	High	Medium	High	High	Low-High	Low	High	Limited	Not Effective	Limited	Limited	Effective	No	No	
Ex-Situ Thermal Treatment (assuming removal by excavation)																	Implementation of ex situ technologies requires a portion of the site to be dedicated for a moderate to long-term timeframe to the treatment and monitoring of excavated soils. Based on the commercial use of the site, small size (3.36 acres including buildings), and very limited exterior area available, ex situ technologies do not appear to be compatible for the site. Therefore, on-site ex situ technologies have been screened out and will not be evaluated further.
Hot Gas Decontamination	No	No	Low	High	High	High	Low	Low	Medium	Not Demonstrated	Not Effective	Not Demonstrated	Not Demonstrated	Not Demonstrated	No	No	
Incineration	Yes	Yes	Low	N/A	High	Medium	High	Low	High	Effective	Limited	Effective	Effective	Not Effective	No	No	
Pyrolysis	No	Yes	Medium	High	High	Low	High	Low	High	Limited	Not Effective	Limited	Effective	Not Effective	No	No	
Thermal Desorption	Yes	Yes	Medium-High	Medium-High	High	Medium	Medium-High	Low	High	Effective	Limited	Effective	Limited	Not Effective	No	No	
Removal/Excavation, Off-Site Disposal	Yes	Yes	Low	Low	Low-Medium	High	Medium	Low	High	Effective	Effective	Effective	Effective	Effective	Yes	**YES**	This alternative involves removing all or a significant portion of the contaminated soil and disposing of in a permitted landfill. It meets the RAOs and is often a fast and cost-effective remedy.

O&M – relative overall cost and performance of operation and maintenance. Capital – relative overall cost and performance of capital investment. Adapted from Federal Remediation Technologies Roundtable Technology Screening Matrix, 2007. www.frtr.gov.

Table 12 – Identification and Screening of Technologies – Groundwater

	Presumptive Remedy	Established Technology	Complexity	Overall Cost and Performance: O&M	Overall Cost and Performance: Capital	Overall Cost and Performance: Reliability/ Maintain-ability	Overall Cost and Performance: Cost	Overall Cost and Performance: Time	Availability	Treatment Effectiveness: VOCs	Treatment Effectiveness: CVOCs	Treatment Effectiveness: SVOCs	Treatment Effectiveness: Inorganics	Implementable at Site	Retained for Alternative Evaluation	Reason(s)
Containment																
Physical Barriers	No	Yes	Low	Medium	High	High	Medium-High	Medium-High	High	Effective	Effective	Effective	Effective	No	No	Groundwater contamination is too deep for the use of physical barriers. Deep well injection can't be used because of the sole source aquifer designation on Long Island.
In-Situ Biological Treatment																
Enhanced Bioremediation	*Yes	Yes	Low-Medium	Medium-High	Medium	Medium	Low	Medium-High	High	Effective	Limited	Limited	Limited	Yes	No	Biological treatment is less proven than other technologies for CVOCs. Bioremediation is a Presumptive Remedy only for petroleum hydrocarbons. Evidence of natural subsurface processes that reduce contamination is lacking at the site, thus Monitored Natural Attenuation is not retained. However, Long Term Monitoring will be utilized in conjunction with other technologies. Phytoremediation is not effective for VOC treatment and is not implementable at the site.
Monitored Natural Attenuation/ LTM	No	Yes	Low	High	Medium	Medium	Low	Medium-High	High	Effective	Limited	Limited	Limited	Yes	**YES** (LTM only)	
Phytoremediation	No	Yes	Low	Low	Low	Low	Low	High	Medium	Limited	Limited	Limited	Limited	No	No	
In-Situ Physical/Chemical Treatment																
Air Sparging	Yes	Yes	Low	Low	Low-Medium	High	Low	Low-Medium	High	Effective	Effective	Limited	Not Effective	Yes	**YES**	Air sparging and ISCO are both presumptive remedies that are very effective for the treatment of VOCs in groundwater.
Chemical Oxidation (ISCO)	Yes	Yes	Low	High	Medium	Medium	Medium	Low	High	Effective	Effective	Limited	Limited	Yes	**YES**	
Directional Wells (enhancement)	No	Yes	Low-Medium	Medium	High	Medium	Medium	Medium	Medium	Limited	Limited	Limited	Limited	Yes	No	Directional wells are not applicable as the contamination is mainly exterior to the buildings.
Thermal Treatment	No	Yes	High	High	High	Medium	Medium	Low-Medium	Medium	Effective	Effective	Effective	Not Effective	Yes	No	Thermal treatment is not appropriate given the highly developed nature of the area, its size and contaminants of concern constituting the plume, and that the presence of DNAPL has not been identified to date.
In-Well Air Stripping	Yes	Yes	Medium	Medium	High	Medium	Medium	High	Low	Effective	Effective	Limited	Not Effective	Yes	No	In-well air stripping is a group of proprietary technologies that limits competitive bidding. It is also more costly than equally effective technologies.
Passive/Reactive Treatment Walls	No	Yes	Low	Medium	High	Medium-High	Medium-High	Medium-High	Medium	Effective	Effective	Effective	Limited	No	No	Groundwater contamination is too deep for the use of passive or reactive treatment walls.
Ex-Situ Biological Treatment																
Bioreactors	No	Yes	Low-Medium	Medium	High	Medium	Low	Medium	High	Effective	Effective	Limited	Not Effective	No	No	The small size of the site limits implementation of ex situ technologies that requires a portion of the site to be dedicated for a moderate to long-term timeframe to treatment.
Constructed Wetlands	No	Yes	Low-Medium	Medium	High	Medium-High	Medium	Medium	Medium	Limited	Limited	Limited	Effective	No	No	

Table 12 – Identification and Screening of Technologies – Groundwater (continued)

	Presumptive Remedy	Established Technology	Complexity	Overall Cost and Performance					Availability	Treatment Effectiveness				Implementable at Site	Retained for Alternative Evaluation	Reason(s)
				O&M	Capital	Reliability/ Maintain-ability	Cost	Time		VOCs	CVOCs	SVOCs	Inorganics			
Ex-Situ Physical/Chemical Treatment (assuming groundwater extraction)																
Granulated Activated Carbon (GAC)	Yes	Yes	Low	Medium-High	Medium	High	Low-Medium	Medium-High	High	Effective	Effective	Effective	Limited	Yes		GAC and air stripping are technologies that are used as part of a pump and treat system. Together these are retained for further analysis. Advanced oxidation processes such as ultraviolet light have high energy requirements and are more costly relative to other equally effective technologies. Ion exchange and precipitation/coagulation/ flocculation are not effective for VOC contamination. *GAC is a form of separation that has been retained for further analysis. Sprinkler irrigation requires vegetated open land and is therefore not applicable.
Air Stripping	Yes	Yes	Medium	Medium-High	Medium	High	Low	High	High	Effective	Effective	Not Effective	Not Effective	Yes	**YES**	
Groundwater Pumping/Pump & Treat	Yes	Yes	Medium-High	High	Medium-High	High	Medium-High	Medium-High	High	Effective	Effective	Limited	Effective	Yes		
Advanced Oxidation Processes	No	Yes	Medium	High	High	Medium	High	Low-Medium	High	Effective	Effective	Effective	Limited	Yes	No	
Discharge/Disposal																
Disposal of treated groundwater to surface water, sanitary sewer or POTW	NA	Yes	Low	Low	Low	High	Low-High	NA	High	Effective	Effective	Effective	Effective	Yes	**YES**	In conjunction with other treatment technologies.

O&M – relative overall cost and performance of operation and maintenance. Capital – relative overall cost and performance of capital investment. Adapted from Federal Remediation Technologies Roundtable Technology Screening Matrix, 2007. www.frtr.gov.

Table 13 – Evaluation of Soil and Soil Vapor Alternatives

Alt. No.	Alternative Name	Overall Protection of Public Health and the Environment	Compliance with SCGs	Long Term Effectiveness and Permanence	Reduction of Toxicity, mobility or Volume of Contamination thru Treatment	Short Term Impact and Effectiveness	Implementability	Cost Effectiveness		Land Use Criteria
S1	**No Action**	- Will not meet any of the RAOs for the site.	- Will not comply with SCGs.	- Contaminants remain in the environment and may transform into other compounds. - Magnitude of remaining risks will be unchanged.	- Does not reduce toxicity, mobility or volume of contamination present in the site soils.	- Does not result in disruption of site operations or pose a short term threat to public health or the environment. - No remedial timeframe is associated with this alternative.	- No technical or administrative difficulties or constraints.	Capital Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost: Average Annual Site Management Cost:	$0 $0 $0 $0 $0	- Will not comply with SCGs. Not sufficient for the current, intended and reasonably anticipated future use of the site which is commercial.
S2	**SSDS for vapor intrusion mitigation;** **Excavation and Off-Site Disposal of Pesticide/PCB soil contamination area; and** **SVE System for VOC contaminated soil area**	- Mitigates the potential for inhalation of volatilized contaminants for site workers and visitors. - Eliminates contact with pesticide and PCB-contaminated soil. - Reduces and eventually eliminates concentrations of VOCs in soil which further reduces groundwater impacts.	-Indoor air concentrations of TCE and PCE will comply with air guideline values. - URU and POGW SCOs for pesticides and PCBs will be achieved through excavation and off-site disposal. - URU and POGW SCOs for VOCs will eventually be achieved through SVE remediation.	- SSDS system will remain in operation as long as VOC concentrations in soil exceed the URU SCOs. - Excavation will permanently remove pesticide and PCB contaminants at the site. - SVE will permanently reduce VOC contaminants at the site.	-SSDS does not reduce toxicity or volume of contaminated soil vapor. It will prevent movement into the on-site buildings. - The volume of pesticide and PCB-contaminated soil is removed. - SVE will reduce the volume of VOCs in soil by transferring contaminants to the vapor phase and treating.	- Temporary disruption to current site operations during limited excavation and SVE system construction. - Will generate noise and traffic during construction. - Dust control measures will need to be implemented. - Remedial timeframe – 5 years.	-SSDS systems can be designed for this type of structure. - Limited excavation is not constrained by building foundations. - Existing building and pavement cap should increase the effectiveness of the SVE system.	Capital Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost: Average Annual Site Management Cost:	$1,084,000 $874,000 $77,000 $2,035,000 $220,000	- Will comply with applicable SCGs and will prevent vapor intrusion into on-site structures. Sufficient for the current, intended and reasonably anticipated future use of the site which is commercial.

Table 13 – Evaluation of Soil and Soil Vapor Alternatives

Alt. No.	Alternative Name	Overall Protection of Public Health and the Environment	Compliance with SCGs	Long Term Effectiveness and Permanence	Reduction of Toxicity, mobility or Volume of Contamination thru Treatment	Short Term Impact and Effectiveness	Implementability	Cost Effectiveness		Land Use Criteria
S3	**SSDS for vapor intrusion mitigation; and** **In-Situ Thermal Treatment for VOC contaminated soil area**	- Mitigates the potential for inhalation of volatilized contaminants for site workers and visitors. - Eliminates concentrations of VOCs in soil which further reduces groundwater impacts.	-Indoor air concentrations of TCE and PCE will comply with air guideline values. - POGW SCOs for pesticides and PCBs are not exceeded. - URU and POGW SCOs for VOCs will be achieved through ISTT remediation.	- SSDS system will remain in operation as long as VOC concentrations in soil exceed the URU SCOs. - ISTT will permanently remove VOC contaminants at the site.	-SSDS does not reduce toxicity or volume of contaminated soil vapor. It will prevent movement into the on-site buildings. - ISTT will remove the volume of VOCs in soil by hastening the transferring of contaminants to the vapor phase and treating.	- Temporary disruption to current site operations during ISTT system construction. - Will generate noise and traffic during construction. - Dust control measures will need to be implemented. - Remedial timeframe less than 6 months.	-SSDS systems can be designed for this type of structure. - Existing building and pavement cap should increase the effectiveness of the SVE component of the ISTT system.	Capital Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost: Average Annual Site Management Cost:	$1,537,000 $508,000 $16,000 $2,061,000 $35,000	- Will comply with applicable SCGs for VOCs and will prevent vapor intrusion into on-site structures. Sufficient for the current, intended and reasonably anticipated future use of the site which is commercial.
S4	**SSDS for vapor intrusion mitigation;** **Excavation and Off-Site Disposal of Pesticide/PCB and VOC soil contamination areas; and** **Use of Existing Building Foundation as Cap over Remaining VOC soil contamination area.**	- Mitigates the potential for inhalation of volatilized contaminants for site workers and visitors. - Eliminates contact with pesticide, PCB and VOC-contaminated soil as a result of the combination of excavation and a cap. - Prevents liquid infiltration through the contaminated soils and eliminates the transport mechanism for contaminant migration to groundwater	-Indoor air concentrations of TCE and PCE will comply with air guideline values. - URU and POGW SCOs for pesticides and PCBs will be achieved through excavation and off-site disposal. - Commercial SCOs for VOCs will be achieved through excavation and off-site disposal.	- SSDS system will remain in operation as long as VOC concentrations in soil exceed the URU SCOs. - Excavation will permanently remove pesticide and PCB contaminants at the site. - Excavation will permanently remove VOC contaminants exceeding commercial SCOs at the site. - The cap will function as long as the building foundation remains sound and unaltered.	-SSDS does not reduce toxicity or volume of contaminated soil vapor. It will prevent movement into the on-site buildings. - The volume of pesticide and PCB-contaminated soil is removed. - The volume of VOC contaminated soil is reduced. - The existing building foundation cap will prevent stormwater infiltration at the area with remaining VOCs which will reduce the mobility of the contaminants.	- Will cause significant temporary disruption to the current site operations. - Will generate considerable noise and traffic during construction. - Dust control, health and safety, and traffic control measures will need to be implemented. - Remedial timeframe less than 6 months.	- Specialized engineering needed for excavations proximate to foundation. - Demolition of large pavement areas and underground drainage systems required.	Capital Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost: Average Annual Site Management Cost:	$2,261,000 $508,000 $24,000 $2,793,000 $35,000	- Will comply with applicable SCGs and will prevent vapor intrusion into on-site structures. Sufficient for the current, intended and reasonably anticipated future use of the site which is commercial.

Table 14 – Evaluation of Groundwater Alternatives

Alt. No.	Alternative Name	Overall Protectiveness of Public Health and the Environment	Compliance with SCGs	Long Term Effectiveness and Permanence	Reduction of Toxicity, mobility or Volume of Contamination Thru Treatment	Short Term Impact and Effectiveness	Implementability	Cost Effectiveness		Land Use Criteria
G1	**No Action**	- Will not meet any of the RAOs for the site.	- Will not meet SCGs.	- Contaminants remain in the environment. - Magnitude of remaining risks will be unchanged.	- Does not reduce toxicity, mobility or volume of contamination present at the site.	- Does not result in disruption of site operations or pose a short term threat to public health or the environment. - No remedial timeframe is associated with this alternative.	- No technical or administrative difficulties or constraints.	Capital Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost: Average Annual Site Management Cost:	$0 $0 $0 $0 $0	- Will not comply with SCGs. Not sufficient for the current, intended and reasonably anticipated future use of the site which is commercial.
G2	**In-Situ Chemical Oxidation** **Long Term Monitoring**	- Will result in a reduction of VOC concentrations in a sole-source aquifer.	- Will result in a reduction of VOC concentrations achieving the groundwater SCGs within the treatment area. - Upgradient sources of TCE at concentrations that contravene the SCGs may make it impractical to achieve the SCGs on-site.	- Permanent reduction of groundwater contaminants from active groundwater remediation. - May require multiple injections to achieve long term effectiveness.	- Will reduce the volume of VOCs in groundwater on-site. - Active treatment at the source area and site boundary will reduce the volume of contaminated groundwater migrating off-site.	- Temporary disruption of current site operations. - Will generate noise and traffic during construction. - Dust control and health and safety plan measures will be needed. - Remedial timeframe – 5 years.	- Installation is similar to monitoring wells. - Minimal technical or administrative difficulties or constraints. - Concerns with transport, storage and handling the oxidizing agent in the field	Capital Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost: Average Annual Site Management Cost:	$8,286,000 $858,000 $2,000,000 $11,144,000 $661,000	- Will comply with applicable SCGs. Sufficient for the current, intended and reasonably anticipated future use of the site which is commercial.
G3	**Air Sparging with SVE** **Long Term Monitoring**	- Will result in a reduction of VOC concentrations in a sole source aquifer.	- Will result in a reduction of VOC concentrations achieving the groundwater SCGs within the treatment area. - Upgradient sources of TCE at concentrations that contravene the SCGs may make it impractical to achieve the SCGs on-site.	- Permanent reduction of groundwater contaminants from active groundwater remediation.	- Will reduce the volume of VOCs in groundwater at the site. - Active treatment at the source area and site boundary will reduce the volume of contaminated groundwater migrating off-site.	- Can be implemented with temporary disruption of current site operations during construction of the AS/SVE system. - Will generate noise and traffic during construction. - Dust control and health and safety plan measures will be needed. - Remedial timeframe – 11 years.	- Requires limited excavation for construction. - Minimal technical or administrative difficulties or constraints.	Capital Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost: Average Annual Site Management Cost:	$2,366,000 $3,329,000 $296,000 $5,991,000 $437,000	- Will comply with applicable SCGs. Sufficient for the current, intended and reasonably anticipated future use of the site which is commercial.

Table 14 – Evaluation of Groundwater Alternatives

Alt. No.	Alternative Name	Overall Protectiveness of Public Health and the Environment	Compliance with SCGs	Long Term Effectiveness and Permanence	Reduction of Toxicity, mobility or Volume of Contamination Thru Treatment	Short Term Impact and Effectiveness	Implementability	Cost Effectiveness		Land Use Criteria
G4	**Pump and Treat** **Long Term Monitoring**	- Will result in a reduction of VOC concentrations in a sole source aquifer.	- Will result in a reduction of VOC concentrations achieving the groundwater SCGs within the treatment area over the long term. - Upgradient sources of TCE at concentrations that contravene the SCGs may make it impractical to achieve the SCGs on-site.	- Permanent reduction of groundwater contaminants from active groundwater remediation.	- Will reduce the volume of VOCs in groundwater at the site. - Will establish hydraulic control of the aquifer to minimize off-site migration of the plume.	- Can be implemented with some temporary disruption of current site operations during construction of the pump and treat system. - Will generate minimal noise and traffic during construction. - Dust control and health and safety plan measures will be needed. - Remedial timeframe – 30 years.	- Requires limited excavation for construction. - Minimal technical or administrative difficulties or constraints.	Capital Cost: O&M Present Worth Cost: Periodic Present Worth Cost: Total Present Worth Cost: Average Annual Site Management Cost:	$3,301,000 $19,334,000 $208,000 $22,843,000 $1,258,000	- Will comply with applicable SCGs. Sufficient for the current, intended and reasonably anticipated future use of the site which is commercial.

Table 15 – Complementary Groundwater Alternatives for Soil Alternative S4 that Meet the 6 NYCRR Part 375-6.5 Criteria

	Environmental Easement for Groundwater Use Restriction	Alternative(s) that include Controls or Treatment to Address Off-Site Migration	Groundwater Quality Likely to Improve Over Time
Soil Alternative S4 (does not meet POGW SCOs for VOCs)			
VOC and Pesticide/PCB excavation, SSDS			
Groundwater			
G1 No Action	No*	No	No
G2 ISCO	Yes	Yes	Yes
G3 Air Sparging/SVE	Yes	Yes	Yes
G4 Pump & Treat	Yes	Yes	Yes

Abbreviations: VOC – volatile organic compounds; PCB – polychlorinated biphenyls; SVE – soil vapor extraction; SSDS – sub-slab depressurization system; ISCO – in-situ chemical oxidation; POGW – protection of groundwater; SCOs – soil cleanup objectives.

*Both 161 Bethpage-Sweethollow Road and 301 Winding Road currently have declarations of restrictive covenants that include prohibitions on the use of groundwater without treatment.

Table 16 - Cost Estimate for Alternative S2

Alternative S2

SSDS/Excavation of PCB/Pesticides Contaminated Soil/SVE

COST ESTIMATE SUMMARY

Site: Former Aluminum Louvre Site (#130195)
Location: Old Bethpage, Nassau County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2013
Date: January 24, 2013

Description: Alternative 2 consists of excavation of PCB/Pesticides contaminated soil, sub-slab depressurization system, and SVE for contaminated soil greater than unrestricted SCOs outside the building

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Sub-Slab Depressurization System Installation**					For both buildings
1.1	Connectivity Testing	1	LS	$ 10,000	$ 10,000	Pilot Study to optimize extraction points
1.2	Mobilization	1	LS	$ 10,000	$ 10,000	
1.3	Install Extraction Points	20	EA	$ 750	$ 15,000	Assume 10 points per building
1.4	Install Monitoring Points	20	EA	$ 500	$ 10,000	Assume 10 points per building
1.5	Transmission Piping	1,000	LF	$ 15	$ 15,000	Assume 500 LF per building
1.6	Fans/Blowers	6	EA	$ 250	$ 1,500	
1.7	Equipment Enclosures	6	EA	$ 250	$ 1,500	
1.8	Stacks	6	EA	$ 250	$ 1,500	
1.9	Power Service	1	LS	$ 7,500	$ 7,500	
1.10	Electrical Controls	1	LS	$ 7,500	$ 7,500	
1.11	System Installation	2	EA	$ 25,000	$ 50,000	
1.12	System Startup	1	LS	$ 10,000	$ 10,000	
1.13	Permits	1	LS	$ 10,000	$ 10,000	
1.14	Reporting, Documentation and Surveying	1	LS	$ 10,000	$ 10,000	
1.15	IDW	1	LS	$ 3,000	$ 3,000	
	Sub-Total				**$ 162,500**	
2	**PCB/Pesticides Excavation**					
2.1	Remedial Action Work Plan/Permitting	1	LS	$ 25,000	$ 25,000	RAWP, PAMP, CPP
2.2	Submittals/Implementation Plans	1	LS	$ 25,000	$ 25,000	QAPP, HASP, shop dwgs and work plans
2.3	PE Sealed Shoring Plan	1	LS	$ 25,000	$ 25,000	
2.4	Construction Equipment Mob/Demob	1	LS	$ 6,000	$ 6,000	
2.5	Decontamination Pad	1	LS	$ 5,000	$ 5,000	Portable decontamination pad/truck tire wash
2.6	Soil Erosion and Sedimentation Controls	1	LS	$ 1,000.00	$ 1,000	Erosion protection around all work areas/storm water inlet structures
2.7	Saw Cut Pavement	100	LF	$ 4.50	$ 450	
2.8	Excavation Shoring and Bracing	580	VSF	$ 20.00	$ 11,600	
2.9	Excavation	64	CY	$ 25.00	$ 1,600	Excavate impacted soil
2.10	Stockpile Area	1	LS	$ 500	$ 500	
2.11	Load out Area	1	LS	$ 1,000	$ 1,000	
2.12	Load out	64	CY	$ 20.00	$ 1,280	Loading of trucks for off-site disposal
2.13	Transportation & Disposal	112	Ton	$ 100.00	$ 11,200	Trucking and Landfill Tipping fees
2.14	Backfill	112	Ton	$ 28.00	$ 3,136	Importing, placement and compaction of clean fill
2.15	Compaction	225	SF	$ 3.50	$ 788	12" lifts, mechanical compaction
2.16	Surface Restoration	25	SY	$ 40.00	$ 1,000	Asphalt paving
2.17	Post Excavation Sampling	5	EA	$ 1,000.00	$ 5,000	PCBs/Pesticides, VOCs, SVOCs analysis
2.18	Backfill Source Sampling	1	EA	$ 1,500.00	$ 1,500	TAL/TCL analysis.
2.19	Waste Characterization Sampling	1	EA	$ 950.00	$ 950	TCLP/TAL/TCL Analysis
2.20	Perimeter Air monitoring	1	Week	$ 1,200.00	$ 1,200	Tripod station with Dust and PID monitors.
2.21	H&S Monitoring	1	Week	$ 300.00	$ 300	Meters for monitoring work zone.
2.22	PPE and Field Supplies	1	LS	$ 1,000.00	$ 1,000	Boots, glasses, hard hat, gloves, etc.
2.23	Post Construction Submittals/Report	1	LS	$ 25,000.00	$ 25,000	Manifests, asbuilts, warranties,
	Sub-Total				**$ 154,504**	
3	**SVE System**					
3.1	Pilot Test Work Plan	1	LS	$ 15,000	$ 15,000	
3.2	Pilot Test					
3.2.1	Mobilization/Demobilization	1	LS	$ 20,000	$ 20,000	
3.2.2	Installation of vapor extraction points	2	EA	$ 5,000	$ 10,000	2 Wells
3.2.3	Installation of performance monitoring points	4	EA	$ 5,000	$ 20,000	4 locations
3.2.4	Trailer with Blower and Treatment System Rental	1	LS	$ 8,000	$ 8,000	
3.2.5	Field Testing	1	LS	$ 15,000	$ 15,000	
3.2.6	Air Sampling	1	LS	$ 5,000	$ 5,000	
3.2.7	Data Reduction/Evaluation and Reporting	1	LS	$ 15,000	$ 15,000	
3.2.8	IDW (Soil Non-hazardous)	1	LS	$ 10,000	$ 10,000	
3.3	Remedial Action Work Plan/Permitting	1	LS	$ 20,000	$ 20,000	
3.4	Contractor Mobilization/Demobilization	1	LS	$ 30,000	$ 30,000	
3.5	Soil Vapor Extraction System					
3.5.1	Installation of vapor extraction points	7	EA	$ 5,000	$ 35,000	7 wells
3.5.2	Installation of performance monitoring points	6	EA	$ 5,000	$ 30,000	6 locations
3.5.3	Transmission piping and trenching	100	LF	$ 40.00	$ 4,000	
3.5.4	Treatment Building/Shed	1	LS	$ 15,000	$ 15,000	
3.5.5	Condensate Knockout Tank	1	LS	$ 3,000	$ 3,000	
3.5.6	Condensate Screw Pump	1	LS	$ 1,500	$ 1,500	
3.5.7	Liquid Vapor GAC Drums	1	LS	$ 1,000	$ 1,000	
3.5.8	Effluent Piping	1	LS	$ 1,500	$ 1,500	
3.5.9	Liquid Ring Pump	1	EA	$ 4,500	$ 4,500	
3.5.10	Vapor Phase GAC Vessels	2	EA	$ 10,000	$ 20,000	Two 2,000 lb GAC vessels
3.5.11	Organoclay Vessel	0	EA	$ 2,500	$ -	Vinyl chloride not a COC
3.5.12	Piping, instrumentation and valves	1	LS	$ 10,000	$ 10,000	
3.5.13	HVAC Systems	1	LS	$ 3,000	$ 3,000	
3.5.14	Electrical Control Panel and Wiring	1	LS	$ 3,500	$ 3,500	
3.5.15	Electrical Service Drop	1	LS	$ 3,000	$ 3,000	
3.5.16	System Assembly	1	LS	$ 50,000	$ 50,000	
3.5.17	Asphalt Surface Repair	30	SY	$ 40	$ 1,200	
3.5.18	IDW (Soil Non-hazardous)	1	LS	$ 5,000	$ 5,000	
3.5.19	Auto Dialer	1	LS	$ 5,000	$ 5,000	
3.5.20	System Startup	1	LS	$ 10,000	$ 10,000	
	Sub-Total				**$ 374,200**	
	Sub-Total				**$ 691,204**	Sub-Total All Construction Costs.
	Contingency	25%			$ 173,000	10% scope + 15% bid
	Sub-Total				**$ 864,204**	
	Project Management				$ 20,000	
	Remedial Design				$ 60,000	
	Construction Management				$ 30,000	
	Sub-Total				**$ 110,000**	
	TOTAL CAPITAL COST				**$ 1,084,000**	

HDR

Table 16 - Cost Estimate for Alternative S2

Alternative S2

SSDS/Excavation of PCB/Pesticides Contaminated Soil/SVE

COST ESTIMATE SUMMARY

Site: Former Aluminum Louvre Site (#130195)
Location: Old Bethpage, Nassau County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2013
Date: January 24, 2013

Description: Alternative 2 consists of excavation of PCB/Pesticides contaminated soil, sub-slab depressurization system, and SVE for contaminated soil greater than unrestricted SCOs outside the building

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
ANNUAL O&M COST:						
1	**Annual Operations and Sampling - SSDS**					
1.1	Yearly Inspection	1	EA	$ 2,000	$ 2,000	
1.2	Yearly Report	1	LS	$ 2,500	$ 2,500	
1.3	Yearly Sampling Event	1	LS	$ 3,000	$ 3,000	
1.4	Electrical Usage	30,000	Kw	$ 0.15	$ 4,500	
	Sub-Total				**$ 12,000**	
2	**Maintenance - SSDS**					
2.1	Maintennace	2	EA	$ 250	$ 500	SSDS - 2 systems
2.2	Misc. Repair and Maintenance	2	EA	$ 250	$ 500	
	Sub-Total				**$ 1,000**	
	Sub-Total				**$ 13,000**	
	Contingency	15%			$ 2,000	
	Sub-Total				**$ 15,000**	
	Project Management				$ 3,000	
	Technical Support				$ 3,000	
	TOTAL ANNUAL O&M COST - SSDS				**$ 21,000**	
3	**Annual Operations and Sampling - SVE System**					
3.1	Biweekly Inspection	26	EA	$ 1,000	$ 26,000	
3.2	Quarterly Air Sampling Event	8	EA	$ 1,500	$ 12,000	SVE system effluent, between GAC vessels
3.3	Yearly Report	1	LS	$ 10,000	$ 10,000	
3.4	Electrical Usage	60,000	Kw	$ 0.15	$ 9,000	SVE system
3.5	Vapor Carbon Change out	2,000	LB	$ 3.30	$ 6,600	change out lead vessels 1x per year
3.6	Liquid Carbon Change out	112	LB	$ 2.10	$ 235	Assume change out once every 2 years
	Sub-Total				**$ 63,835**	
4	**Maintenance - SVE System**					
4.1	Liquid Ring Pump	1	LS	$ 500	$ 500	
4.2	Screw Pump	1	LS	$ 100	$ 100	
	Sub-Total				**$ 600**	
	Sub-Total				**$ 64,435**	
	Contingency	15%			$ 10,000	
	Sub-Total				**$ 74,435**	
	Project Management				$ 5,000	
	Technical Support				$ 5,000	
	TOTAL ANNUAL O&M COST - SVE				**$ 84,500**	

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Five Year Demobilization**						
1.1	Abandon extraction and performance MWs	5	1	LS	$ 5,000	$ 5,000	
1.2	Abandon transmission piping	5	1	LS	$ 5,000	$ 5,000	
1.3	Demobilize Treatment System	5	1	LS	$ 10,000	$ 10,000	
	Sub-Total					**$ 20,000**	
2	**Confirmatory Samples**						
2.1	Driller	5	1	LS	$ 10,000	$ 10,000	5 borings
2.2	Soil Sample Analytical Results	5	1	LS	$ 15,000	$ 15,000	20 samples
2.3	Remedial Action Report	5	1	LS	$ 25,000	$ 25,000	
	Sub-Total					**$ 50,000**	
3	**Equipment Replacement SSDS**						
3.1	Fan Replacement	5	6	EA	$ 500	$ 3,000	Replace fans every 5 years for 30 years
	Sub-Total					**$ 3,000**	

PRESENT VALUE ANALYSIS: Rate of Return: 5% Inflation Rate 3%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0		**$ 1,084,000**	
2	**Annual O&M Cost**				
2.1	SSDS O&M	1-30	21,000	$474,200	
2.2	SVE O&M	1-5	84,500	$ 399,000	
	Sub-Total			**$ 874,000**	
3	**Periodic Costs**				
3.1	Year 5	5	73,000	$ 66,307	
3.2	Year 10	10	3,000	$ 2,475	
3.3	Year 15	15	3,000	$ 2,248	
3.4	Year 20	20	3,000	$ 2,042	
3.5	Year 25	25	3,000	$ 1,855	
3.6	Year 30	30	3,000	$ 1,685	
	Sub-Total			**$ 77,000**	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 2,035,000**	

Table 17 - Cost Estimate for Alternative S3

Alternative S3

SSDS/In-Situ Thermal Treatment

COST ESTIMATE SUMMARY

Site: Former Aluminum Louvre Site (#130195)
Location: Old Bethpage, Nassau County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2013
Date: January 24, 2013

Description: Alternative 3 consists of subslab depressurization system, and In-situ Thermal Treatment (ISTT) for soil contaminated with volatile organic compounds greater than unrestricted SCOs.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Sub-Slab Depressurization System Installation**					For both buildings
1.1	Connectivity Testing	1	LS	$ 10,000	$ 10,000	Pilot Study to optimize extraction points
1.2	Mobilization	1	LS	$ 10,000	$ 10,000	
1.3	Install Extraction Points	20	EA	$ 750	$ 15,000	Assume 10 points per building
1.4	Install Monitoring Points	20	EA	$ 500	$ 10,000	Assume 10 points per building
1.5	Transmission Piping	1,000	LF	$ 15.00	$ 15,000	Assume 500 LF per building
1.6	Fans/Blowers	6	EA	$ 250	$ 1,500	
1.7	Equipment Enclosures	6	EA	$ 250	$ 1,500	
1.8	Stacks	6	EA	$ 250	$ 1,500	
1.9	Power Service	1	LS	$ 7,500	$ 7,500	
1.10	Electrical Controls	1	LS	$ 7,500	$ 7,500	
1.11	System Installation	2	EA	$ 25,000	$ 50,000	
1.12	System Startup	1	LS	$ 10,000	$ 10,000	
1.13	Permits	1	LS	$ 10,000	$ 10,000	
1.14	Reporting, Documentation and Surveying	1	LS	$ 10,000	$ 10,000	
1.15	IDW	1	LS	$ 3,000	$ 3,000	
	Sub-Total				**$ 162,500**	
2	**In-Situ Thermal Treatment**					
2.1	Remedial Action Workplan/Permitting	1	LS	$ 20,000	$ 20,000	
2.2	Mobilization/Demobilization	1	LS	$ 20,000	$ 20,000	
2.3	Submittal/Implementation Plans	1	LS	$ 25,000	$ 25,000	
2.4	Drilling Mob/Demob	1	LS	$ 3,000	$ 3,000	
2.5	Drilling Heater Wells	46	EA	$ 2,000	$ 92,000	
2.6	Drilling Vacuum Wells	46	EA	$ 2,000	$ 92,000	
2.7	Drilling Termacouple Wells	35	EA	$ 1,200	$ 42,000	
2.8	Drill Cutting Disposal	1	LS	$ 10,000	$ 10,000	
2.9	Natural Gas Use and Connections	1	LS	$ 33,600	$ 33,600	
2.10	Concrete Vapor and Insulation Cover	1	EA	$ 22,500	$ 22,500	
2.11	Power Supply and Electricity at Site	1	LS	$ 66,224	$ 66,224	
2.12	SVE System	1	EA	$ 50,000	$ 50,000	
2.13	Water Treatment	1	EA	$ 6,500	$ 6,500	
2.14	System Installation	1	LS	$ 210,000	$ 210,000	
2.15	Startup and Operations	1	LS	$ 75,000	$ 75,000	
2.16	Reporting	1	LS	$ 15,000	$ 15,000	
2.17	Well Decommissioning	127	EA	$ 800	$ 101,600	
2.18	Driller	1	LS	$ 10,000	$ 10,000	5 borings
2.19	Soil Sample Analytical Results	1	LS	$ 15,000	$ 15,000	20 samples
2.20	Remedial Action Report	1	LS	$ 25,000	$ 25,000	
2.21	Site Restoration	2,900	SF	$ 12.00	$ 34,800	
	Sub-Total				**$ 969,224**	
3	**Institutional Controls**					
3.1	Institutional Control & Site Management Plan	1	LS	$ 10,000	$ 10,000	Environmental easement/deed restriction, legal fees.
	Sub-Total				**$ 10,000**	
	Sub-Total				**$ 1,141,724**	Sub-Total All Construction Costs.
	Contingency	25%			$ 285,000	10% scope + 15% bid
	Sub-Total				**$ 1,426,724**	
	Project Management				$ 20,000	
	Remedial Design				$ 60,000	
	Construction Management				$ 30,000	
	TOTAL CAPITAL COST				**$ 1,537,000**	

Table 17 - Cost Estimate for Alternative S3

Alternative S3

SSDS/In-Situ Thermal Treatment

COST ESTIMATE SUMMARY

Site: Former Aluminum Louvre Site (#130195)
Location: Old Bethpage, Nassau County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2013
Date: January 24, 2013

Description: Alternative 3 consists of subslab depressurization system, and In-situ Thermal Treatment (ISTT) for soil contaminated with volatile organic compounds greater than unrestricted SCOs.

Item No.		Description	Quantity	Unit	Unit Cost	Total	Notes
ANNUAL O&M COST:							
1		**Annual Operations and Sampling - SSDS**					
	1.1	Yearly Inspection	1	EA	$ 2,000	$ 2,000	
	1.2	Yearly Report	1	LS	$ 2,500	$ 2,500	
	1.3	Yearly Sampling Event	1	LS	$ 3,000	$ 3,000	
	1.4	Electrical Usage	30,000	Kw	$ 0.15	$ 4,500	
		Sub-Total				**$ 12,000**	
2		**Maintenance - SSDS**					
	2.1	Fan Maintennace	2	EA	$ 250	$ 500	SSDS - 2 systems
	2.2	Misc. Repair and Maintenance	2	EA	$ 250	$ 500	
		Sub-Total				**$ 1,000**	
3		**Site Management**					
	3.1	Maintain Institutional Controls	1	LS	$ 1,500	$ 1,500	
		Sub-Total				**$ 1,500**	
		Sub-Total				**$ 14,500**	
		Contingency	15%			$ 2,000	
		Sub-Total				**$ 16,500**	
		Project Management				$ 3,000	
		Technical Support				$ 3,000	
		TOTAL ANNUAL O&M COST				**$ 22,500**	

PERIODIC COSTS:

Item No.		Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1		**Equipment Replacement SSDS**						
	1.1	Fan Replacement	5	6	EA	$ 600	$ 3,600	Replace fans every 5 years for 30 years
		Sub-Total					**$ 3,600**	

PRESENT VALUE ANALYSIS: Rate of Return: 5% Inflation Rate 3%

Item No.		Cost Type	Year	Total Cost	Present Value	Notes
1		**Capital Cost**	0		**$ 1,537,000**	
2		**Annual O&M Cost**	1-30	22,500	**$ 508,000**	
3		**Periodic Costs**				
	3.1	Year 5	5	3,600	$ 3,270	
	3.2	Year 10	10	3,600	$ 2,970	
	3.3	Year 15	15	3,600	$ 2,698	
	3.4	Year 20	20	3,600	$ 2,451	
	3.5	Year 25	25	3,600	$ 2,226	
	3.6	Year 30	30	3,600	$ 2,022	
		Sub-Total			**$ 16,000**	
		TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 2,061,000**	

Table 18 - Cost Estimate for Alternative S4

Alternative S4

SSDS/Excavation of PCB/Pesticides Contaminated Soil and TCE Contaminated Soil

COST ESTIMATE SUMMARY

Site: Former Aluminum Louvre Site (#130195)
Location: Old Bethpage, Nassau County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2013
Date: January 24, 2013

Description: Alternative 4 consists of a sub-slab depressurization system and excavation of soils contaminated with PCBs/Pesticides and volatile organic compounds over the unrestricted use SCOs.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Sub-Slab Depressurization System Installation**					
1.1	Connectivity Testing	1	LS	$ 10,000	$ 10,000	Pilot Study to confirm radius of influence and appropriate blowers
1.2	Mobilization	1	LS	$ 10,000	$ 10,000	
1.3	Install Extraction Points	20	EA	$ 750	$ 15,000	Including blowers, knockout tanks and stack, piping, Electrical controls and acoustical enclosure
1.4	Install Monitoring Points	20	EA	$ 500	$ 10,000	
1.5	Transmission Piping	1,000	LF	$ 15	$ 15,000	
1.6	Fans/Blowers	6	EA	$ 250	$ 1,500	
1.7	Equipment Enclosures	6	EA	$ 250	$ 1,500	
1.8	Stacks	6	EA	$ 250	$ 1,500	
1.9	Power Service	1	LS	$ 7,500	$ 7,500	
1.10	Electrical Controls	1	LS	$ 7,500	$ 7,500	
1.11	System Installation	2	EA	$ 25,000	$ 50,000	
1.12	System Startup	1	LS	$ 10,000	$ 10,000	
1.13	Permits	1	LS	$ 10,000	$ 10,000	
1.14	Reporting, Documentation and Surveying	1	LS	$ 10,000	$ 10,000	
1.15	IDW	1	LS	$ 3,000	$ 3,000	
	Sub-Total				**$ 162,500**	
2	**PCB/Pesticides Excavation**					
2.1	Remedial Action Work Plan/Permitting	1	LS	$ 25,000	$ 25,000	RAWP, PAMP, CPP
2.2	Submittals/Implementation Plans	1	LS	$ 25,000	$ 25,000	QAPP, HASP, shop dwgs and work plans
2.3	PE Sealed Shoring Plan	1	LS	$ 25,000	$ 25,000	
2.4	Construction Equipment Mob/Demob	1	LS	$ 6,000	$ 6,000	
2.5	Decontamination Pad	1	LS	$ 5,000	$ 5,000	Portable decontamination pad/truck tire wash
2.6	Soil Erosion and Sedimentation Controls	1	LS	$ 1,000.00	$ 1,000	Erosion protection around all work areas/storm water inlet structures
2.7	Saw Cut Pavement	100	LF	$ 4.50	$ 450	
2.8	Excavation Shoring and Bracing	580	VSF	$ 20.00	$ 11,600	
2.9	Excavation	64	CY	$ 25.00	$ 1,600	Excavate impacted soil
2.10	Stockpile Area	1	LS	$ 500	$ 500	
2.11	Load out Area	1	LS	$ 1,000	$ 1,000	
2.12	Load out	64	CY	$ 20.00	$ 1,280	Loading of trucks for off-site disposal
2.13	Transportation & Disposal	112	Ton	$ 100.00	$ 11,200	Trucking and Landfill Tipping fees
2.14	Backfill	112	Ton	$ 28.00	$ 3,136	Importing, placement and compaction of clean fill
2.15	Compaction	225	SF	$ 3.50	$ 788	12" lifts, mechanical compaction
2.16	Surface Restoration	25	SY	$ 40.00	$ 1,000	Asphalt paving
2.17	Post Excavation Sampling	5	EA	$ 1,000.00	$ 5,000	PCBs/Pesticides, VOCs, SVOCs analysis
2.18	Backfill Source Sampling	1	EA	$ 1,500.00	$ 1,500	TAL/TCL analysis.
2.19	Waste Characterization Sampling	1	EA	$ 950.00	$ 950	TCLP/TAL/TCL Analysis
2.20	Perimeter Air monitoring	1	Week	$ 1,200.00	$ 1,200	Tripod station with Dust and PID monitors.
2.21	H&S Monitoring	1	Week	$ 300.00	$ 300	Meters for monitoring work zone.
2.22	PPE and Field Supplies	1	LS	$ 1,000.00	$ 1,000	Boots, glasses, hard hat, gloves, etc.
2.23	Post Construction Submittals/Report	1	LS	$ 25,000.00	$ 25,000	Manifests, asbuilts, warranties,
	Sub-Total				**$ 154,504**	
3	**TCE Excavation**					
3.1	Remedial Action Work Plan/Permitting	1	LS	$ 30,000	$ 30,000	RAWP, PAMP, CPP, SESCP
3.2	Submittals/Implementation Plans	1	LS	$ 20,000	$ 20,000	QAPP, HASP, shop dwgs and work plans
3.3	PE Sealed Shoring Plan	1	LS	$ 25,000	$ 25,000	Building engineering evaluation
3.4	Construction Equipment Mob/Demob	1	LS	$ 20,000	$ 20,000	Mobilize Equipment, Temporary Offices
3.5	Decontamination Pad	1	LS	$ 5,000	$ 5,000	Portable Decontamination Pad/Truck Tire Wash
3.6	Soil Erosion and Sedimentation Controls	1	LS	$ 5,000	$ 5,000	Protection of work area and storm water inlets
3.7	Saw Cut Pavement	500	LF	$ 4.50	$ 2,250	
3.8	Sheet Piling	14,000	VSF	$ 30.00	$ 420,000	Assume bury depth 2x excavation depth
3.9	Water Supply	10,000	Gallons	$ 0.50	$ 5,000	Dust control/Decontamination
3.10	Excavation	2,600	CY	$ 25.00	$ 65,000	Excavate impacted soil.
3.11	Stockpile Area	6	EA	$ 500	$ 3,000	
3.12	Load out Area	1	EA	$ 1,000	$ 1,000	
3.13	Load out	2,600	CY	$ 20.00	$ 52,000	Loading of trucks for off-site disposal.
3.14	Transportation & Disposal	4,550	Ton	$ 100	$ 455,000	Trucking and Landfill Tipping fees
3.15	Backfill	4,550	Ton	$ 28.00	$ 127,400	Importing certified clean fill
3.16	Compaction	2,000	SF	$ 3.50	$ 7,000	12" lifts, mechanical compaction
3.17	Surface Restoration	222	SY	$ 40.00	$ 8,889	Asphalt pavement
3.18	Post Excavation Sampling	20	EA	$ 650	$ 13,000	Total VOCs. Includes sample collection and analytical
3.19	Backfill Source Sampling	3	EA	$ 1,500	$ 4,500	TAL/TCL for every 1,000 CY
3.20	Waste Characterization Sampling	6	EA	$ 950	$ 5,700	TCLP/TAL/TCL for every 500 CY
3.21	Water Storage, Characterization and Disposal	1	LS	$ 15,000	$ 15,000	
3.22	Street Sweeper	1	LS	$ 10,000	$ 10,000	
3.23	Surveying	1	LS	$ 25,000	$ 25,000	
3.24	Perimeter Air monitoring	3	Week	$ 1,200	$ 3,600	Tripod station with Dust and PID monitors
3.25	H&S Monitoring	3	Week	$ 300	$ 900	Meters for monitoring work zone
3.26	PPE and Field Supplies	1	LS	$ 2,000	$ 2,000	Boots, glasses, hard hat, gloves, etc.
3.27	Post Construction Submittals/Report	1	LS	$ 50,000	$ 50,000	Manifests, asbuilts, RAR
	Sub-Total				**$ 1,381,239**	
4	**Institutional Controls**					
4.1	Institutional Control & Site Management Plan	1	LS	$ 10,000	$ 10,000	Environmental easement/deed restriction, legal fees.
	Sub-Total				**$ 10,000**	
	Sub-Total				**$ 1,708,242**	Sub-Total All Construction Costs.
	Contingency	25%			$ 427,061	10% scope + 15% bid
	Sub-Total				**$ 2,135,303**	
	Project Management				$ 20,000	
	Remedial Design				$ 75,000	
	Construction Management				$ 30,000	
	TOTAL CAPITAL COST				**$ 2,261,000**	

Table 18 - Cost Estimate for Alternative S4

Alternative S4

SSDS/Excavation of PCB/Pesticides Contaminated Soil and TCE Contaminated Soil

COST ESTIMATE SUMMARY

Site: Former Aluminum Louvre Site (#130195)
Location: Old Bethpage, Nassau County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2013
Date: January 24, 2013

Description: Alternative 4 consists of a sub-slab depressurization system and excavation of soils contaminated with PCBs/Pesticides and volatile organic compounds over the unrestricted use SCOs.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
	ANNUAL O&M COST:					
1	**Annual Operations and Sampling - SSDS**					
1.1	Yearly Inspection	1	EA	$ 2,000	$ 2,000	
1.2	Yearly Report	1	LS	$ 2,500	$ 2,500	
1.3	Yearly Sampling Event	1	LS	$ 3,000	$ 3,000	
1.4	Electrical Usage	30,000	Kw	$ 0.15	$ 4,500	
	Sub-Total				**$ 12,000**	
2	**Maintenance - SSDS**					
2.1	Fan Maintennace	2	EA	$ 250	$ 500	SSDS - 2 systems
2.2	Misc. Repair and Maintenance	2	EA	$ 250	$ 500	
	Sub-Total				**$ 1,000**	
3	**Site Management**					
3.1	Maintain Institutional Controls	1	LS	$ 1,500	$ 1,500	
	Sub-Total				**$ 1,500**	
	Sub-Total				**$ 14,500**	Sub-Total O&M Costs.
	Contingency	15%			$ 2,000	
	Sub-Total				**$ 16,500**	
	Project Management				$ 3,000	
	Technical Support				$ 3,000	
	TOTAL ANNUAL O&M COST				**$ 22,500**	

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Equipment Replacement SSDS**						
1.1	Fan Replacement	5	6	EA	$ 500	$ 3,000	Replace fans every 5 years for 30 years
	Sub-Total					**$ 3,000**	
2	**5 Year Review and Certification**						
2.1	5 Year Inspection	5	1	LS	$ 1,000	$ 1,000	
2.2	Prepare Report and Certification	5	1	LS	$ 1,500	$ 1,500	
	Sub-Total					**$ 2,500**	

PRESENT VALUE ANALYSIS: Rate of Return: 5% Inflation Rate 3%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0		**$ 2,261,000**	
2	**Annual O&M Cost**	1-30	22,500	**$508,000**	
3	**Periodic Costs**				
3.1	Year 5	5	5,500	$ 4,996	
3.2	Year 10	10	5,500	$ 4,538	
3.3	Year 15	15	5,500	$ 4,122	
3.4	Year 20	20	5,500	$ 3,744	
3.5	Year 25	25	5,500	$ 3,401	
3.6	Year 30	30	5,500	$ 3,089	
	Sub-Total			**$ 24,000**	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 2,793,000**	

Table 19 - Cost Estimate for Alternative G2

Alternative G2

In-Situ Chemical Oxidation with LTM

COST ESTIMATE SUMMARY

Site: Former Aluminum Louvre Site (#130195)
Location: Old Bethpage, Nassau County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2013
Date: January 24, 2013

Description: Alternative G2 consists of implementing active In-Situ Chemical Oxidation in both the shallow and deep remediation zones. Long-term monitoring will be implemented outside of the active remediation area.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Pre-Design Investigation**					
1.1	Investigation Work Plan	1	LS	$ 25,000	$ 25,000	Sampling Plan, QAPP, HASP
1.2	Well Driller Mob/Demob	1	LS	$ 6,000	$ 6,000	
1.3	Monitoring Well Installation - Shallow	5	EA	$ 7,600	$ 38,000	Drilling, construction and development. 2-inch diameter; 95 ft depth, inc. IDW for soil cuttings and well development
1.4	Monitoring Well Installation - Deep	5	EA	$ 9,200	$ 46,000	Drilling, construction and development. 2-inch diameter; 125 ft depth, inc. IDW for soil cuttings and well development
1.5	Geotechnical Investigation Borings	5	EA	$ 3,500	$ 17,500	
1.6	IDW	15	EA	$ 350	$ 5,250	
1.7	Aquifer Pump Test	1	LS	$ 30,000	$ 30,000	
1.8	Water Level Measurements/Transducers	1	LS	$ 5,000	$ 5,000	
1.9	Groundwater Sampling	26	EA	$ 1,500	$ 39,000	Sampling 11 existing MWs and 10 new MWs; includes sampling and VOC analysis, includes QC samples
1.10	Bench Scale Testing	1	LS	$ 15,000	$ 15,000	
1.11	Site Survey	3	DAY	$ 1,500	$ 4,500	
1.12	Data Evaluation/Reporting	1	LS	$ 25,000	$ 25,000	
	Sub-Total				**$ 256,250**	
2	**Pilot Test**					
2.1	Well Driller Mob/Demob	1	LS	$ 6,000	$ 6,000	Hollow stem auger rig, decon pad, water truck
2.2	Injection Well - Shallow	10	EA	$ 6,550.00	$ 65,500	
2.3	Injection Well Drilling- Deep	10	EA	$ 8,650	$ 86,500	100 sf area assume 10 wells drilled for testing
2.4	Performance Monitoring Wells - Shallow	2	EA	$ 7,600	$ 15,200	Drilling, construction and development. 2-inch diameter; 95 ft depth, inc. IDW for soil cuttings and well development
2.5	Performance Monitoring Wells - Deep	2	EA	$ 9,200	$ 18,400	Drilling, construction and development. 2-inch diameter; 125 ft depth, inc. IDW for soil cuttings and well development
2.6	Injection Mob/Demob	1	LS	$ 16,000	$ 16,000	
2.7	Injection Substrate Material	20	EA	$ 1,347	$ 26,940	898 gallons per injection point
2.8	Injection Labor and Equipment	10	DAY	$ 3,985	$ 39,850	Labor and equipment for 1 crews + per diem
2.9	IDW	4	EA	$ 350	$ 1,400	Includes soil cuttings from installation and water disposal from development of injection wells only
2.10	Performance Sampling	8	EA	$ 1,000	$ 8,000	Sampling at 8 wells 4 new and 4 existing, includes sample and VOCs analysis
2.11	Data Reduction, Evaluation, Reporting	1	LS	$ 25,000	$ 25,000	
2.12	Surface Repair	11	SY	$ 40	$ 427	4 sf area per well installation
2.13	Flush-mount curb box with inner locking cap	24	EA	$ 275	$ 6,600	For injection wells and monitoring wells
	Sub-Total				**$ 315,817**	
3	**Injection Well Installation**					
3.1	Well Driller Mob/Demob	1	LS	$ 6,000.00	$ 6,000	Mob/demob hollow stem auger rig, decon pad, water truck
3.2	Groundwater Injection Wells - Shallow	220	EA	$ 6,550.00	$ 1,441,000	Drilling, construction and development. 2-inch diameter; 95 ft depth.
3.3	Groundwater Injection Wells - Deep	175	EA	$ 8,650.00	$ 1,513,750	Drilling, construction and development. 2-inch diameter; 135 ft depth.
3.4	IDW	395	EA	$ 350.00	$ 138,250	Includes soil cuttings from installation and water disposal from development of injection wells only
3.5	Survey	5	DAY	$ 1,500.00	$ 7,500	
3.6	Surface Repair	176	SY	$ 40.00	$ 7,022	4 sf area per well installation
3.7	Flush-mount curb box with inner locking cap	395	EA	$ 275.00	$ 108,625	For injection wells
3.8	Injection Well Piping and Trench	345	LF	$ 40.00	$ 13,800	
3.9	Saw Cut Slab	690	LF	$ 4.50	$ 3,105	
	Sub-Total				**$ 3,239,052**	
4	**Initial Injections During Active Remediation Year**					
4.1	Injection Mob/Demob	1	LS	$ 16,000.00	$ 16,000	
4.2	Injection Substrate Material	415	EA	$ 1,347.00	$ 559,005	898 gallons per injection point
4.3	Injection Labor and Equipment	70	DAY	$ 7,970.00	$ 557,900	Labor and equipment for 2 crews + per diem
4.4	Performance Sampling	20	EA	$ 1,500.00	$ 30,000	2 rounds of sampling for VOCs, labor, mobilization, data management and sample analysis at 9 performance wells + 2 QC samples
	Sub-Total				**$ 1,162,905**	
5	**Second Injections During Active Remediation Year**					
5.1	Injection Mob/Demob	1	LS	$ 16,000.00	$ 16,000	
5.2	Injection Substrate Material	415	EA	$ 1,347.00	$ 559,005	898 gallons per injection point
5.3	Injection Labor and Equipment	70	DAY	$ 7,970.00	$ 557,900	Labor and equipment for 2 crews + per diem
5.4	Performance Sampling	20	EA	$ 1,500.00	$ 30,000	2 rounds of sampling for VOCs, labor, mobilization, data management and sample analysis at 9 performance wells + 2 QC samples
	Sub-Total				**$ 1,162,905**	
6	**LTM and Institutional Controls**					
	Institutional Controls					
6.1	Institutional Control & Site Management Plan	1	EA	$ 60,000.00	$ 60,000	Environmental easement/deed restriction, legal fees.
6.2	Site Information Database	1	LS	$ 25,000.00	$ 25,000	Setup data management system.
	LTM					
6.3	Groundwater Sampling	84	EA	$ 950	$ 79,800	Quarterly sampling of 21 wells
6.4	Groundwater Sample Laboratory Analysis	104	EA	$ 550	$ 57,200	Sampling 21 wells quarterly for Total VOCs analysis + QC samples.
6.5	Fate and Transport Modeling/Calculation	1	LS	$ 10,000	$ 10,000	
6.6	Reporting and Monitoring Program Development	4	LS	$ 10,000	$ 40,000	
	Sub-Total				**$ 272,000**	
	Sub-Total				**$ 6,408,929**	Sub-Total All Construction Costs.
	Contingency	25%			$ 1,602,000	10% scope + 15% bid.
	Sub-Total				**$ 8,010,929**	
	Project Management				$ 50,000	
	Remedial Design				$ 60,000	
	Permitting				$ 15,000	
	Construction Management				$ 50,000	
	Construction Oversight				$ 100,000	
	TOTAL CAPITAL COST				**$ 8,286,000**	

Table 19 - Cost Estimate for Alternative G2

Alternative G2
In-Situ Chemical Oxidation with LTM

COST ESTIMATE SUMMARY

Site: Former Aluminum Louvre Site (#130195)
Location: Old Bethpage, Nassau County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2013
Date: January 24, 2013

Description: Alternative G2 consists of implementing active In-Situ Chemical Oxidation in both the shallow and deep remediation zones. Long-term monitoring will be implemented outside of the active remediation area.

Item No.		Description	Quantity	Unit	Unit Cost	Total	Notes
O&M COST:							
1		**LTM and Institutional Controls - Years 1 & 2**					
	1.1	Maintain Institutional Controls	1	LS	$ 6,000	$ 6,000	Site Management Plan
	1.2	Groundwater Sampling	84	EA	$ 950	$ 79,800	Quarterly sampling of 21 wells
	1.3	Groundwater Sample Laboratory Analysis	104	EA	$ 550	$ 57,200	Sampling 21 wells quarterly for Total VOCs analysis + QC samples.
	1.4	Data Reduction, Evaluation and Reporting	4	EA	$ 20,000	$ 80,000	
		Sub-Total				**$ 223,000**	
		Sub-Total				**$ 223,000**	
		Contingency	15%			$ 33,000	5% scope + 10% bid.
		Sub-Total				**$ 256,000**	
		Project Management				$ 6,000	
		Technical Support				$ 6,000	
		TOTAL ANNUAL O&M COST				**$ 268,000**	
2		**LTM and Institutional Controls - Years 3 & 4**					
	2.1	Maintain Institutional Controls	1	LS	$ 6,000	$ 6,000	Site Management Plan
	2.2	Groundwater Sampling	42	EA	$ 950	$ 39,900	Semi-annually sampling of 21 wells
	2.3	Groundwater Sample Laboratory Analysis	52	EA	$ 550	$ 28,600	Sampling 21 wells semi-annually for Total VOCs analysis + QC samples.
	2.4	Data Reduction, Evaluation and Reporting	2	EA	$ 20,000	$ 40,000	
		Sub-Total				**$ 114,500**	
		Sub-Total				**$ 114,500**	
		Contingency	15%			$ 17,000	5% scope + 10% bid.
		Sub-Total				**$ 131,500**	
		Project Management				$ 6,000	
		Technical Support				$ 6,000	
		TOTAL ANNUAL O&M COST				**$ 143,500**	
3		**LTM and Institutional Controls - Year 5**					
	3.1	Maintain Institutional Controls	1	LS	$ 6,000	$ 6,000	Site Management Plan
	3.2	Groundwater Sampling	21	EA	$ 950	$ 19,950	Annually
	3.3	Groundwater Sample Laboratory Analysis	26	EA	$ 550	$ 14,300	Sampling 21 wells annually for Total VOCs analysis + QC samples.
	3.4	Data Reduction, Evaluation and Reporting	1	EA	$ 20,000	$ 20,000	
		Sub-Total				**$ 60,250**	
		Sub-Total				**$ 60,250**	
		Contingency	15%			$ 9,000	5% scope + 10% bid.
		Sub-Total				**$ 69,250**	
		Project Management				$ 3,000	
		Technical Support				$ 3,000	
		TOTAL ANNUAL O&M COST				**$ 75,250**	

PERIODIC COSTS:

Item No.		Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1		**Injections to Hot Spots During Year 1**						
	1.1	Injection Event Coordination/Mob and Demob	1	1	LS	$ 25,000	$ 25,000	Property access.
	1.2	Injection Substrate Material	1	415	EA	$ 1,500	$ 622,500	Assume half the injection points for hot spot treatment
	1.3	Injection Labor and Equipment	1	75	DAY	$ 7,970	$ 601,373	Assumes 5.5 days per injection point
	1.4	Performance Sampling	1	22	EA	$ 1,500	$ 33,000	9 performance wells, 2 rounds of VOCs analysis + QC samples.
	1.5	Data Reduction, Evaluation, Reporting	1	2	EA	$ 25,000	$ 50,000	Two reports prepared for each round of samples
		Sub-Total					**$ 1,331,873**	
2		**System Decommissioning**						
	2.1	Injection Well Abandonment	2	415	EA	$ 1,500	$ 622,500	Drilling subcontractor, abandonment of injection wells
	2.2	Permitting and Reporting	2	1	LS	$ 15,000	$ 15,000	
		Sub-Total					**$ 637,500**	
3		**Site Close Out**						
	3.1	Monitoring Well Abandonment	5	25	EA	$ 1,500	$ 37,500	Drilling subcontractor, abandonment of monitoring wells and performance wells.
	3.2	Final Closure Report	5	1	LS	$ 50,000	$ 50,000	
		Sub-Total					**$ 87,500**	

PRESENT VALUE ANALYSIS: Rate of Return: 5% Inflation Rate: 3%

Item No.		Description	Year	Total Cost	Present Value	Notes
1		**Capital Cost**	0		**$ 8,286,000**	
2		**Annual O&M Cost**				
	2.1	Years 1 & 2	1 & 2	$ 268,000	$ 520,783	
	2.2	Years 3 & 4	3 & 4	$ 143,500	$ 268,330	
	2.3	Years 5	5	$ 75,250	$ 68,351	
		Sub-Total			**$ 858,000**	
3		**Periodic Costs**				
	3.1	Year 1	1	$1,331,873	$ 1,306,504	
	3.2	Year 2	2	$ 637,500	$ 613,446	
	3.3	Year 10	5	$ 87,500	$ 79,478	
		Sub-Total			**$ 2,000,000**	
		TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 11,144,000**	

Table 20 - Cost Estimate for Alternative G3

Alternative G3

Air Sparging/Soil Vapor Extraction System with LTM

COST ESTIMATE SUMMARY

Site: Former Aluminum Louvre Site (#130195)
Location: Old Bethpage, Nassau County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2013
Date: January 24, 2013

Description: Alternative G3 consists of implementing air sparging in saturated shallow and deep remediation zones and collecting vapor from unsaturated zone through soil vapor extraction system. Extracted vapor will be treated using vapor phase GAC. Long-term monitoring will be implemented outside the area of active remediation.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Pre-Design Investigation**					
1.1	Investigation Work Plan	1	LS	$ 25,000	$ 25,000	Sampling Plan, QAPP, HASP
1.2	Well Driller Mob/Demob	1	LS	$ 6,000	$ 6,000	
1.3	Monitoring Well Installation - Shallow	5	EA	$ 7,600	$ 38,000	
1.4	Monitoring Well Installation - Deep	5	EA	$ 9,200	$ 46,000	
1.5	Geotechnical Investigation Borings	5	EA	$ 3,500	$ 17,500	
1.6	IDW	15	EA	$ 350	$ 5,250	
1.7	Aquifer Pump Test	1	LS	$ 30,000	$ 30,000	
1.8	Water Level Measurements/Transducers	1	LS	$ 5,000	$ 5,000	
1.9	Groundwater Sampling	26	EA	$ 1,500	$ 39,000	Sampling 11 existing MWs and 10 new MWs; includes sampling and VOC analysis
1.10	Site Survey	3	DAY	$ 1,500	$ 4,500	
1.11	Data Evaluation/Reporting	1	LS	$ 25,000	$ 25,000	
	Sub-Total				**$ 241,250**	
2	**Pilot Test and Treatability Study**					
2.1	Well Driller Mob/Demob	1	LS	$ 7,000	$ 7,000	
2.2	Air Sparging Wells - Shallow	4	EA	$ 6,550	$ 26,200	Drilling, construction and development. 2-inch diameter; 95 ft depth.
2.3	Air Sparging Wells - Deep	4	EA	$ 8,650	$ 34,600	Drilling, construction and development. 2-inch diameter; 135 ft depth.
2.4	Soil Vapor Extraction Well	1	EA	$ 1,500	$ 1,500	Drilling, construction and development. 2-inch diameter; 20 ft depth.
2.5	Performance Monitoring Wells - Shallow	2	EA	$ 7,600	$ 15,200	Drilling, construction and development. 2-inch diameter; 95 ft depth, inc. IDW for soil cuttings and well development.
2.6	Performance Monitoring Wells - Deep	2	EA	$ 9,200	$ 18,400	Drilling, construction and development. 2-inch diameter; 125 ft depth, inc. IDW for soil cuttings and well development
2.7	Air Sparging Equipment	1	EA	$ 10,000	$ 10,000	Includes equipment, mobilization and start up, technical assistance and consulting, and material and expenses.
2.8	Vapor Treatment Skid	1	LS	$ 15,000	$ 15,000	Includes trailer mount set up, carbon disposal and labor.
2.9	Labor	1	LS	$ 5,000	$ 5,000	3 day pilot test, for one person oversight for 12 hours/day.
2.10	Performance Sampling	18	EA	$ 1,500	$ 27,000	9 wells, two rounds of sampling; Includes sampling and analysis.
2.11	Data Reduction, Evaluation, Reporting	1	LS	$ 15,000	$ 15,000	
2.12	IDW	9	EA	$ 350.00	$ 3,150	For air sparging and SVE well installation
	Sub-Total				**$ 178,050**	
3	**Mobilization and Demobilization**					
3.1	Construction Equipment and Personnel Mob/Demob	1	LS	$ 50,000	$ 50,000	Excavator, loader, trailer, frac tank, etc.
3.2	Waste Water Storage (Frac Tank)	1	Month	$ 1,500	$ 1,500	1 tank for 1 month.
3.3	Submittals/Implementation Plans	1	LS	$ 12,000	$ 12,000	QAPP, HASP, shop dwgs and work plans.
3.4	Post Construction Submittals	1	LS	$ 8,000	$ 8,000	Equipment O&M Manuals, as-builts, warranties.
	Sub-Total				**$ 71,500**	
4	**Air Sparging/SVE Well Installation**					
4.1	Air Sparging Wells - Shallow	53	EA	$ 4,450.00	$ 235,850	Drilling, construction and development. 2-inch diameter; 95 ft depth.
4.2	Air Sparging Wells - Deep	45	EA	$ 6,250.00	$ 281,250	Drilling, construction and development. 2-inch diameter; 135 ft depth.
4.3	Soil Vapor Extraction Well	53	EA	$ 1,000.00	$ 53,000	Drilling, construction and development. 2-inch diameter; 20 ft depth.
4.4	Air Sparging/SVE Equipment/Components	1	LS	$ 119,000	$ 119,000	Includes equipment, mobilization and start up, technical assistance and consulting, and material and expenses.
4.5	Vapor Phase GAC Vessels	2	EA	$ 10,000	$ 20,000	2,000 lb vapor phase GAC vessel
4.6	IDW	151	EA	$ 350	$ 52,850	
4.7	Surface Repair	67	SY	$ 40.00	$ 2,684	4 sf area per well installation
4.8	Well Survey	5	DAY	$ 1,500	$ 7,500	
4.9	Performance Sampling	20	EA	$ 1,500	$ 30,000	9 wells, two rounds of sampling; Includes sampling and analysis + QC samples
4.10	Data Reduction, Evaluation, Reporting	1	LS	$ 15,000	$ 15,000	
4.11	Treatment Plant Building	1	LS	$ 15,000	$ 15,000	
4.12	Oversight	1	LS	$ 50,000	$ 50,000	
4.13	Installation & Startup	1	LS	$ 70,000	$ 70,000	
	Sub-Total				**$ 952,134**	
5	**Earthwork, Trenching, Site Work**					
5.1	Trenching	2,500	LF	$ 40.00	$ 100,000	Excavation, piping, bedding.
5.2	Surface Repair	556	SY	$ 40.00	$ 22,222	Site restoration (grassy areas and sidewalks).
5.3	Soil Disposal	278	Tons	$ 100	$ 27,778	1 foot x 2 foot wide by total length x 1.5 tons/CY.
	Sub-Total				**$ 150,000**	
6	**LTM and Institutional Controls**					
	Institutional Controls					
6.1	Institutional Control & Site Management Plan	1	EA	$ 60,000	$ 60,000	Environmental easement/deed restriction, legal fees.
6.2	Site Information Database	1	LS	$ 25,000	$ 25,000	Setup data management system.
	LTM					
6.3	Groundwater Sampling	42	EA	$ 950	$ 39,900	Semi-annual sampling of 21 wells
6.4	Groundwater Sample Laboratory Analysis	52	EA	$ 550	$ 28,600	Sampling 21 wells semi-annually for Total VOCs analysis + QC samples.
6.5	Fate and Transport Modeling/Calculation	1	LS	$ 10,000	$ 10,000	
6.6	Reporting and Monitoring Program Development	4	LS	$ 10,000	$ 40,000	
	Sub-Total				**$ 203,500**	
	Sub-Total				**$ 1,796,434**	Sub-Total All Construction Costs.
	Contingency	25%			$ 449,000	10% scope + 15% bid.
	Sub-Total				**$ 2,245,434**	
	Project Management				$ 20,000	
	Remedial Design				$ 50,000	
	Permitting				$ 10,000	
	Construction Management				$ 30,000	
	Construction Oversight				$ 10,000	
	TOTAL CAPITAL COST				**$ 2,366,000**	

Table 20 - Cost Estimate for Alternative G3

Alternative G3

Air Sparging/Soil Vapor Extraction System with LTM

COST ESTIMATE SUMMARY

Site:	Former Aluminum Louvre Site (#130195)
Location:	Old Bethpage, Nassau County, New York
Phase:	Feasibility Study (-30% - +50%)
Base Year:	2013
Date:	January 24, 2013

Description: Alternative G3 consists of implementing air sparging in saturated shallow and deep remediation zones and collecting vapor from unsaturated zone through soil vapor extraction system. Extracted vapor will be treated using vapor phase GAC. Long-term monitoring will be implemented outside the area of active remediation.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
	ANNUAL O&M COST:					
	Operation of AS/SVE System for 5 years					
1	**Operation**					
1.1	Electrical Usage	450,000	KW-Hr	$ 0.15	$ 67,500	System operates for 5 years
1.2	Vapor Carbon Usage	2,000	Lb	$ 3.30	$ 6,600	Assume change out lead unit annually
1.3	Bi-weekly Inspections	26	EA	$1,000	$ 26,000	8 hours/month.
1.4	Effluent Sampling	36	EA	$ 1,500	$ 54,000	Monthly, VOCs, Effluent Air Sampling and between GAC vessels
1.5	Reporting	12	Month	$ 5,000	$ 60,000	Monthly.
	Sub-Total				**$ 214,100**	
2	**Maintenance**					
2.1	Repair/Replacement of Equipment	1	LS	$ 1,000	$ 1,000	
	Sub-Total				**$ 1,000**	
3	**LTM and Institutional Controls**					
3.1	Maintain Institutional Controls	1	LS	$ 12,000	$ 12,000	
3.2	Groundwater Sampling	42	EA	$ 950	$ 39,900	21 wells semi-annually
3.3	Groundwater Sample Laboratory Analysis	52	EA	$ 550	$ 28,600	Total VOCs analysis + QC samples.
3.4	Data Reduction, Evaluation and Reporting	2	EA	$ 20,000	$ 40,000	Two reports per year.
	Sub-Total				**$ 120,500**	
4	**Performance Sampling**					
4.1	Performance Sampling and Analysis	40	EA	$ 1,500	$ 60,000	Quarterly samples of performance wells, + QC sample
4.2	Air Sampling and Analysis (TO-15 Analysis)	36	EA	$ 1,500	$ 54,000	1 influent, between lead/lag, 1 effluent, monthly, VOCs analysis only
4.3	Data Reduction, Evaluation, Reporting	1	LS	$ 20,000	$ 20,000	
	Sub-Total				**$ 134,000**	
	Sub-Total				**$ 469,600**	
	Contingency	15%			$ 70,000	
	Sub-Total				**$ 539,600**	
	Project Management				$ 10,000	
	Technical Support				$ 10,000	
	TOTAL ANNUAL O&M COST				**$ 559,600**	
	Long Term Monitoring - Years 6 - 10					
5	**LTM and Institutional Controls**					
5.1	Maintain Institutional Controls	1	LS	$ 12,000	$ 12,000	
5.2	Groundwater Sampling	42	EA	$ 950	$ 39,900	21 wells semi-annually
5.3	Groundwater Sample Laboratory Analysis	52	EA	$ 550	$ 28,600	Total VOCs analysis + QC samples.
5.4	Data Reduction, Evaluation and Reporting	2	EA	$ 20,000	$ 40,000	Two reports per year.
	Sub-Total				**$ 120,500**	
	Sub-Total				**$ 120,500**	
	Contingency	15%			$ 18,000	
	Sub-Total				**$ 138,500**	
	Project Management				$ 3,000	
	Technical Support				$ 3,000	
	TOTAL ANNUAL O&M COST				**$ 144,500**	
	Long Term Monitoring - Year 11					
6	**LTM and Institutional Controls**					
6.1	Maintain Institutional Controls	1	LS	$ 12,000	$ 12,000	
6.2	Groundwater Sampling	21	EA	$ 950	$ 19,950	21 wells annually
6.3	Groundwater Sample Laboratory Analysis	26	EA	$ 550	$ 14,300	Total VOCs analysis + QC samples.
6.4	Data Reduction, Evaluation and Reporting	1	EA	$ 20,000	$ 20,000	Two reports per year.
	Sub-Total				**$ 66,250**	
	Sub-Total				**$ 66,250**	
	Contingency	15%			$ 10,000	
	Sub-Total				**$ 76,250**	
	Project Management				$ 3,000	
	Technical Support				$ 3,000	
	TOTAL ANNUAL O&M COST				**$ 82,250**	

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**System Decommissioning**						
1.1	AS Well Abandonment	5	110	EA	$ 1,500	$ 165,000	AS/SVE well points, monitoring wells and performance wells
1.2	SVE Well Abandonment	5	54	EA	$ 800	$ 43,200	
1.3	Injection Piping Removal	5	1	LS	$ 20,000	$ 20,000	Shallow and deep.
1.4	Demobilize Treatment Plant	5	1	LS	$ 15,000	$ 15,000	Decommission plant, remove piping, repair streets.
1.5	Permitting and Reporting	5	1	LS	$ 10,000	$ 10,000	
	Sub-Total					**$ 253,200**	
2	**Site Close Out**						
2.1	Monitoring Well Abandonment	11	21	EA	$ 1,500	$ 31,500	Drilling subcontractor, abandonment of monitoring wells.
2.2	Final Closure Report	11	1	LS	$ 50,000	$ 50,000	
	Sub-Total					**$ 81,500**	

Table 20 - Cost Estimate for Alternative G3

Alternative G3

Air Sparging/Soil Vapor Extraction System with LTM

COST ESTIMATE SUMMARY

Site: Former Aluminum Louvre Site (#130195)
Location: Old Bethpage, Nassau County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2013
Date: January 24, 2013

Description: Alternative G3 consists of implementing air sparging in saturated shallow and deep remediation zones and collecting vapor from unsaturated zone through soil vapor extraction system. Extracted vapor will be treated using vapor phase GAC. Long-term monitoring will be implemented outside the area of active remediation.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes

PRESENT VALUE ANALYSIS: Rate of Return: 5% Inflation Rate: 3%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0		**$ 2,366,000**	
2	**Annual O&M Cost**				
2.1	Years 1-5	1-5	$ 559,600	$ 2,642,117	
2.2	Years 6-10	6-10	$ 144,500	$ 619,701	
2.3	Year 11	11	$ 82,250	$ 66,568	
	Sub-Total			**$ 3,329,000**	
3	**Periodic Costs**				
3.1	Year 5	5	$ 253,200	$ 229,987	
3.3	Year 11	11	$ 81,500	$ 65,961	
	Sub-Total			**$ 296,000**	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 5,991,000**	

Table 21 - Cost Estimate for Alternative G4

Alternative G4

Pump and Treat with LTM

COST ESTIMATE SUMMARY

Site: Former Aluminum Louvre Site (#130195)
Location: Old Bethpage, Nassau County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2013
Date: January 24, 2013

Description: Alternative G4 consists of pumping groundwater to remove mass from high concentration areas of the aquifer and to establish hydraulic control of the aquifer to minimize off-Site migration of the groundwater plume. Extracted groundwater will be treated via an air stripper prior to reinjecting into the aquifer. The air stream will be treated using vapor phase GAC. Long-term monitoring will be implemented outside the area of active remediation.

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:						
1	**Pre-Design Investigation**					
1.1	Investigation Work Plan	1	LS	$ 25,000	$ 25,000	Sampling Plan, QAPP, HASP
1.2	Well Driller Mob/Demob	1	LS	$ 6,000	$ 6,000	
1.3	Monitoring Well Installation - Shallow	5	EA	$ 7,600	$ 38,000	
1.4	Monitoring Well Installation - Deep	5	EA	$ 9,200	$ 46,000	
1.5	Geotechnical Investigation Borings	5	EA	$ 3,500	$ 17,500	
1.6	IDW	15	EA	$ 350	$ 5,250	
1.7	Aquifer Pump Test	1	LS	$ 30,000	$ 30,000	
1.8	Water Level Measurements/Transducers	1	LS	$ 5,000	$ 5,000	
1.9	Groundwater Sampling	26	EA	$ 1,500	$ 39,000	Sampling 11 existing MWs and 10 new MWs; includes sampling and VOC analysis
1.10	Site Survey	3	DAY	$ 1,500	$ 4,500	
1.11	Data Evaluation/Reporting	1	LS	$ 25,000	$ 25,000	
	Sub-Total				**$ 241,250**	
2	**Pilot and Treatability Study**					
2.1	Well Driller Mob/Demob	1	LS	$ 18,000	$ 18,000	Hollow stem auger rig, test extraction well rig, water truck, decon pad
2.2	Extraction Well Installation - Shallow	1	EA	$ 12,800	$ 12,800	6-inch diameter to 95 ft bgs, stainless steel casing & 10 ft stainless steel screen, inc. 2 hr development, inc. decon
2.3	Extraction Well Installation - Deep	1	EA	$ 17,308	$ 17,308	6-inch diameter to 135 ft bgs. Stainless steel well screens, inc. decon.
2.4	Performance Well Installation- Shallow	1	EA	$ 4,500	$ 4,500	2-inch diameter; 65 ft deep, PVC inc. riser, screen and development
2.5	Performance Well Installation - Intermediate	1	EA	$ 6,300	$ 6,300	2-inch diameter; 95 ft deep, PVC inc. riser, screen and development
2.6	Performance Well Installation- Deep	3	EA	$ 8,000	$ 24,000	2-inch diameter; 125 ft deep, PVC inc. riser, screen and development
2.7	Extraction Pump, Transducer, Flush	2	EA	$ 6,000	$ 12,000	
2.8	Flush-mount curb box with inner locking cap	5	EA	$ 275.00	$ 1,375	For monitoring wells
2.9	IDW	1	LS	$ 15,125	$ 15,125	Soil cuttings and groundwater waste from well installations and development.
2.10	Surface Repair	4	SY	$ 40.00	$ 160	9 sf area per well installation
2.11	Pilot Test	1	LS	$ 15,000	$ 15,000	Air stripper and carbon evaluation.
2.12	Water Level Measurements/Transducers	1	LS	$ 5,000	$ 5,000	For pump test
2.13	Field Work Oversight	1	LS	$ 150,000	$ 150,000	150 man-days
2.14	Data Evaluation/Reporting	1	LS	$ 120,000	$ 120,000	
					$ 401,568	
3	**Mobilization and Demobilization**					
3.1	Construction Equipment and Personnel	1	LS	$ 50,000	$ 50,000	
3.2	Submittals/Implementation Plans	1	LS	$ 50,000	$ 50,000	QAPP, HASP, shop dwgs and work plans.
3.3	Post Construction Submittals	1	LS	$ 40,000	$ 40,000	As-builts, O&M Manuals, warranties, etc.
	Sub-Total				**$ 140,000**	
4	**Monitoring, Sampling, Testing and Analysis**					
4.1	Well Driller Mob/Demob	1	LS	$ 18,000	$ 18,000	Hollow stem auger rig, test extraction well rig, water truck, decon pad
4.2	Extraction Well Installation - Shallow	3	EA	$ 12,800	$ 38,400	6-inch diameter to 95 ft bgs, stainless steel casing & 40 ft stainless steel screen, inc. 2 hr development, inc. decon
4.3	Extraction Well Installation - Deep	2	EA	$ 17,308	$ 34,616	6-inch diameter to 135 ft bgs. Stainless steel screen 40 ft, inc. decon.
4.4	Extraction Pump, Transducer, Flush	5	EA	$ 6,000	$ 30,000	
4.5	IDW	1	LS	$ 18,700	$ 18,700	Soil cuttings and groundwater waste from well installations and development.
4.6	Well Survey	1	DAY	$ 1,500	$ 1,500	Asbuilt survey of extraction wells and equipment
	Sub-Total				**$ 141,216**	
5	**Conveyance Piping**					
5.1	Trenching, Bedding, Pipe	920	LF	$ 50	$ 46,000	3-inch HDPE double walled pipe.
5.2	Surface Restoration	409	SY	$ 40	$ 16,356	
5.3	Effluent Discharge Pipe	2,000	LF	$ 50	$ 100,000	Pipe to injection wells and discharge to POTW for backwash
5.4	Soil Disposal	324	Tons	$ 100	$ 32,444	1 foot x 2 foot wide by total length x 1.5 tons/CY.
	Sub-Total				**$ 194,800**	
6	**Treatment System**					
6.1	Sodium Hypochlorite Addition System	1	LS	$ 15,000	$ 15,000	
6.2	Green Sand Filtration System	1	LS	$ 330,000	$ 330,000	Skid mounted green sand filtration system 140-250 gpm
6.3	Bag Filter Skid System	1	LS	$ 14,000	$ 14,000	
6.4	Air Stripper	1	LS	$ 95,000	$ 95,000	6 trays, low profile stripper, blower, piping, sump, alarms
6.5	Liquid GAC	1	LS	$ 77,500	$ 77,500	2 - 5,000 lb GAC vessels
6.6	Vapor GAC	1	LS	$ 45,000	$ 45,000	2 - 5,000 lb GAC vessels
6.7	Interconnecting pipes and valves	1	LS	$ 10,000	$ 10,000	
6.8	PCL Controller	1	LS	$ 50,000	$ 50,000	Controller for overall system (each system comes with individual controller
6.9	Electrical Components	1	LS	$ 10,000	$ 10,000	
6.10	Discharge Pump	1	LS	$ 10,000	$ 10,000	
	Sub-Total				**$ 656,500**	
7	**Treatment Plant Building**					
7.1	Concrete Foundation	1	LS	$ 30,000	$ 30,000	
7.2	Steel Building	1	LS	$ 60,000	$ 60,000	
7.3	HVAC System	1	LS	$ 30,000	$ 30,000	
7.4	Windows and Doors	1	LS	$ 20,000	$ 20,000	
7.5	Electrical Power and Lighting	1	LS	$ 25,000	$ 25,000	
	Sub-Total				**$ 165,000**	

Table 21 - Cost Estimate for Alternative G4

Alternative G4
Pump and Treat with LTM

COST ESTIMATE SUMMARY

Site: Former Aluminum Louvre Site (#130195)
Location: Old Bethpage, Nassau County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2013
Date: January 24, 2013

Description: Alternative G4 consists of pumping groundwater to remove mass from high concentration areas of the aquifer and to establish hydraulic control of the aquifer to minimize off-Site migration of the groundwater plume. Extracted groundwater will be treated via an air stripper prior to reinjecting into the aquifer. The air stream will be treated using vapor phase GAC. Long-term monitoring will be implemented outside the area of active remediation.

Item No.		Description	Quantity	Unit	Unit Cost	Total	Notes
8		**System Start-up and Prove-out**					
	8.1	System Start-up	1	LS	$ 70,000	$ 70,000	
		Sub-Total				**$ 70,000**	
9		**Re-injection System**					
	9.1	Dry Wells	10	EA	$ 10,000	$ 100,000	8-ft diameter
	9.2	Disposal Costs	10	EA	$ 1,800	$ 18,000	
		Sub-Total				**$ 118,000**	
10		**LTM and Institutional Controls**					
		Institutional Controls					
	10.1	Institutional Control and Site Management Plan	1	EA	$ 60,000	$ 60,000	Environmental easement/deed restriction, legal fees.
	10.2	Site Information Database	1	LS	$ 25,000	$ 25,000	Setup data management system.
		LTM				$ -	
	10.3	Sampling and Reporting	26	EA	$ 1,500	$ 39,000	Annually for 12 samples, VOCs only + QC samples
	10.4	Fate and Transport Modeling/Calculation	1	LS	$ 10,000	$ 10,000	
	10.5	Reporting and Monitoring Program Development	1	LS	$ 10,000	$ 10,000	
		Sub-Total				**$ 144,000**	
		Sub-Total				**$ 2,272,334**	Sub-Total All Construction Costs.
		Contingency	25%			$ 568,000	10% scope + 15% bid.
		Sub-Total				**$ 2,840,334**	
		Project Management				$ 50,000	
		Remedial Design				$ 250,000	
		Permitting				$ 30,000	
		Construction Management				$ 30,000	
		Construction Oversight				$ 100,000	
		TOTAL CAPITAL COST				**$ 3,301,000**	

O&M COST:

Item		Description	Quantity	Unit	Unit Cost	Total	Notes
1		**Operation**					
	1.1	Electrical Usage	500,000	KW-Hr	$ 0.15	$ 75,000	
	1.2	Vapor Carbon Usage	30,000	LB	$ 3.30	$ 99,000	Carbon change out 3x / year
	1.3	Liquid Carbon Usage	1,666	LB	$ 2.10	$ 3,499	Change out lead Carbon unit every 3 years
	1.4	Chemical Usage	2,072	gal	$ 2.00	$ 4,144	
	1.5	Plant Operator	2,080	HR	$ 100.00	$ 208,000	Full time (40 hr/week; 52 weeks;yr).
	1.6	Reporting	12	Month	$ 7,500	$ 90,000	Monthly.
	1.8	Permitting and Disposal Fee for Discharging to POTW	1	yearly	$ 8,200	$ 8,200	Yearly cost to discharge backwash water to POTW
		Sub-Total				**$ 487,843**	
2		**Maintenance**					
	2.1	Repair/Replacement of Equipment	1	LS	$ 5,000	$ 5,000	
	2.2	Well Repair and Maintenance	1	LS	$ 5,000	$ 5,000	
		Sub-Total				**$ 10,000**	
3		**LTM and Institutional Controls**					
	3.1	Maintain Institutional Controls	1	LS	$ 12,000	$ 12,000	
	3.2	Groundwater Sampling	42	EA	$ 950	$ 39,900	21 wells semi-annually
	3.3	Groundwater Sample Laboratory Analysis	52	EA	$ 550	$ 28,600	Total VOCs analysis + QC samples.
	3.4	Data Reduction, Evaluation and Reporting	1	EA	$ 20,000	$ 20,000	
		Sub-Total				**$ 100,500**	
4		**Performance Sampling**					
	4.1	Performance Sampling and Analysis	12	EA	$ 1,500	$ 18,000	4 extraction wells + combined influent + effluent + 2 samples between Liquid phase GAC, VOCs analysis only, monthly from year 0-30, sewer discharge (VOC+TSS), 2 QC samples.
	4.2	Air Sampling and Analysis (TO-15 Analysis)	48	EA	$ 1,500	$ 72,000	1 influent, 2 between lead/lag, 1 effluent, monthly, VOCs analysis only
	4.3	Data Reduction, Evaluation, Reporting	1	LS	$ 30,000	$ 30,000	
		Sub-Total				**$ 120,000**	
		Sub-Total				**$ 718,343**	
		Contingency	15%			$ 108,000	
		Sub-Total				**$ 826,343**	
		Project Management				$ 15,000	
		Technical Support				$ 15,000	
		TOTAL ANNUAL O&M COST				**$ 856,343**	

Table 21 - Cost Estimate for Alternative G4

Alternative G4
Pump and Treat with LTM

COST ESTIMATE SUMMARY

Site: Former Aluminum Louvre Site (#130195)
Location: Old Bethpage, Nassau County, New York
Phase: Feasibility Study (-30% - +50%)
Base Year: 2013
Date: January 24, 2013

Description: Alternative G4 consists of pumping groundwater to remove mass from high concentration areas of the aquifer and to establish hydraulic control of the aquifer to minimize off-Site migration of the groundwater plume. Extracted groundwater will be treated via an air stripper prior to reinjecting into the aquifer. The air stream will be treated using vapor phase GAC. Long-term monitoring will be implemented outside the area of active remediation.

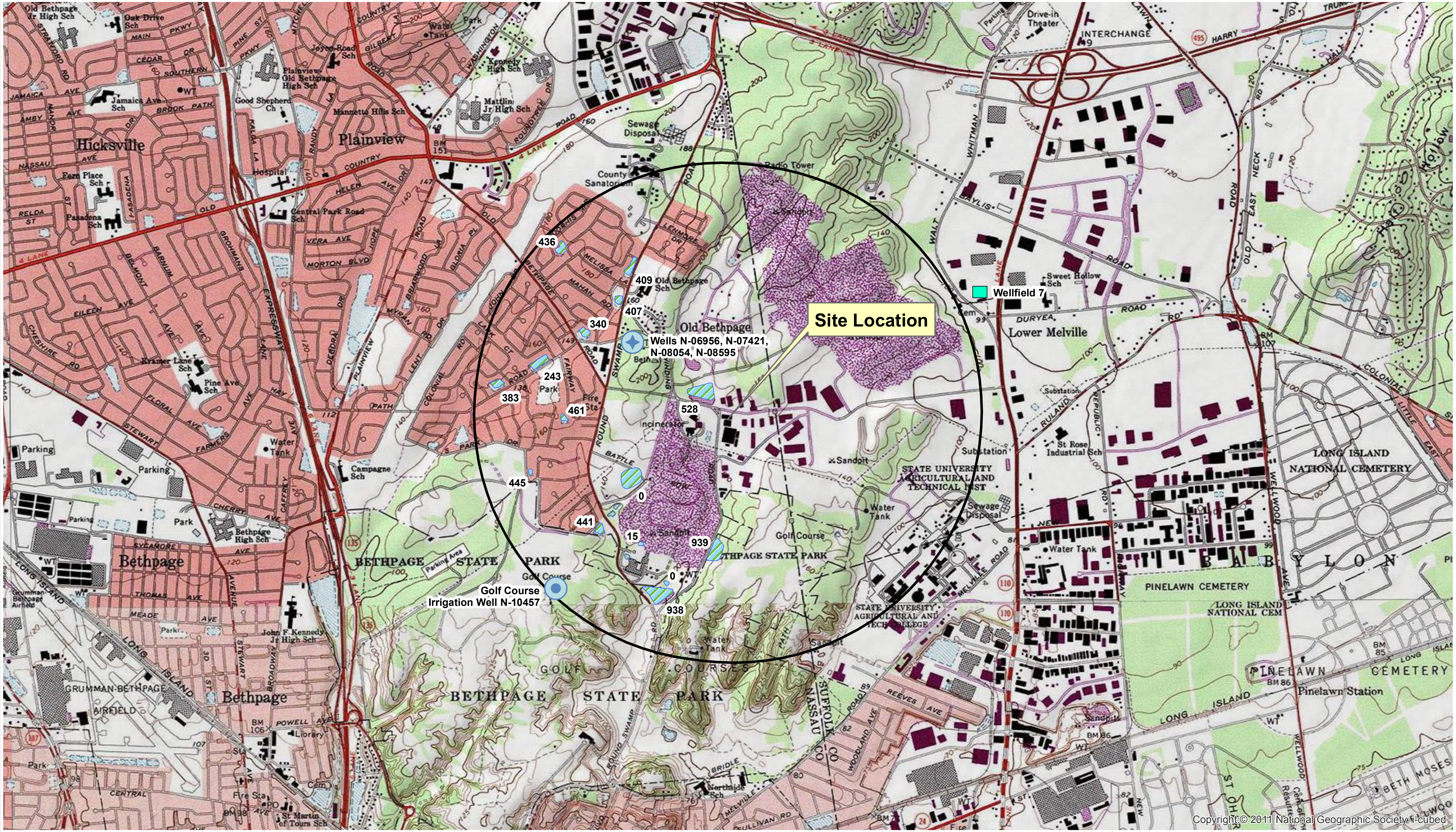
Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Periodic Maintenance**						
1.1	Equipment Replacement/Repair	5	1	LS	$ 15,000	$ 15,000	
	Sub-Total					**$ 15,000**	
2	**System Decommissioning**						
2.1	Demobilize Treatment System	30	1	LS	$ 130,000	$ 130,000	
2.2	Well Abandonment	30	11	LS	$ 1,500	$ 16,500	Abandon injection wells, extraction wells, and monitoring wells
2.3	Treatment System Piping	30	1	LS	$ 20,000	$ 20,000	
2.4	Permitting and Reporting	30	1	LS	$ 20,000	$ 20,000	
	Sub-Total					**$ 186,500**	
3	**Site Close Out**						
3.1	Monitoring Well Abandonment	15	21	EA	$ 1,500	$ 31,500	Drilling subcontractor, abandonment of monitoring wells.
3.2	Final Closure Report	15	1	LS	$ 50,000	$ 50,000	
	Sub-Total					**$ 81,500**	

PRESENT VALUE ANALYSIS: Rate of Return: 5% Inflation Rate: 3%

Item No.	Description	Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0		**$ 3,301,000**	
2	**Annual O&M Cost**	1-30	$ 856,343	**$ 19,334,000**	
3	**Periodic Costs**				
3.1	Year 5	5	$ 15,000	$ 13,625	
3.2	Year 10	10	$ 15,000	$ 12,376	
3.3	Year 15	15	$ 15,000	$ 11,241	
3.4	Year 20	20	$ 15,000	$ 10,211	
3.5	Year 25	25	$ 15,000	$ 9,274	
3.6	Year 30	30	$ 268,000	$ 150,512	
	Sub-Total			**$ 208,000**	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 22,843,000**	



N

0 0.25 0.5 0.75 1

Miles

Copyright © 2011 National Geographic Society, i-cubed

Active Potable Wells - Plainview Water District, Magothy Aquifer, Screened 482-540 ft

Nassau County Recharge Basin Label (528) is Basin Number

One Mile Radius from Site Location

South Huntington Water District Potable Wellfield

HDR

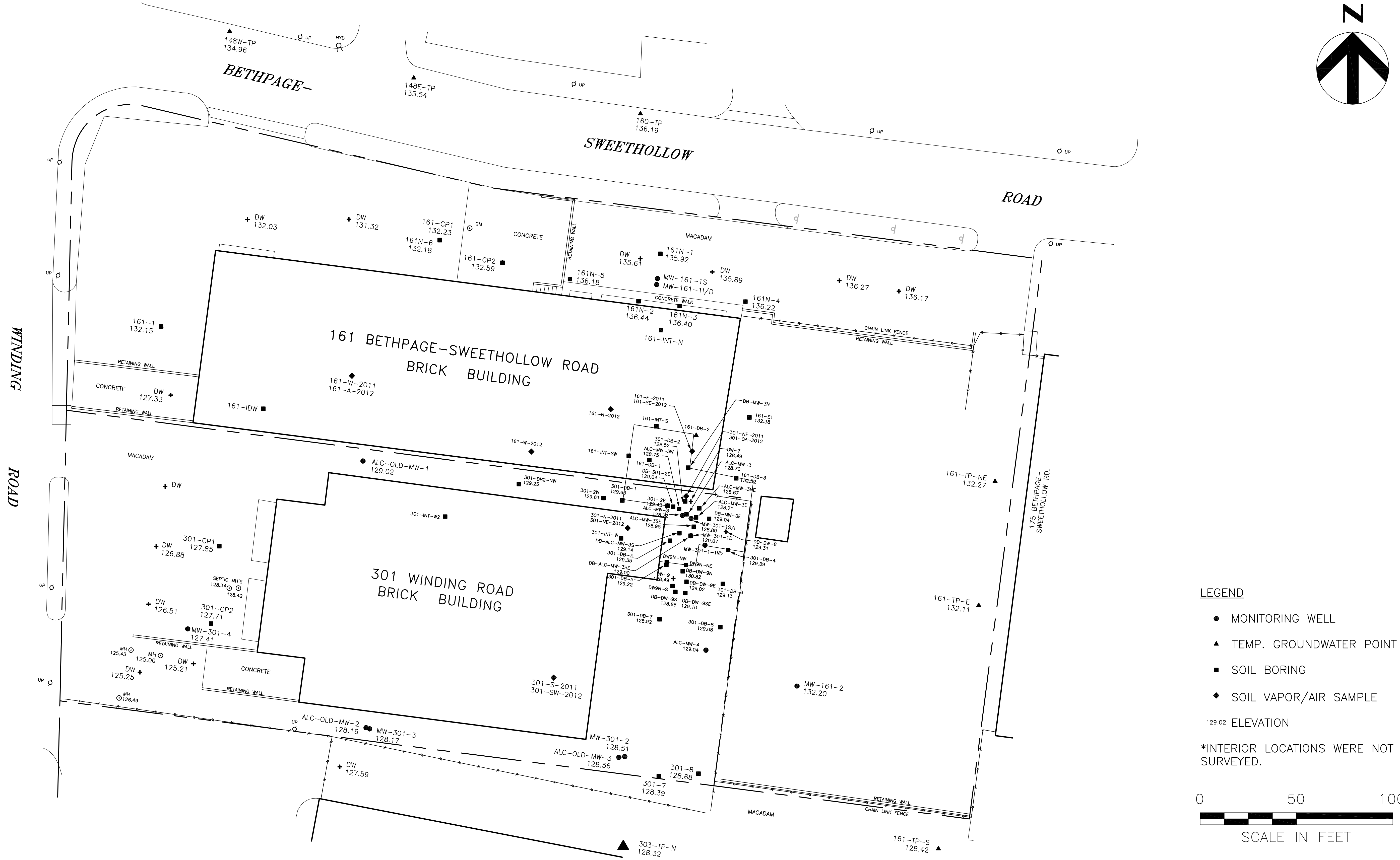
Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

Site Location Map (with Potable Wells and Recharge Basins)

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site #130195
Old Bethpage, NY

DATE
1-23-2013

FIGURE
1



HDR

Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

SITE PLAN

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130195
Old Bethpage, NY

DATE
01-24-2013

FIGURE
2

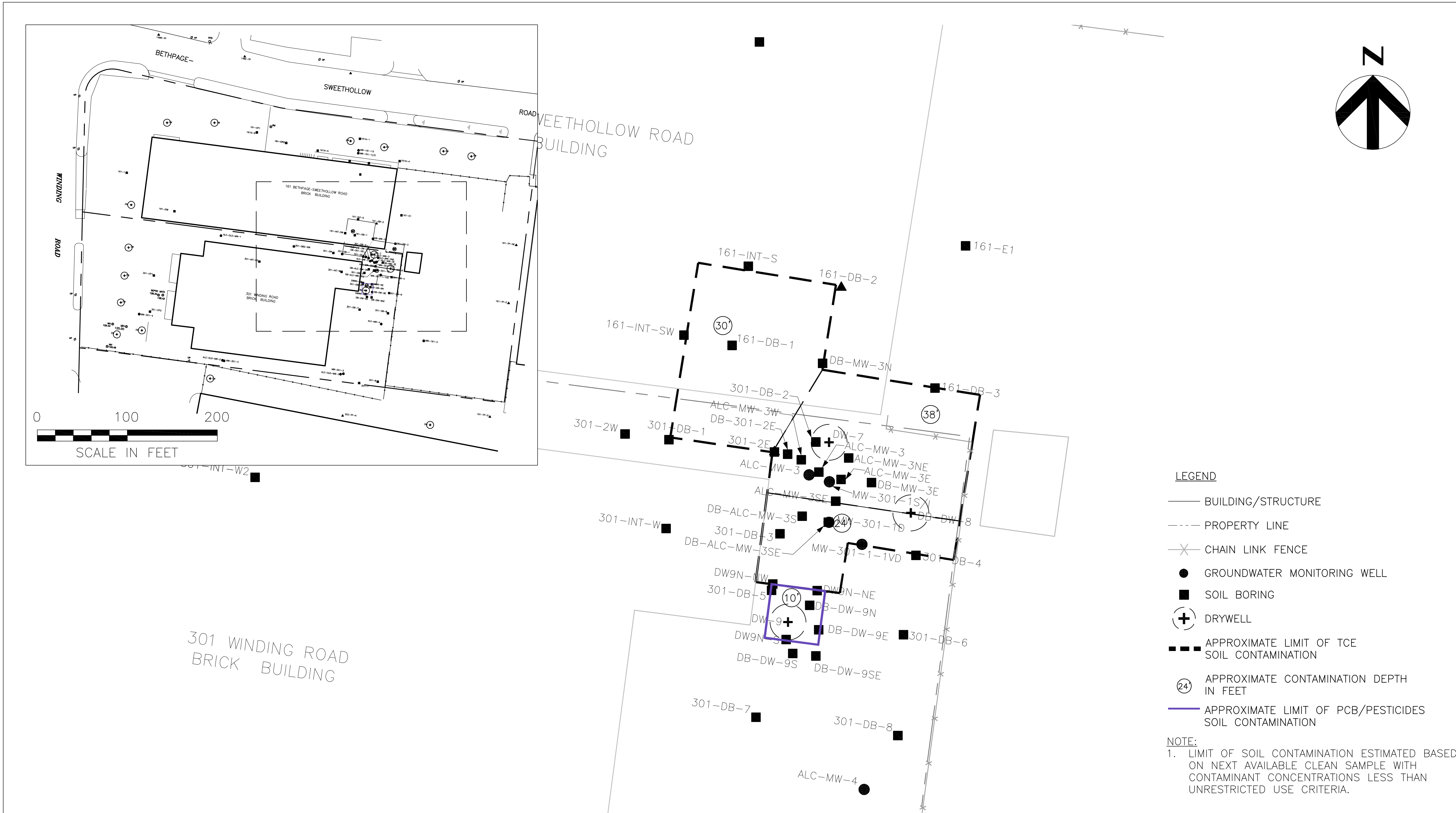
HDR

Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

Groundwater Elevations
Water Table, Intermediate and Deep Depth Wells (August 2012)

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130195
Old Bethpage, NY

DATE	FIGURE
01-24-2013	3



HDR

Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

NATURE AND EXTENT OF SOIL CONTAMINATION

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130196
Old Bethpage, NY

DATE	01-24-2013
FIGURE	4

DW-7	05/31/12
	DW-7-053112
Depth (ft)	3.5
1,1,1-TCA	7.1 ND
cis-1,2-DCE	34
PCE	2 J
TCE	29
Toluene	14
Xylene (Total)	7.1 ND

MW-301-1-SI	04/04/11	4/6/2011
	MW-301-1-14	MW-301-1-94
Depth (ft)	14	94
1,1,1-TCA	5.3 ND	5.7 ND
cis-1,2-DCE	5.3 ND	5.7 ND
PCE	3.4 J	5.7 ND
TCE	5.4	5.7 ND
Toluene	5.3 ND	5.7 ND
Xylene (Total)	1.4 J	5.7 ND

ALC-MW-3NE	01/19/11
	ALC-MW-3NE-18
Depth (ft)	18
1,1,1-TCA	3700 ND
cis-1,2-DCE	3700 ND
PCE	3700 ND
TCE	***<u>600000 D</u>***
Toluene	***<u>2200 J</u>***
Xylene (Total)	3700 ND

ALC-MW-3W	01/21/11
	ALC-MW-3W-17
Depth (ft)	17
1,1,1-TCA	190 J
cis-1,2-DCE	***<u>910</u>***
PCE	***<u>2900</u>***
TCE	***<u>380000 D</u>***
Toluene	***<u>1100</u>***
Xylene (Total)	400 ND

301-DB-2	03/16/11
	301-DB-2-18
Depth (ft)	18
1,1,1-TCA	***<u>3000 J</u>***
cis-1,2-DCE	8300 ND
PCE	***<u>13000</u>***
TCE	***<u>1000000 D</u>***
Toluene	***<u>4200 J</u>***
Xylene (Total)	8300 ND

161-DB-1	03/16/11
	161-DB-1-23
Depth (ft)	23
1,1,1-TCA	6.6 ND
cis-1,2-DCE	7.3
PCE	37
TCE	***<u>1000 D</u>***
Toluene	6.6 ND
Xylene (Total)	6.6 ND

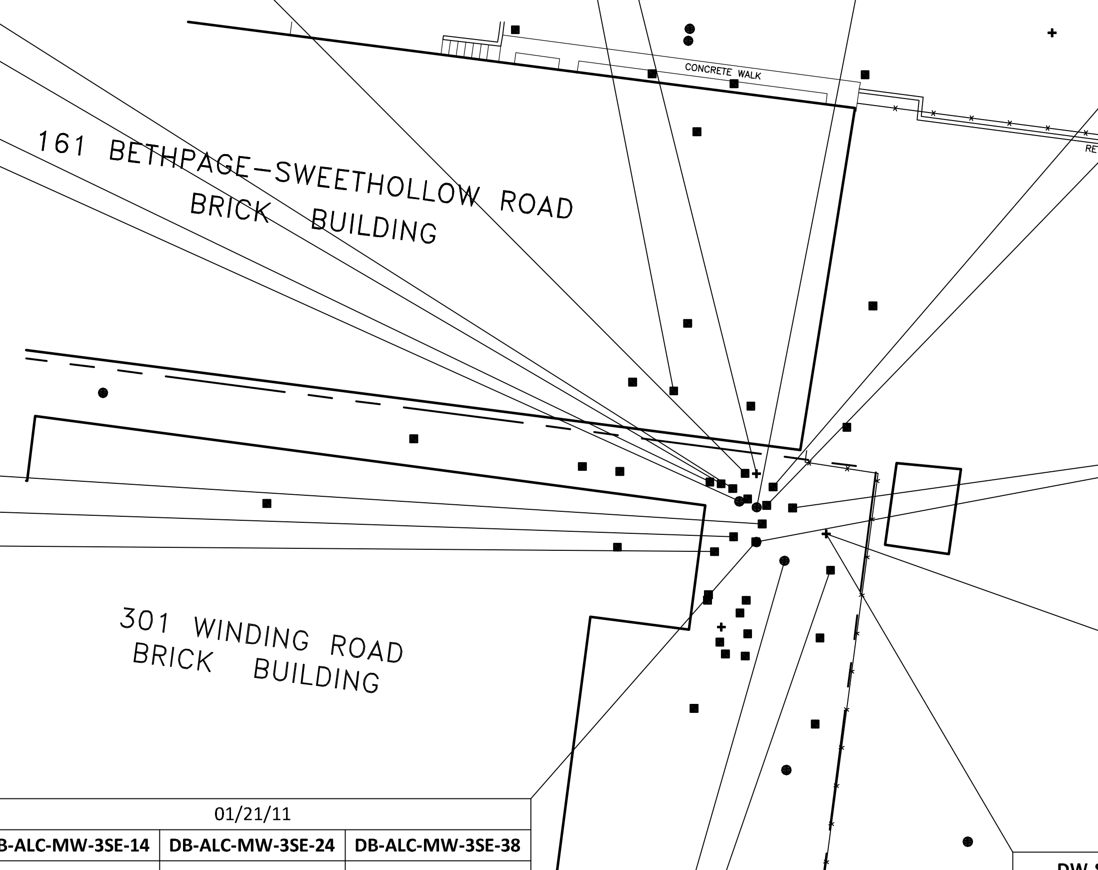
DB-301-2E	01/21/11	
	DB-301-2E-18	DB-301-2E-38
Depth (ft)	18	38
1,1,1-TCA	130 J	4.9 ND
cis-1,2-DCE	***<u>1000</u>***	4.9 ND
PCE	***<u>1500</u>***	4.9 ND
TCE	***<u>430000 D</u>***	2.2 B
Toluene	***<u>800</u>***	4.9 ND
Xylene (Total)	410 ND	4.9 ND

301-2E	01/11/11
	301-2E-11.5
Depth (ft)	11.5
All six results	5.7 ND

ALC-MW-3E	01/19/11	
	ALC-MW-3E-17	ALC-MW-3E-38
Depth (ft)	17	38
1,1,1-TCA	3800 ND	5.2 ND
cis-1,2-DCE	3800 ND	5.2 ND
PCE	***<u>4500</u>***	5.2 ND
TCE	***<u>140000</u>***	1.5 B
Toluene	***<u>1300 J</u>***	5.2 ND
Xylene (Total)	3800 ND	5.2 ND

ALC-MW3-SO	01/19/11		
	ALC-MW3-SO-18	ALC-MW3-SO-33	ALC-MW3-SO-44
Depth (ft)	18	33	44
1,1,1-TCA	4000 ND	5.4 ND	5.1 ND
cis-1,2-DCE	4000 ND	5.4 ND	5.1 ND
PCE	***<u>13000</u>***	5.4 ND	5.1 ND
TCE	***<u>950000 D</u>***	3.9 B	2.3 B
Toluene	***<u>3200 J</u>***	5.4 ND	5.1 ND
Xylene (Total)	4000 ND	5.4 ND	5.1 ND

ALC-MW-3SE	01/19/11
	ALC-MW-3SE-16
Depth (ft)	16
1,1,1-TCA	1600 ND
cis-1,2-DCE	1600 ND
PCE	1100 J
TCE	***<u>28000</u>***
Toluene	230 J
Xylene (Total)	1600 ND



DB-MW-3E	01/19/11
	DB-MW-3E-17.5
Depth (ft)	17.5
1,1,1-TCA	380 ND
cis-1,2-DCE	380 ND
PCE	290 J
TCE	***<u>1600</u>***
Toluene	39 J
Xylene (Total)	380 ND

MW-301-1-D	04/06/11
	MW-301-1-114
Depth (ft)	114
All six results	5.3 ND

DB-ALC-MW-3S	01/21/11
	DB-ALC-MW-3S-17
Depth (ft)	17
1,1,1-TCA	410 ND
cis-1,2-DCE	***<u>410 J</u>***
PCE	***<u>3600</u>***
TCE	***<u>6700</u>***
Toluene	220 J
Xylene (Total)	***<u>430</u>***

301-DB-3	03/16/11
	301-DB-3-17
Depth (ft)	17
1,1,1-TCA	220 J
cis-1,2-DCE	***<u>520 J</u>***
PCE	***<u>3300</u>***
TCE	***<u>32000</u>***
Toluene	680 J
Xylene (Total)	***<u>450 J</u>***

DB-DW-8	01/21/11
	DB-DW-8-15
Depth (ft)	15
1,1,1-TCA	4 J
cis-1,2-DCE	1.9 J
PCE	3.4 J
TCE	***<u>560 D</u>***
Toluene	2.5 B
Xylene (Total)	5.9 ND

DB-ALC-MW-3SE	01/21/11		
	DB-ALC-MW-3SE-14	DB-ALC-MW-3SE-24	DB-ALC-MW-3SE-38
Depth (ft)	14	24	38
1,1,1-TCA	220 J	5 ND	4.6 ND
cis-1,2-DCE	310 ND	5 ND	4.6 ND
PCE	***<u>11000 D</u>***	5 ND	4.6 ND
TCE	***<u>39000 D</u>***	2.4 B	1.5 B
Toluene	***<u>1400</u>***	5 ND	4.6 ND
Xylene (Total)	***<u>1800</u>***	5 ND	4.6 ND

DW-8	08/30/12
	DW-8-083012
Depth (ft)	14
Five results	11 ND
Toluene	8.3 J

301-DB-4	03/17/11
	301-DB-4-18
Depth (ft)	18
Five results	5.5 ND
TCE	19

MW-301-1-VD	05/10/12	
	MW-301-1-VD-26	MW-301-1-VD-185
Depth (ft)	26	185
All six results	5.1 ND	6.1 ND

<u>Notes</u>			
Result units:	µg/kg	micrograms per kilogram	<u>Criteria</u>
Abbreviations:	1,1,1-TCA	1) 1,1,1-Trichloroethane	680
	cis-1,2-DCE	2) cis-1,2-Dichloroethene	250
	PCE	3) Tetrachloroethene	1300
	TCE	4) Trichloroethene	470
		5) Toluene	700
		6) Xylene (Total)	260
	ND	not detected	
	NDJ	not detected; estimated value	
	D	value from secondary dilution analysis	
	J	estimated value	
	B	also detected in associated method blank	

Criteria: 6NYCRR Part 375 Unrestricted Use Soil Cleanup Objectives

Bold/italic/underlined value in table is exceedance of applicable criteria

N

GROUNDWATER FLOW

LEGEND

● MONITORING WELL

■ SOIL BORING

+ DRYWELL

0 50 100

SCALE IN FEET

HDR

Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

Soil Sample Results
301 Winding Road - Eastern Portion of the Site
Chlorinated VOCs, Toluene and Xylene

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130195
Old Bethpage, NY

DATE **01-24-2013**

FIGURE **5**

161-W-2011/	1/13/2011		3/12/2012	
161-A-2012	161-W-AMB	161-W-SS-1	161-A-IA	161-A-SS
Depth	BZ	0" - 6"	BZ	0" - 6"
1,1,1-TCA	0.83 ND	0.83 ND	0.83 ND	120
PCE	11	1.4	3.1	1100
TCE	0.49	0.98	2	460

161-N-2012	3/12/2012	
	161-N-IA	161-N-SS
Depth	BZ	0" - 6"
1,1,1-TCA	0.83 ND	560
PCE	34	2000
TCE	2.8	8600

N

161-E-2011/ 161-SE-2012	1/13/2011		3/12/2012	
	161-E-AMB	161-E-SS	161-SE-IA	161-SE-SS
Depth	BZ	0" - 6"	BZ	0" - 6"
1,1,1-TCA	0.83 ND	4.9	0.83 ND	530
PCE	***<u>3200*</u>***	3000	57	1300
TCE	2.6	52	2.9	4200

*Chemicals used indoors at this location assumed to have contributed to indoor air result

301-NE-2011/ 301-OA-2012	1/13/2011	3/12/2012
	301-NE-OA	301-OA
Depth	BZ	BZ
1,1,1-TCA	0.83 ND	0.83 NDJ
PCE	5.9	3.8 J
TCE	1.7	3.8 J

161-W-2012	3/12/2012	
	161-W-IA	161-W-SS
Depth	BZ	0" - 6"
1,1,1-TCA	0.83 ND	100
PCE	14	2000
TCE	3.8	9500

301-N-2011/ 301-NE-2012	1/13/2011		3/12/2012
	301-N-AMB	301-N-SS	301-NE-SS1
Depth	BZ	0" - 6"	0" - 6"
1,1,1-TCA	0.83 ND	0.83 ND	260
PCE	3.7	2	2100
TCE	1.9	1.4	9000

LEGEND

◆ SOIL VAPOR/AIR SAMPLE

Notes			
Result units:	$\mu g/m^3$	micrograms per cubic meter	Criteria
Abbreviations:	1,1,1-TCA	1,1,1-Trichloroethane	NA
	PCE	Tetrachloroethene	100 $\mu g/m^3$
	TCE	Trichloroethene	5 $\mu g/m^3$
NA - not available		SS - sub-slab soil vapor sample	
IA - indoor air sample		AMB - ambient (indoor) air sample	
OA - outdoor air sample		BZ - breathing zone (approx. 4-5 ft above floor)	
		Results Qualifiers:	
		ND - not detected	
		NDJ - not detected; detection limit estimated	
		J - estimated concentration	
Criteria: NYS Dept. of Health indoor air guideline values			
Bold/italic/underlined value in table is exceedance of applicable criteria			

301-S-2011/ 301-SW-2012	1/13/2011		3/12/2012
	301-S-AMB	301-S-SS	301-SW-SS
Depth	BZ	0" - 6"	0" - 6"
1,1,1-TCA	0.83 ND	1.3	440
PCE	2.4	3.9	8300
TCE	1.9	2.9	23000

0 50 100

SCALE IN FEET

HDR

Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

Vapor Intrusion Samples

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130195
Old Bethpage, NY

DATE **01-24-2013**

FIGURE **6**

161-1	1/17/2011		
	161-1-66	161-1-91	161-1-116
Depth (ft)	66	91	116
1,1,1-TCA	1 ND	1 ND	1 ND
1,1,2-TCA	1 ND	1 ND	1 ND
1,1-DCA	1 ND	1 ND	1 ND
cis-1,2-DCE	1 ND	1 ND	1 ND
PCE	1 ND	1 ND	1 ND
TCE	1.5	1 ND	1 ND

161-CP-2	1/13/2011		
	161-CP2-66	161-CP2-91	161-CP2-121
Depth (ft)	66	91	121
1,1,1-TCA	1 ND	1 ND	1 ND
1,1,2-TCA	1 ND	1 ND	1 ND
1,1-DCA	1 ND	1 ND	1 ND
cis-1,2-DCE	1 ND	1 ND	1 ND
PCE	1 ND	1 ND	1 ND
TCE	1.9	1.4	1.7

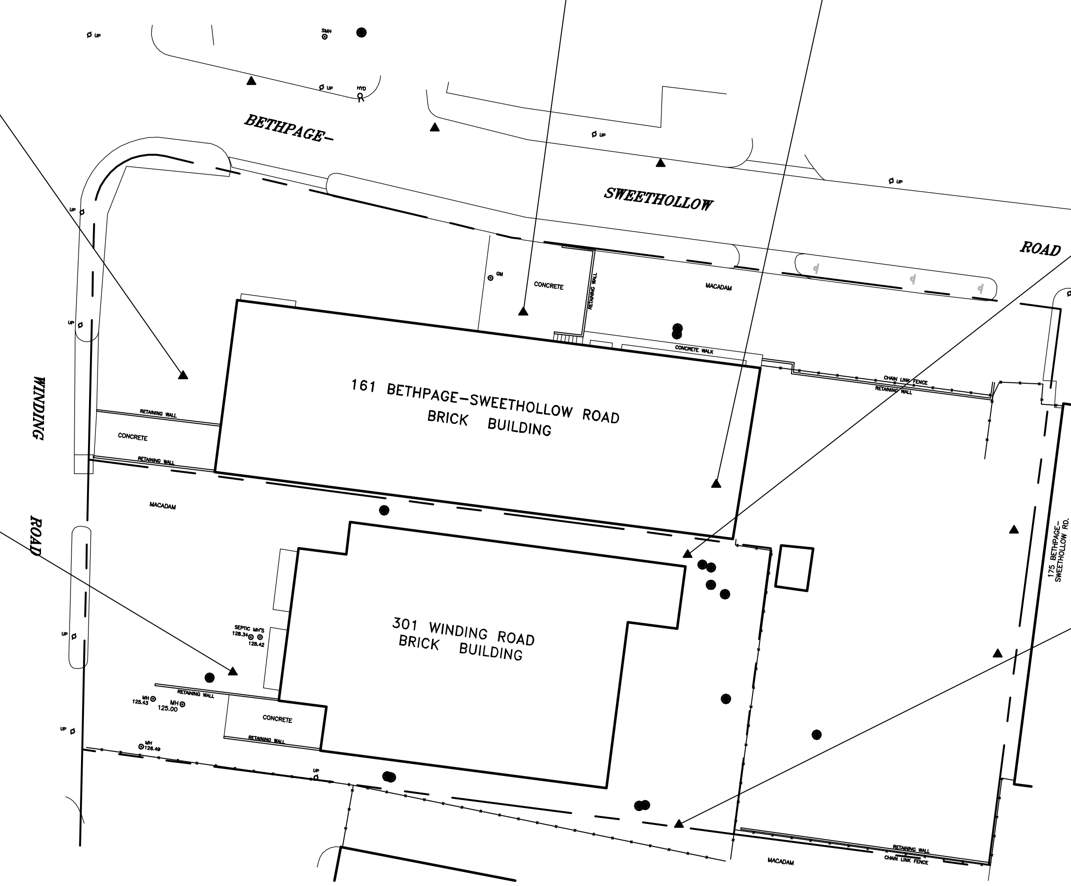
161-DB-2	3/16/2011
	161-DB-2-66
Depth (ft)	66
1,1,1-TCA	***<u>8</u>***
1,1,2-TCA	0.56 J
1,1-DCA	1 ND
cis-1,2-DCE	***<u>22</u>***
PCE	***<u>30</u>***
TCE	***<u>1000 D</u>***

301-2E	1/12/2011		
	301-2E-58	301-2E-91	301-2E-111
Depth (ft)	58	91	111
1,1,1-TCA	1 ND	1 ND	1 ND
1,1,2-TCA	1 ND	1 ND	1 ND
1,1-DCA	1 ND	1 ND	1 ND
cis-1,2-DCE	2.1	0.73 J	0.59 J
PCE	1.3	0.77 J	1 ND
TCE	***<u>56 J</u>***	***<u>22</u>***	***<u>14</u>***

301-CP2	1/18/2011		
	301-CP2-60	301-CP2-91	301-CP2-121
Depth (ft)	60	91	121
1,1,1-TCA	1 ND	1 ND	1 ND
1,1,2-TCA	1 ND	1 ND	1 ND
1,1-DCA	1 ND	1 ND	1 ND
cis-1,2-DCE	1 ND	1 ND	1 ND
PCE	1 ND	1 ND	1 ND
TCE	1 ND	1 ND	1 ND
Acetone*	***<u>130</u>***	***<u>120</u>***	***<u>160</u>***

*Acetone criteria is 50 ug/L

301-7	1/12/2011		
	301-7-58	301-7-91	301-7-121
Depth (ft)	58	91	121
1,1,1-TCA	1 ND	1 ND	1 ND
1,1,2-TCA	1 ND	1 ND	1 ND
1,1-DCA	1 ND	1 ND	1 ND
cis-1,2-DCE	0.58 J	1 ND	1 ND
PCE	1	1 ND	1 ND
TCE	***<u>18 J</u>***	1	2.4



Notes

Result units:	µg/l	micrograms per liter	Criteria
Abbreviations:	1,1,1-TCA	1,1,1-Trichloroethane	5
	1,1,2-TCA	1,1,2-Trichloroethane	1
	1,1-DCA	1,1-Dichloroethane	5
	cis-1,2-DCE	cis-1,2-Dichloroethene	5
	PCE	Tetrachloroethene	5
	TCE	Trichloroethene	5
	ND	not detected	
	NDJ	not detected; estimated value	
	D	value from secondary dilution analysis	
	NJ	tentative ID, estimated J estimated value	
	B	also detected in associated method blank	

Criteria: Part 703: Surface Water and Groundwater Quality Standards (Class GA)
Bold/italic/underlined value in table is exceedance of applicable criteria

LEGEND
● MONITORING WELL
▲ TEMP. GROUNDWATER POINT

0 100 200
SCALE IN FEET

HDR
Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

Groundwater Sampling Results
On-Site Chlorinated VOCs and Acetone - January and March 2011 (1 of 5)
Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130195
Old Bethpage, NY

DATE 01-24-2013
FIGURE 7a

MW-161-1-ID	5/17/2011	5/17/2011
	MW-161-1-I-1	MW-161-1-D-1
Depth (ft)	85-95	114.5-124.5
1,1,1-TCA	3.5	1 ND
1,1,2-TCA	1 ND	1 ND
1,1-DCA	1 ND	1 ND
cis-1,2-DCE	***10***	1 ND
PCE	***8.5***	1 ND
TCE	***1100 D***	***18***

MW-161-1-S	5/17/2011
	MW-161-1-S-1
Depth (ft)	60-70
1,1,1-TCA	1 ND
1,1,2-TCA	1 ND
1,1-DCA	1 ND
cis-1,2-DCE	1 ND
PCE	1 ND
TCE	***26***

ALC-MW3	5/23/2011
	ALC-MW3-WT-1
Depth (ft)	59.8
1,1,1-TCA	***20***
1,1,2-TCA	***2.8***
1,1-DCA	***6.4***
cis-1,2-DCE	***110***
PCE	***26***
TCE	***2400 D***

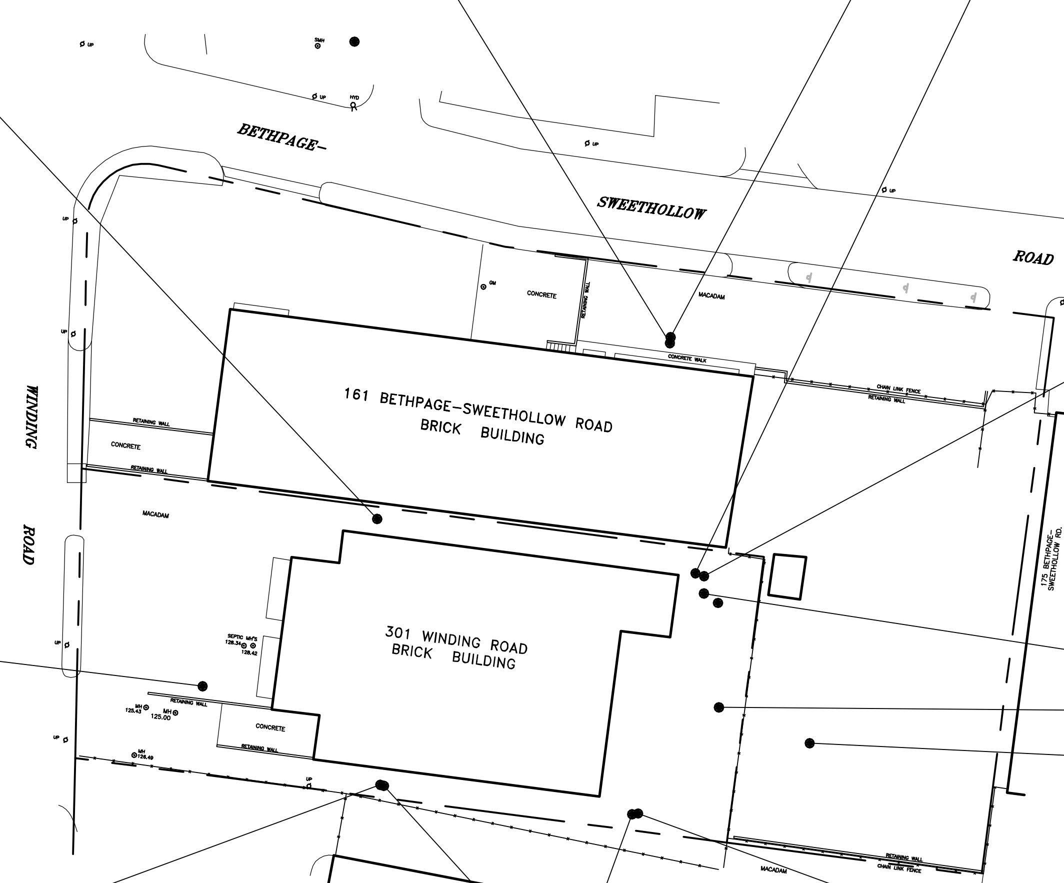
GROUNDWATER FLOW

N

ALC-OLD-MW1	5/23/2011
	ALC-OLD-MW1-WT
Depth (ft)	60.2
1,1,1-TCA	1 ND
1,1,2-TCA	1 ND
1,1-DCA	1 ND
cis-1,2-DCE	1 ND
PCE	1 ND
TCE	1 ND

MW-301-1-SI	5/23/2011	5/23/2011
	MW-301-1-S-1	MW-301-1-I-1
Depth (ft)	56-66	85-95
1,1,1-TCA	***8.6***	1 ND
1,1,2-TCA	***1.9***	1 ND
1,1-DCA	2.1	1 ND
cis-1,2-DCE	***49***	4.1
PCE	***31***	0.68 J
TCE	***1700 D***	***78***

MW-301-4	5/18/2011	5/19/2011	5/18/2011
	MW-301-4-S-1	MW-301-4-I-1	MW-301-4-D-1
Depth (ft)	55-65	85-95	115-125
1,1,1-TCA	1 ND	1 ND	1 ND
1,1,2-TCA	1 ND	1 ND	1 ND
1,1-DCA	1 ND	1 ND	1 ND
cis-1,2-DCE	1.7	1 ND	1 ND
PCE	1 ND	1 ND	1 ND
TCE	0.74 J	1 ND	1 ND



MW-301-1-D	5/23/2011
	MW-301-1-D-1
Depth (ft)	115-125
1,1,1-TCA	1 ND
1,1,2-TCA	1 ND
1,1-DCA	1 ND
cis-1,2-DCE	1
PCE	0.81 J
TCE	***66***

ALC-MW4	5/23/2011
	ALC-MW4-WT-1
Depth (ft)	60
1,1,1-TCA	3
1,1,2-TCA	1 ND
1,1-DCA	1 ND
cis-1,2-DCE	***6.5***
PCE	4.5
TCE	***250 D***

ALC-OLD-MW2	5/19/2011
	ALC-OLD-MW2-WT-1
Depth (ft)	58.8
1,1,1-TCA	1 ND
1,1,2-TCA	1 ND
1,1-DCA	1 ND
cis-1,2-DCE	0.86 J
PCE	1 ND
TCE	***5.3***

MW-161-2	5/20/2011	5/20/2011	5/20/2011
	MW-161-2-S-1	MW-161-2-I-1	MW-161-2-D-1
Depth (ft)	60-70	85-95	115-125
1,1,1-TCA	0.71 NJ	0.77 NJ	1 ND
1,1,2-TCA	1 ND	1 ND	1 NDJ
1,1-DCA	1 ND	1 ND	1 ND
cis-1,2-DCE	0.94 J	4.4	1 ND
PCE	3.1	1.5	1 ND
TCE	***66***	***95***	***23***

MW-301-3	5/19/2011	5/19/2011
	MW-301-3-I-1	MW-301-3-D-1
Depth (ft)	81-91	112-122
1,1,1-TCA	1 ND	1 ND
1,1,2-TCA	1 ND	1 ND
1,1-DCA	1 ND	1 ND
cis-1,2-DCE	1 ND	1 ND
PCE	1 ND	1 ND
TCE	1.7	1 ND

ALC-OLD-MW3	5/20/2011
	ALC-OLD-MW3-WT-1
Depth (ft)	59.9
1,1,1-TCA	1.4 NJ
1,1,2-TCA	1 ND
1,1-DCA	1 ND
cis-1,2-DCE	***8.2***
PCE	4.7
TCE	***250 D***

MW-301-2	5/20/2011	5/20/2011
	MW-301-2-I-1	MW-301-2-D-1
Depth (ft)	85-95	112-122
1,1,1-TCA	1 ND	1 ND
1,1,2-TCA	1 ND	1 ND
1,1-DCA	1 ND	1 ND
cis-1,2-DCE	1 ND	1 ND
PCE	1 ND	1 ND
TCE	***15***	1.4

LEGEND

● MONITORING WELL

Notes

Result units:	µg/l	micrograms per liter	Criteria
Abbreviations:	1,1,1-TCA	1,1,1-Trichloroethane	5
	1,1,2-TCA	1,1,2-Trichloroethane	1
	1,1-DCA	1,1-Dichloroethane	5
	cis-1,2-DCE	cis-1,2-Dichloroethene	5
	PCE	Tetrachloroethene	5
	TCE	Trichloroethene	5
	ND	not detected	
	NDJ	not detected; estimated value	
	D	value from secondary dilution analysis	
	NJ	tentative ID, estimated J estimated value	
	B	also detected in associated method blank	

Criteria: Part 703: Surface Water and Groundwater Quality Standards (Class GA)

Bold/italic/underlined value in table is exceedance of applicable criteria

0 100 200

SCALE IN FEET

HDR

Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

Groundwater Sampling Results
On-Site Chlorinated VOCs -
May 2011 (2 of 5)
Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130195
Old Bethpage, NY

DATE 01-24-2013

FIGURE 7b

ALC-MW3	7/22/2011
	ALC-MW3-WT-2
Depth (ft)	59.8
1,1,1-TCA	***19***
1,1,2-TCA	***2.7***
1,1-DCA	***7.4***
cis-1,2-DCE	***100***
PCE	***17***
TCE	***2400 D***

MW-161-1-ID	7/19/2011	7/25/2011
	MW-161-1-I-2	MW-161-1-D-2
Depth (ft)	85-95	114.5-124.5
1,1,1-TCA	2.4	1 ND
1,1,2-TCA	1 ND	1 ND
1,1-DCA	1 ND	1 ND
cis-1,2-DCE	***7.9***	0.51 J
PCE	1 ND	1 ND
TCE	***190 D***	***43***

MW-161-1-S	7/18/2011
	MW-161-1-S-2
Depth (ft)	60-70
1,1,1-TCA	1 ND
1,1,2-TCA	1 ND
1,1-DCA	1 ND
cis-1,2-DCE	1 ND
PCE	1 ND
TCE	4.6

MW-301-1-SI	7/22/2011	7/22/2011
	MW-301-1-S-2	MW-301-1-I-2
Depth (ft)	56-66	85-95
1,1,1-TCA	***11***	1 ND
1,1,2-TCA	***2.6***	1 ND
1,1-DCA	2.5	1 ND
cis-1,2-DCE	***68***	2.9
PCE	***39***	0.82 J
TCE	***2500 D***	***45***

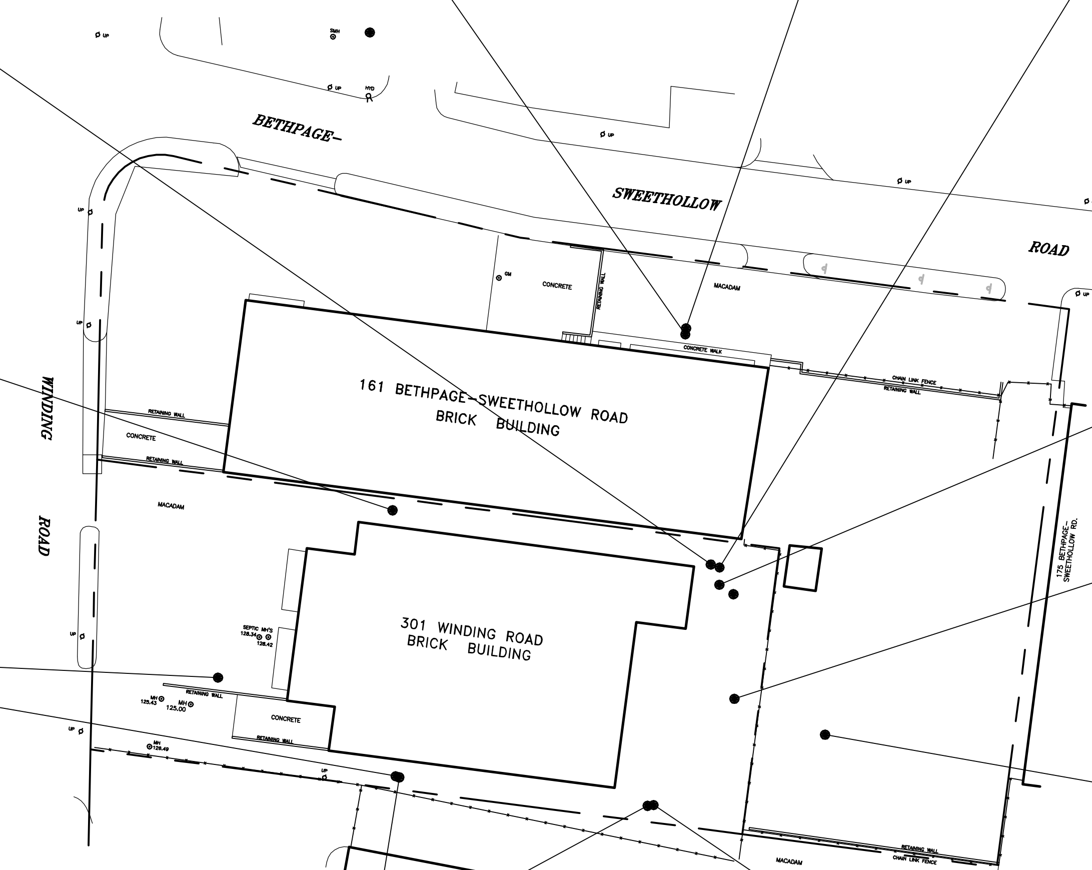
GROUNDWATER FLOW

N

ALC-OLD-MW1	7/21/2011
	ALC-OLD-MW1-WT
Depth (ft)	60.2
1,1,1-TCA	1 ND
1,1,2-TCA	1 ND
1,1-DCA	1 ND
cis-1,2-DCE	1 ND
PCE	1 ND
TCE	1.6

MW-301-1-D	7/22/2011
	MW-301-1-D-2
Depth (ft)	115-125
1,1,1-TCA	1 ND
1,1,2-TCA	1 ND
1,1-DCA	1 ND
cis-1,2-DCE	0.67 J
PCE	1 ND
TCE	***17***

ALC-MW4	7/21/2011
	ALC-MW4-WT-2
Depth (ft)	60
1,1,1-TCA	1.2
1,1,2-TCA	1 ND
1,1-DCA	1 ND
cis-1,2-DCE	5
PCE	1 ND
TCE	***67***



MW-301-4	7/19/2011	7/19/2011	7/19/2011
	MW-301-4-S-2	MW-301-4-I-2	MW-301-4-D-2
Depth (ft)	55-65	85-95	115-125
1,1,1-TCA	1 ND	1 ND	1 ND
1,1,2-TCA	1 ND	1 ND	1 ND
1,1-DCA	1 ND	1 ND	1 ND
cis-1,2-DCE	***5.6***	1 ND	1 ND
PCE	1 ND	1 ND	1 ND
TCE	***6.3***	1 ND	1 ND

MW-161-2	7/20/2011	7/20/2011	7/20/2011
	MW-161-2-S-2	MW-161-2-I-2	MW-161-2-D-2
Depth (ft)	60-70	85-95	115-125
1,1,1-TCA	0.74 J	1 ND	1 ND
1,1,2-TCA	1 ND	1 ND	1 ND
1,1-DCA	1 ND	1 ND	1 ND
cis-1,2-DCE	0.83 J	3.9	1 ND
PCE	1 ND	1 ND	1 ND
TCE	***36***	***26***	***23***

ALC-OLD-MW2	7/21/2011
	ALC-OLD-MW2-WT-2
Depth (ft)	58.8
1,1,1-TCA	1 ND
1,1,2-TCA	1 ND
1,1-DCA	1 ND
cis-1,2-DCE	1.3
PCE	1 ND
TCE	***8***

MW-301-2	7/21/2011	7/21/2011
	MW-301-2-I-2	MW-301-2-D-2
Depth (ft)	85-95	112-122
1,1,1-TCA	1 ND	1 ND
1,1,2-TCA	1 ND	1 ND
1,1-DCA	1 ND	1 ND
cis-1,2-DCE	1 ND	1 ND
PCE	1 ND	1 ND
TCE	4.2	0.87 J

MW-301-3	7/19/2011	7/19/2011
	MW-301-3-I-2	MW-301-3-D-2
Depth (ft)	81-91	112-122
1,1,1-TCA	1 ND	1 ND
1,1,2-TCA	1 ND	1 ND
1,1-DCA	1 ND	1 ND
cis-1,2-DCE	1 ND	1 ND
PCE	1 ND	1 ND
TCE	1.8	1 ND

ALC-OLD-MW3	7/21/2011
	ALC-OLD-MW3-WT-2
Depth (ft)	59.9
1,1,1-TCA	1.8
1,1,2-TCA	1 ND
1,1-DCA	1 ND
cis-1,2-DCE	***11***
PCE	3.2
TCE	***260 D***

Notes			
Result units:	µg/l	micrograms per liter	Criteria
Abbreviations:	1,1,1-TCA	1,1,1-Trichloroethane	5
	1,1,2-TCA	1,1,2-Trichloroethane	1
	1,1-DCA	1,1-Dichloroethane	5
	cis-1,2-DCE	cis-1,2-Dichloroethene	5
	PCE	Tetrachloroethene	5
	TCE	Trichloroethene	5
	ND	not detected	
	NDJ	not detected; estimated value	
	D	value from secondary dilution analysis	
	NJ	tentative ID, estimated J estimated value	
	B	also detected in associated method blank	

Criteria: Part 703: Surface Water and Groundwater Quality Standards (Class GA)

Bold/italic/underlined value in table is exceedance of applicable criteria

LEGEND

● MONITORING WELL

0 100 200

SCALE IN FEET

HDR

Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

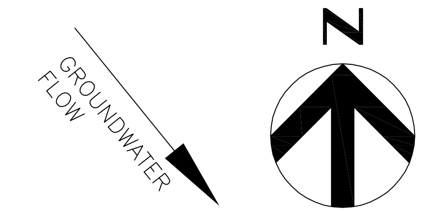
Groundwater Sampling Results
On-Site Chlorinated VOCs -
July 2011 (3 of 5)
Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130195
Old Bethpage, NY

DATE 01-24-2013

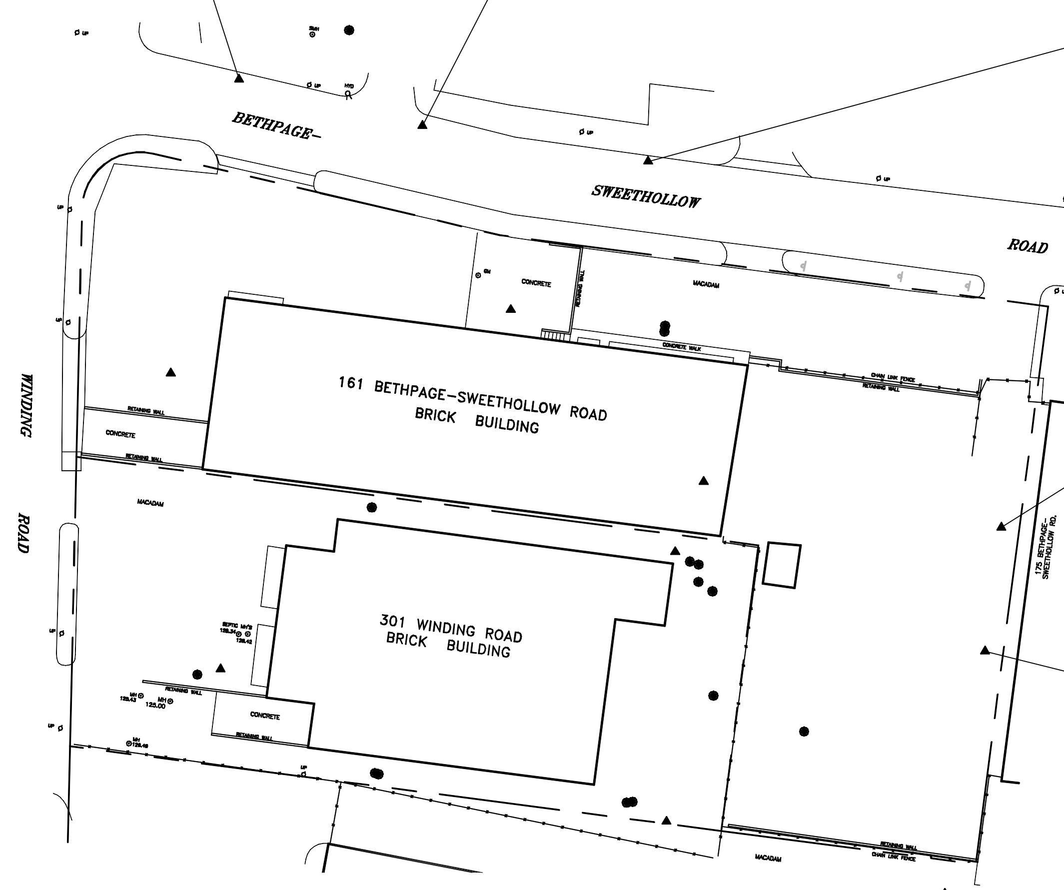
FIGURE 7c

148W-TP	3/21/2012		
	148W-TP-75	148W-TP-95	148W-TP-125
Depth (ft)	75	95	125
1,1,1-TCA	1 ND	1 ND	1 ND
1,1,2-TCA	1 ND	1 ND	1 ND
1,1-DCA	1 ND	1 ND	1 ND
cis-1,2-DCE	1 ND	1 ND	1 ND
PCE	1 ND	1 ND	1 ND
TCE	0.73 J	1 ND	1 ND

148E-TP	3/20/2012			
	148E-TP-70	148E-TP-95	148E-TP-115	148E-TP-125
Depth (ft)	70	95	115	125
1,1,1-TCA	1 ND	1 ND	1 ND	1 ND
1,1,2-TCA	1 ND	1 ND	1 ND	1 ND
1,1-DCA	1 ND	1 ND	1 ND	1 ND
cis-1,2-DCE	1 ND	1 ND	1 ND	1 ND
PCE	1 ND	1 ND	1 ND	1 ND
TCE	1 ND	1 ND	1 ND	1 ND



160-TP	3/21/2012		
	160-TP-75	160-TP-95	160-TP-125
Depth (ft)	75	95	125
1,1,1-TCA	1 ND	1 ND	1 ND
1,1,2-TCA	1 ND	1 ND	1 ND
1,1-DCA	1 ND	1 ND	1 ND
cis-1,2-DCE	1 ND	1 ND	1 ND
PCE	1 ND	1 ND	0.73 J
TCE	2.7	3.1	***6***



161-TP-NE	3/12/2012		
	161-TP-NE-70	161-TP-NE-95	161-TP-NE-125
Depth (ft)	70	95	125
1,1,1-TCA	4.4 NJ	1.6 NDJ	1 ND
1,1,2-TCA	1 ND	1 ND	1 ND
1,1-DCA	1 ND	1 ND	1 ND
cis-1,2-DCE	***9.3 J***	***5.3 J***	1 ND
PCE	***8.8 J***	***11 J***	1 ND
TCE	***550 J***	***410 J***	***27 J***

161-TP-E	3/13/2012
	161-TP-E-125
Depth (ft)	125
1,1,1-TCA	5 ND
1,1,2-TCA	5 ND
1,1-DCA	5 ND
cis-1,2-DCE	5 ND
PCE	***8.2 J***
TCE	***220 J***

LEGEND

- ● MONITORING WELL
- ▲ TEMP. GROUNDWATER POINT

161-TP-S	3/8/2012	3/8/2012	3/9/2012
	161-TP-S-60	161-TP-S-85	161-TP-S-115
Depth (ft)	60	85	115
1,1,1-TCA	1.5	1.7	1 ND
1,1,2-TCA	1 ND	1 ND	1 ND
1,1-DCA	1 ND	1 ND	1 ND
cis-1,2-DCE	2.7	2.8	1 ND
PCE	***11***	***12***	1 ND
TCE	***180 J***	***200 J***	2

Notes			
Result units:	µg/l	micrograms per liter	Criteria
Abbreviations:	1,1,1-TCA	1,1,1-Trichloroethane	5
	1,1,2-TCA	1,1,2-Trichloroethane	1
	1,1-DCA	1,1-Dichloroethane	5
	cis-1,2-DCE	cis-1,2-Dichloroethene	5
	PCE	Tetrachloroethene	5
	TCE	Trichloroethene	5
	ND	not detected	
	NDJ	not detected; estimated value	
	D	value from secondary dilution analysis	
	NJ	tentative ID, estimated J estimated value	
	B	also detected in associated method blank	
Criteria: Part 703: Surface Water and Groundwater Quality Standards (Class GA)			
Bold/italic/underlined value in table is exceedance of applicable criteria			

0 100 200

SCALE IN FEET

HDR

Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

Groundwater Sampling Results
On-Site and Upgradient Chlorinated VOCs -
March 2012 (4 of 5)

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130195
Old Bethpage, NY

DATE 01-24-2013

FIGURE 7d

N

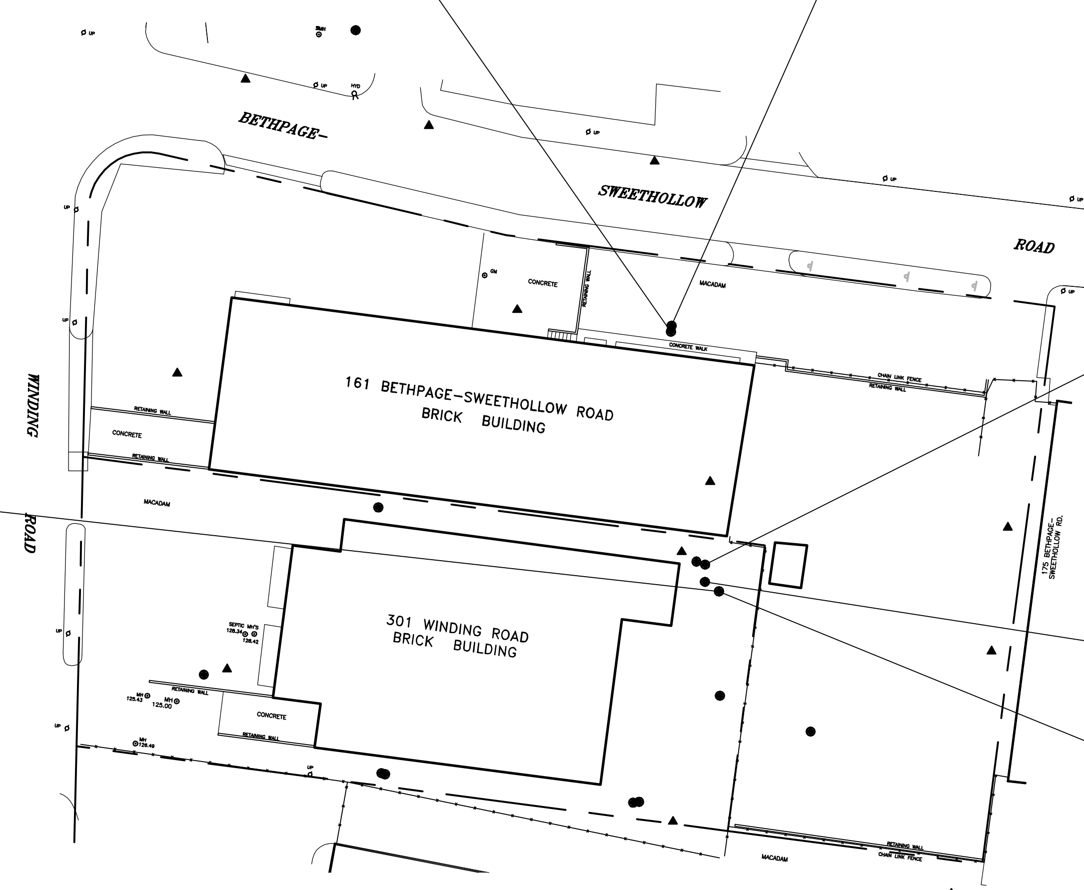
GROUNDWATER FLOW

MW-161-1-ID	8/23/2012	8/23/2012
	MW-161-1-I-3	MW-161-1-D-3
Depth (ft)	85-95	114.5-124.5
1,1,1-TCA	0.84 J	1 ND
1,1,2-TCA	1 ND	1 ND
1,1-DCA	1 ND	1 ND
cis-1,2-DCE	***5.1***	0.6 J
PCE	1 ND	1 ND
TCE	***80***	***24***

MW-161-1-S	8/23/2012
	MW-161-1-S-3
Depth (ft)	60-70
1,1,1-TCA	0.6 J
1,1,2-TCA	1 ND
1,1-DCA	1 ND
cis-1,2-DCE	1 ND
PCE	1.4
TCE	***60***

MW-301-1-SI	8/23/2012	8/23/2012
	MW-301-1-S-3	MW-301-1-I-3
Depth (ft)	56-66	85-95
1,1,1-TCA	4.5	1 ND
1,1,2-TCA	***2.2***	1 ND
1,1-DCA	1.2	1 ND
cis-1,2-DCE	***38***	1.2
PCE	0.79 J	1 ND
TCE	***500 D***	***18***

MW-301-1-VD	6/20/2012
	MW-301-1-183-1
Depth (ft)	173-183
1,1,1-TCA	1 ND
1,1,2-TCA	1 ND
1,1-DCA	1 ND
cis-1,2-DCE	1 ND
PCE	1 ND
TCE	0.73 J



MW-301-1-D	8/23/2012
	MW-301-1-D-3
Depth (ft)	115-125
1,1,1-TCA	1 ND
1,1,2-TCA	1 ND
1,1-DCA	1 ND
cis-1,2-DCE	0.82 J
PCE	1 ND
TCE	***5.1***

MW-301-1-VD	8/24/2012
	MW-301-1-183-2
Depth (ft)	173-183
1,1,1-TCA	1 ND
1,1,2-TCA	1 ND
1,1-DCA	1 ND
cis-1,2-DCE	1 ND
PCE	0.71 J
TCE	0.89 J

LEGEND

- ● MONITORING WELL
- ▲ TEMP. GROUNDWATER POINT

Notes			
Result units:	µg/l	micrograms per liter	Criteria
Abbreviations:	1,1,1-TCA	1,1,1-Trichloroethane	5
	1,1,2-TCA	1,1,2-Trichloroethane	1
	1,1-DCA	1,1-Dichloroethane	5
	cis-1,2-DCE	cis-1,2-Dichloroethene	5
	PCE	Tetrachloroethene	5
	TCE	Trichloroethene	5
	ND	not detected	
	NDJ	not detected; estimated value	
	D	value from secondary dilution analysis	
	NJ	tentative ID, estimated J estimated value	
	B	also detected in associated method blank	
Criteria: Part 703: Surface Water and Groundwater Quality Standards (Class GA)			
Bold/italic/underlined value in table is exceedance of applicable criteria			

0 100 200

SCALE IN FEET

HDR

Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

Groundwater Sampling Results
On-Site Chlorinated VOCs -
Summer 2012 (5 of 5)

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130195
Old Bethpage, NY

DATE 01-24-2013

FIGURE 7e

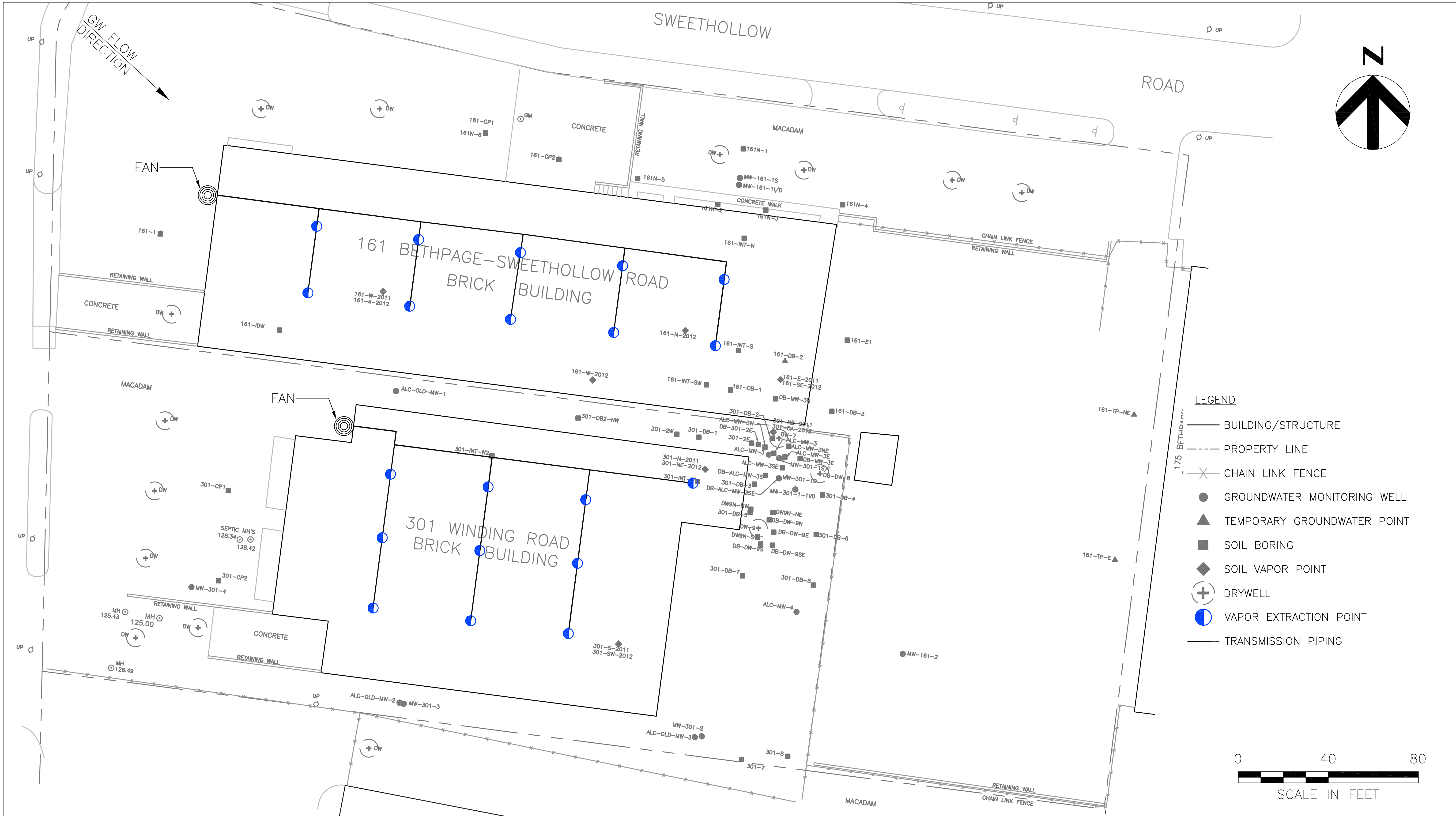
HDR

Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

NATURE AND EXTENT OF GROUNDWATER CONTAMINATION

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130196
Old Bethpage, NY

DATE	FIGURE
01-24-2013	8



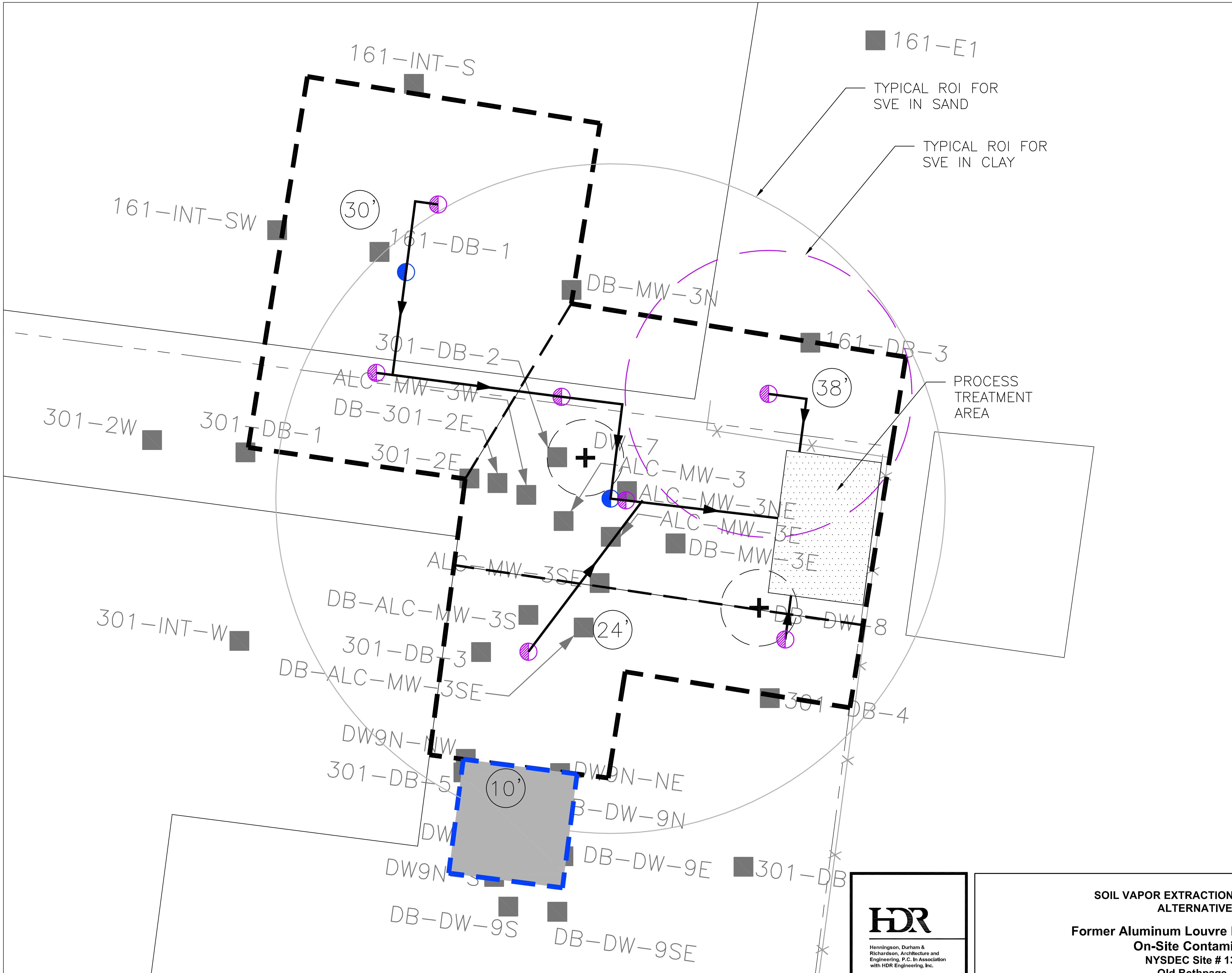
HDR

Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

VAPOR EXTRACTION POINT PLAN - SUB-SLAB DEPRESSURIZATION SYSTEM ALTERNATIVE

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130196
Old Bethpage, NY

DATE	FIGURE
01-24-2013	9



N

LEGEND

- BUILDING/STRUCTURE
- PROPERTY LINE
- CHAIN LINK FENCE
- SVE VACUUM TRANSMISSION PIPING
- SOIL BORING
- DRYWELL
- VACUUM EXTRACTION WELL IN SAND
- VACUUM EXTRACTION WELL IN CLAY
- APPROXIMATE LIMIT OF PCB/PESTICIDES SOIL CONTAMINATION
- APPROXIMATE LIMIT OF TCE SOIL CONTAMINATION
- 24' APPROXIMATE CONTAMINATION DEPTH IN FEET
- EXCAVATION AREA
- PCB POLYCHLORINATED BIPHENYLS
- TCE TRICHLOROETHENE
- SVE SOIL VAPOR EXTRACTION
- ROI RADIUS OF INFLUENCE

NOTES:

1. SVE WELL RADIUS OF INFLUENCE ASSUMED TO BE 35 FEET IN SAND AND 15 FEET IN CLAY.
2. LIMIT OF CONTAMINATION ESTIMATED BASED ON NEXT AVAILABLE (HORIZONTAL AND VERTICAL) CLEAN SAMPLE WITH CONTAMINANT CONCENTRATIONS LESS THAN UNRESTRICTED USE CRITERIA.

0 10 20

SCALE IN FEET

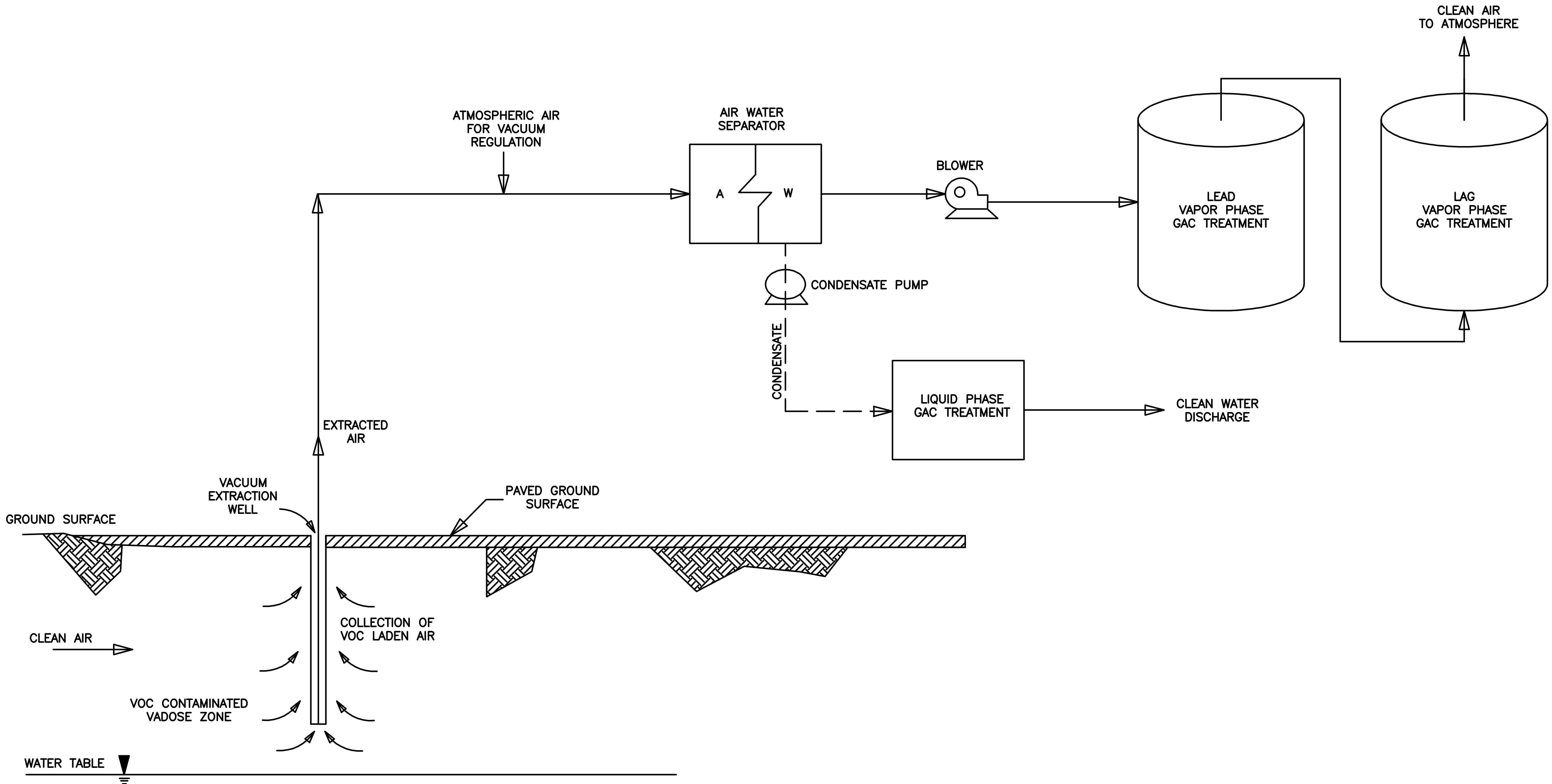
HDR

Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

SOIL VAPOR EXTRACTION SYSTEM PLAN
ALTERNATIVE S2

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130196
Old Bethpage, NY

DATE	01-24-2013
FIGURE	10



SCALE: NOT TO SCALE

HDR

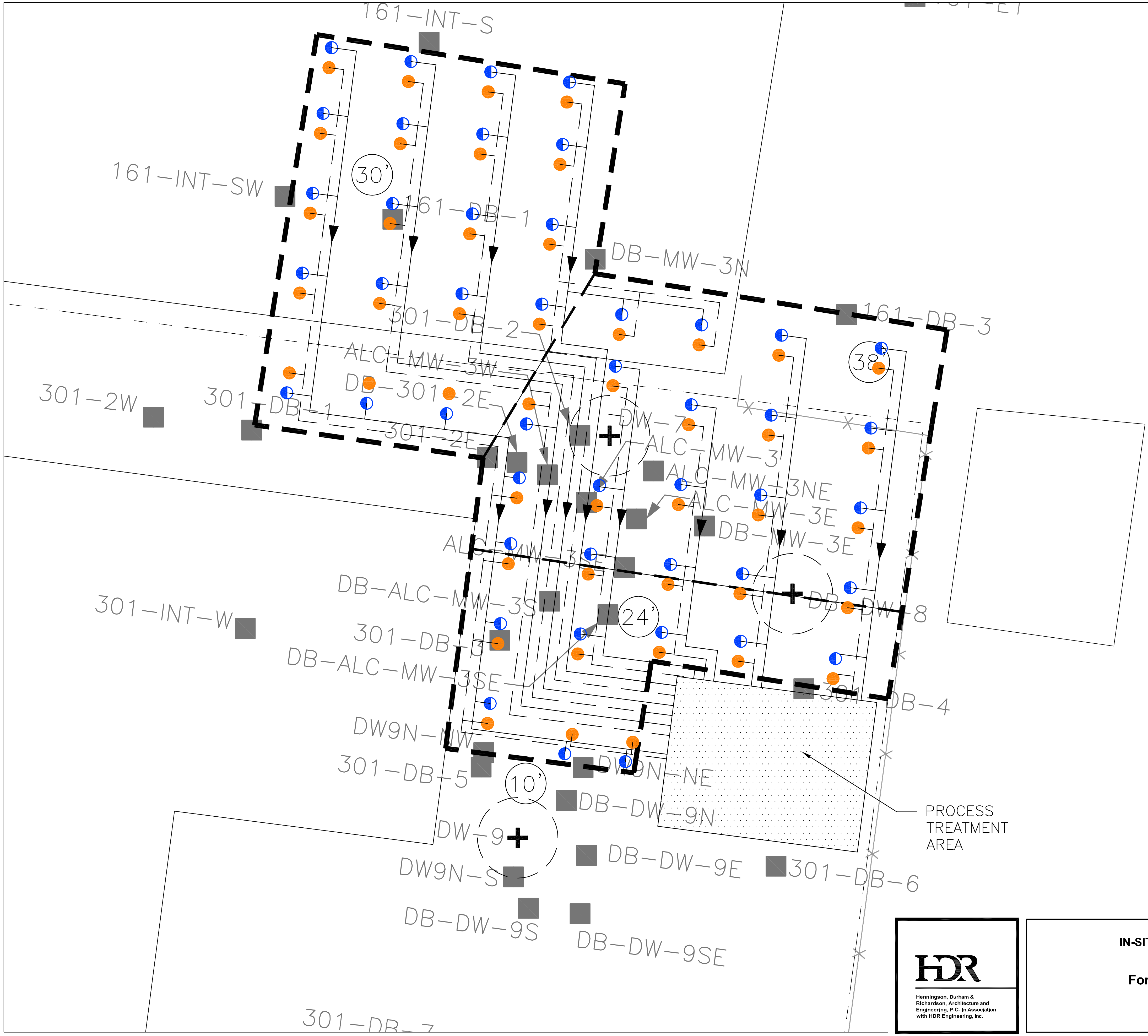
Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

TYPICAL SOIL VAPOR EXTRACTION SYSTEM PROCESS SCHEMATIC

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130196
Old Bethpage, NY

DATE
01-24-2013

FIGURE
11



LEGEND

- BUILDING/STRUCTURE
- PROPERTY LINE
- CHAIN LINK FENCE
- HEATER FUEL TRANSMISSION PIPING
- SVE VACUUM TRANSMISSION PIPING
- SOIL BORING
- DRYWELL
- APPROXIMATE LIMIT OF TCE SOIL CONTAMINATION
- VACUUM EXTRACTION WELL IN SAND
- HEATING WELL

TCE TRICHLOROETHENE

SVE SOIL VAPOR EXTRACTION

NOTES:

1. VACUUM EXTRACTION WELLS AND HEATING WELLS ARE CO-LOCALED AT APPROXIMATELY 10 FOOT SPACING.
2. LIMIT OF CONTAMINATION ESTIMATED BASED ON NEXT AVAILABLE (HORIZONTAL AND VERTICAL) CLEAN SAMPLE WITH CONTAMINANT CONCENTRATIONS LESS THAN UNRESTRICTED USE CRITERIA.

0 10 20

SCALE IN FEET

HDR

Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

IN-SITU LOW TEMPERATURE THERMAL DESORPTION SYSTEM PLAN ALTERNATIVE S3

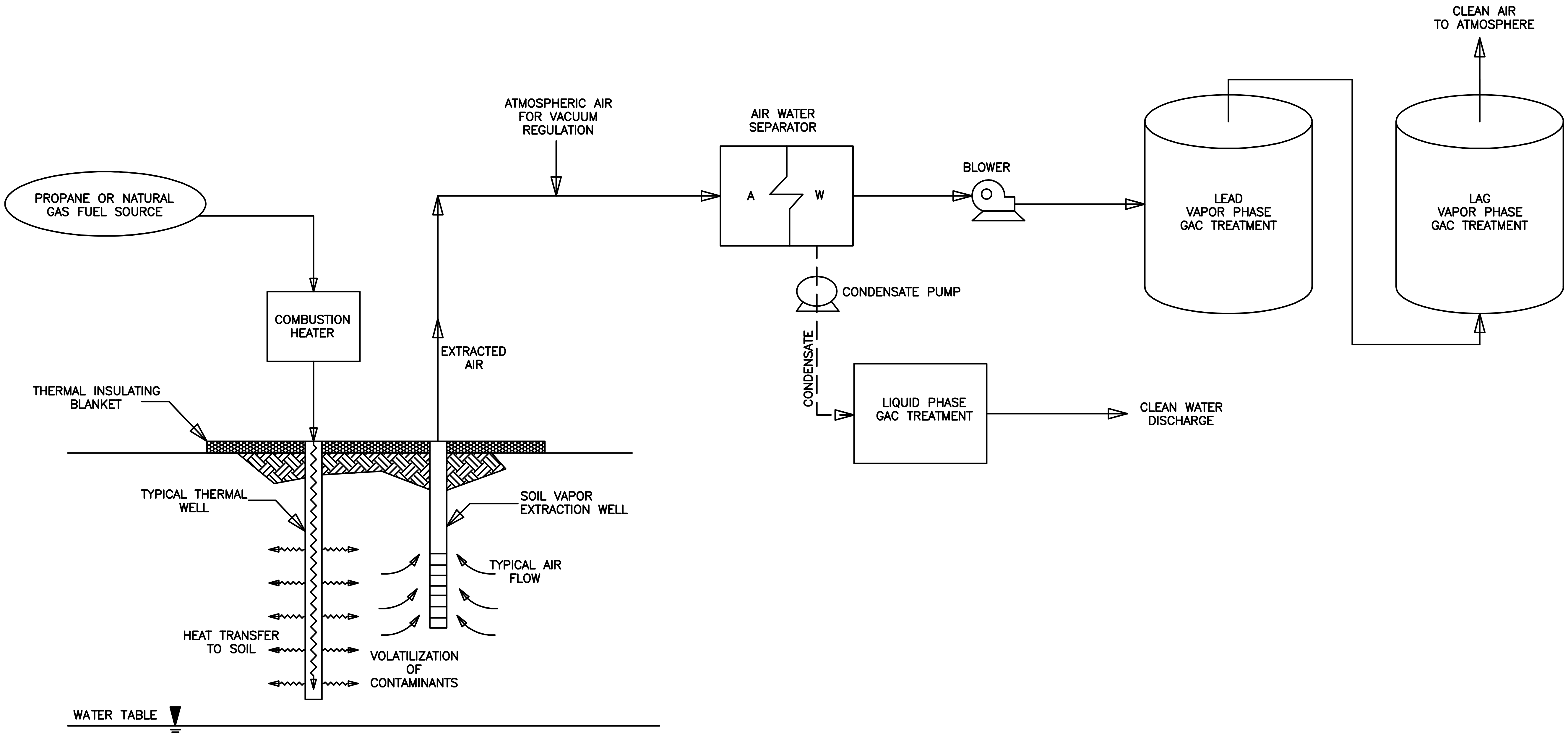
Former Aluminum Louvre Feasibility Study

On-Site Contamination

NYSDEC Site # 130196

Old Bethpage, NY

DATE	01-24-2013
FIGURE	12



SCALE: NOT TO SCALE

HDR

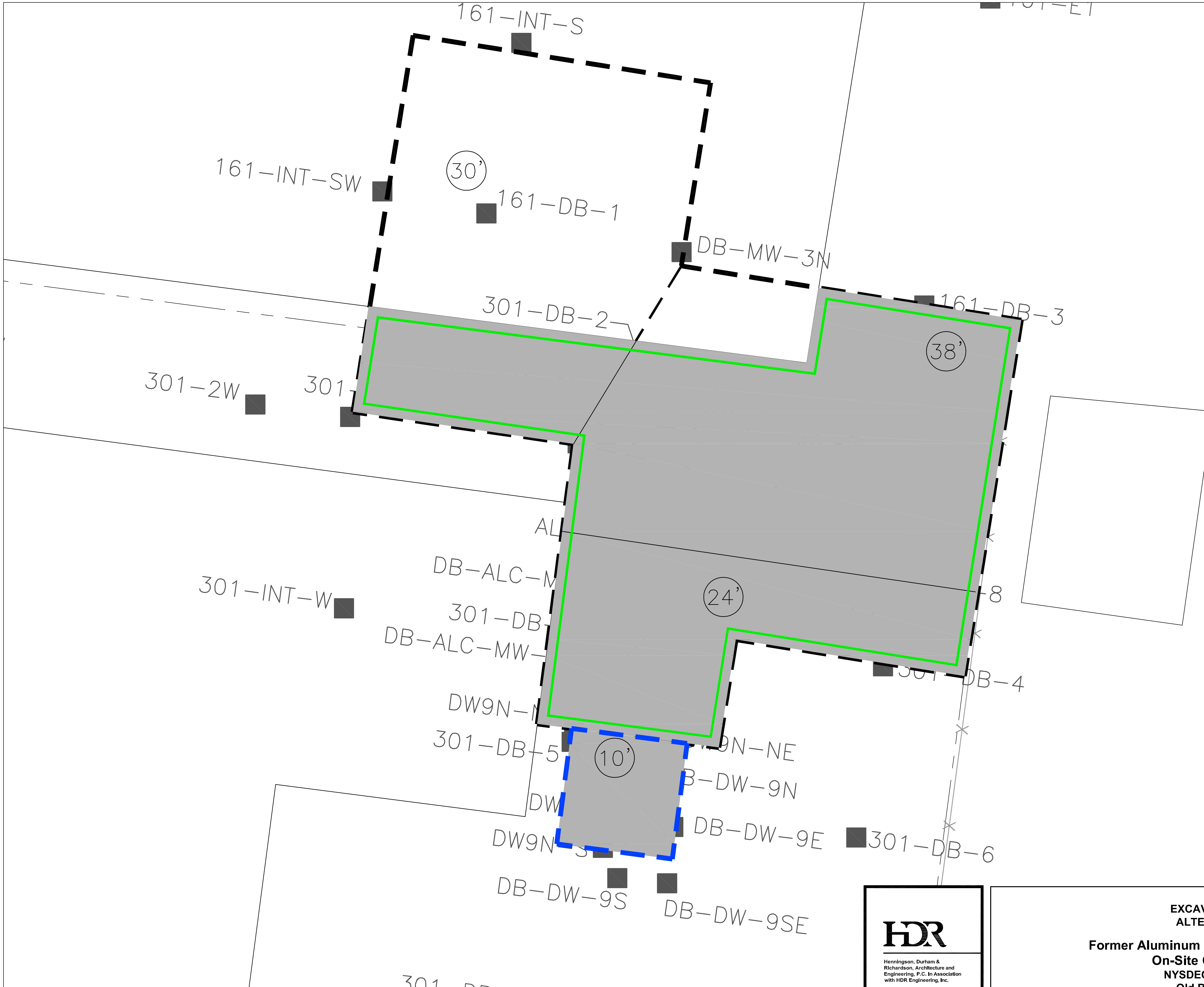
Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

TYPICAL IN-SITU THERMAL REMEDIATION
SYSTEM PROCESS SCHEMATIC

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130196
Old Bethpage, NY

DATE
01-24-2013

FIGURE
13



LEGEND

- BUILDING/STRUCTURE
- PROPERTY LINE
- CHAIN LINK FENCE
- SOIL BORING
- DRYWELL
- APPROXIMATE LIMIT OF PCB/PESTICIDES SOIL CONTAMINATION
- APPROXIMATE LIMIT OF TCE SOIL CONTAMINATION
- (24) APPROXIMATE CONTAMINATION DEPTH IN FEET
- EXCAVATION AREA
- SHEET PILING
- PCB POLYCHLORINATED BIPHENYLS
- TCE TRICHLOROETHENE
- SVE SOIL VAPOR EXTRACTION

NOTES:
1. EXCAVATION DEPTH ASSUME TO EXTEND TO NEXT CLEAN SAMPLE.
2. LIMIT OF CONTAMINATION ESTIMATED BASED ON NEXT AVAILABLE (HORIZONTAL AND VERTICAL) CLEAN SAMPLE WITH CONTAMINANT CONCENTRATIONS LESS THAN UNRESTRICTED USE CRITERIA.

0 10 20
SCALE IN FEET

HDR
Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

EXCAVATION PLAN
ALTERNATIVE S4

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130196
Old Bethpage, NY

DATE	01-24-2013
FIGURE	14

HDR

Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

CHEMICAL OXIDATION INJECTION POINT PLAN
ALTERNATIVE G2

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130196
Old Bethpage, NY

DATE 01-24-2013

FIGURE 15

LEGEND

- GROUNDWATER MONITORING WELL
- TEMPORARY GROUNDWATER POINT
- SHALLOW GROUNDWATER REMEDIATION AREA (40 FEET THICK) (55–95 FEET BGS)
- DEEP GROUNDWATER REMEDIATION AREA (40 FEET THICK) (95–135 FEET BGS)
- VACUUM EXTRACTION WELL
- AIR SPARGE SHALLOW WELL
- AIR SPARGE DEEP WELL
- PRESSURIZED AIR TRANSMISSION PIPING
- SVE VACUUM TRANSMISSION PIPING
- ROI RADIUS OF INFLUENCE
- GW GROUNDWATER
- SVE SOIL VAPOR EXTRACTION
- BGS BELOW GROUND SURFACE

NOTES:
1. VACUUM EXTRACTION WELLS ARE ESTIMATED TO HAVE A 30 FOOT RADIUS OF INFLUENCE.
2. AIR SPARGE WELLS ARE ESTIMATED TO HAVE A 20 FOOT RADIUS OF INFLUENCE.

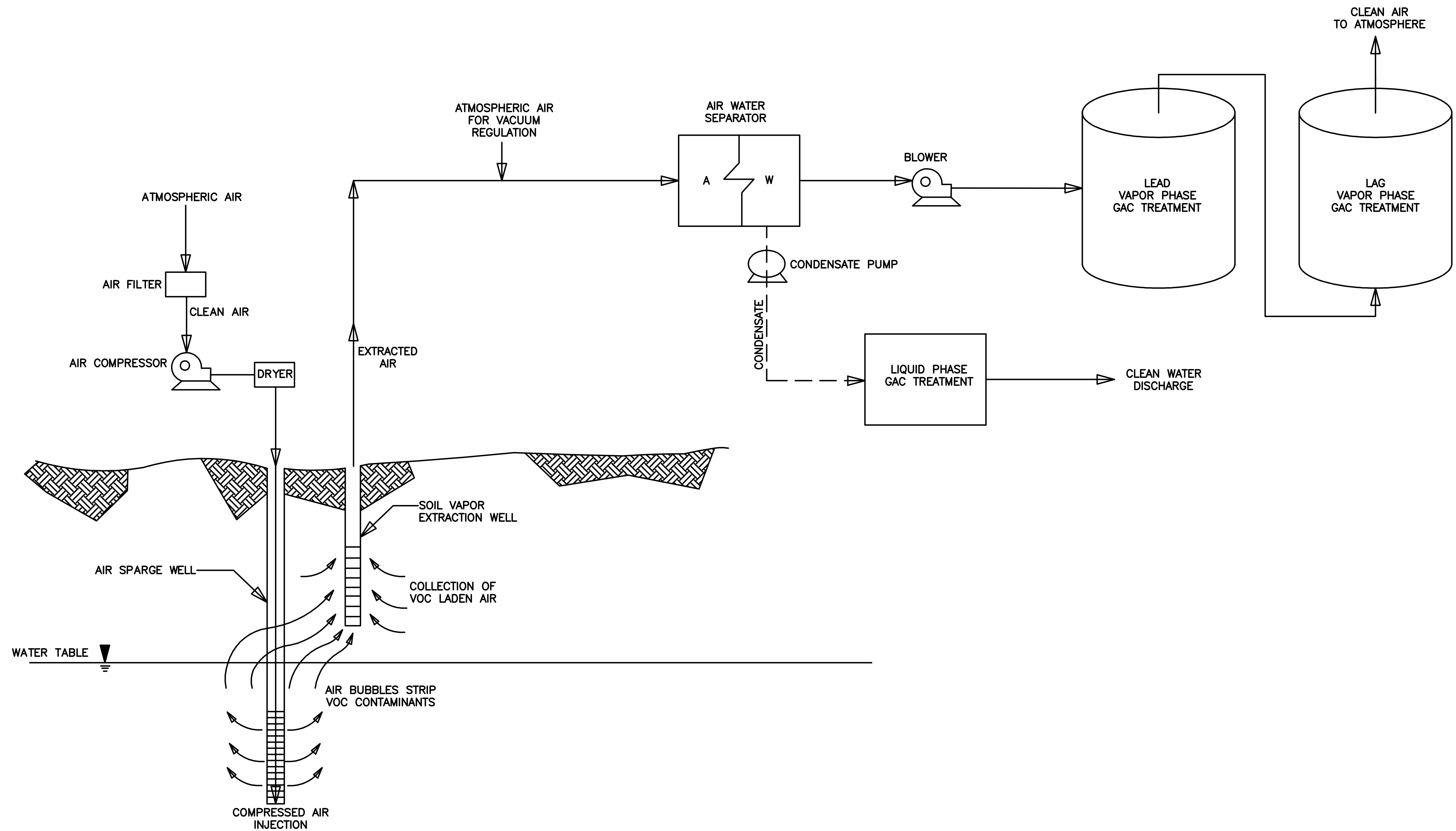
0 40 80
SCALE IN FEET

HDR
Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

AIR SPARGE AND VACUUM WELL PLAN
ALTERNATIVE G3

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130196
Old Bethpage, NY

DATE 01-24-2013
FIGURE 16



SCALE: NOT TO SCALE

HDR
Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

TYPICAL AIR SPARGING/SOIL VAPOR EXTRACTION SYSTEM PROCESS SCHEMATIC

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130196
Old Bethpage, NY

DATE	01-24-2013
FIGURE	17

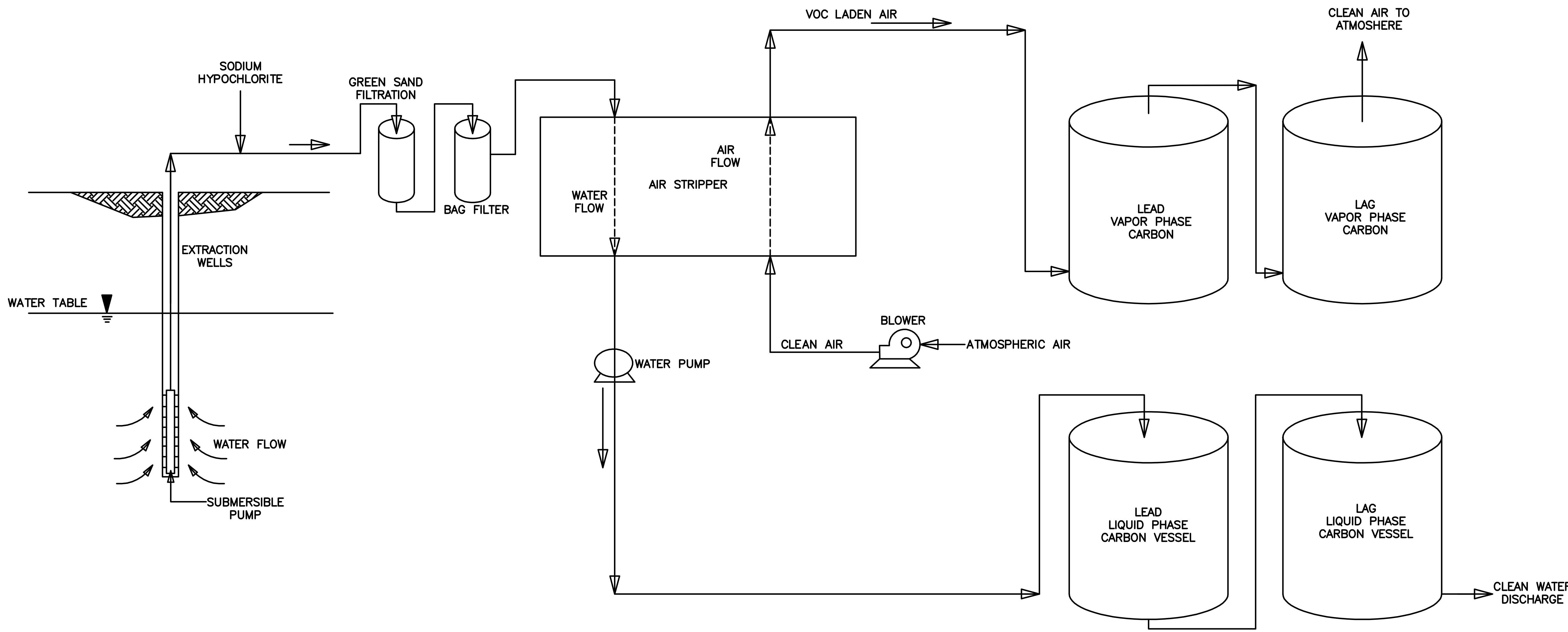
HDR

Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

PUMP AND TREAT EXTRACTION WELL PLAN
ALTERNATIVE G4

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130196
Old Bethpage, NY

DATE	01-24-2013
FIGURE	18



SCALE: NOT TO SCALE

HDR

Henningson, Durham & Richardson, Architecture and Engineering, P.C. In Association with HDR Engineering, Inc.

TYPICAL GROUNDWATER PUMP AND TREAT SYSTEM PROCESS SCHEMATIC

Former Aluminum Louvre Feasibility Study
On-Site Contamination
NYSDEC Site # 130196
Old Bethpage, NY

DATE	01-24-2013
FIGURE	19