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Transmitted Via E-Mail & Federal Express

July 2, 2004

Mr. David A. Camp, P.E.
Environmental Engineer 2
New York State Department of Environmental Conservation
Division of Environmental Remediation
Bureau of Eastern Remedial Action
625 Broadway, 12th Floor
Albany, NY 12233-7015

Re: HWD, Inc. Site
Farmingdale, New York
NYSDEC Site No. 152113
Consent Order Index No. W1-0272-95-05
BBL Project #: 0604.60405 #9

Dear Mr. Camp:

On behalf of the HWD Group, please find enclosed for your review, four copies of revised pages for the Feasibility Study Report (the "FS Report") for the HWD site located at 11A Picone Boulevard in Farmingdale, New York. The FS Report has been revised to address New York State Department of Environmental Conservation (NYSDEC) comments presented in your June 17, 2004 letter and New York State Department of Health (NYSDOH) comments provided as an attachment to your letter. Please replace the report text and cost tables from the 3-ring binders of the May 2004 FS Report submittal with the attached revised text/tables. New report covers to be inserted into the binders are also attached. Additionally, as requested in your e-mail correspondence dated June 10, 2004, please find one copy of the attached "redline" (additions/strikeouts) markup comparison to the previous version of the report. As you will note by the redline, we have been responsive to each NYSDEC and NYSDOH request for language to be deleted, added, or changed in the report.

The revised FS Report pages are being timely submitted in accordance with the schedule outlined in your June 17, 2004 letter. Distribution of the revised report pages is consistent with the previous report submittal and your e-mail correspondence dated May 30, 2004. We're pleased that we have resolved this matter. We look forward to working cooperatively with the NYSDEC and NYSDOH.

Please do not hesitate to me at (315) 446-9120 if you have any questions or require additional information.

Sincerely,

BLASLAND, BOUCK & LEE, INC.

John C. Brussel

John C. Brussel, P.E.
Senior Engineer I

JCB/mbg
Enclosures

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cc: Mr. Peter A. Scully, New York State Department of Environmental Conservation – Region 1 (1 copy)
Denise D'Ambrosio, Esq., New York State Department of Environmental Conservation (1 copy)
Mr. Gary Litwin, New York State Department of Health (2 copies)
HWD, Inc., Site Technical Committee Members
Dean S. Sommer, Esq., Young, Sommer … LLC
Aaron Gershonowitz, Esq., Forchelli, Curto, Schwartz, Mineo, Carlino & Cohn, LLP
Joseph B. Lamberta, Esq., Lamberta, Lawrenceke & Bennett
David T. Noble, Esq., Unisys Corporation
Charles M. Tomaselli, Esq., Dickerson & Reilly
Robert Muccilli, Esq., Capehart & Scatchard
Mr. Frederick J. Kirschenheiter, P.E., Blasland, Bouck & Lee, Inc.

REPORT

Feasibility Study Report

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

September 2003
Latest Revision July 2004

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engineers & scientists

Table of Contents

Figures

Appendices

1. Introduction

1.1 General

This Feasibility Study Report (FS Report) identifies and evaluates potential remedial alternatives to address constituents of interest in soil and groundwater at the Hazardous Waste Disposal, Inc. (HWD) site ("the site") located at 11A Picone Boulevard in Farmingdale, New York. Past site activities, including hazardous waste management using 55-gallon drums, one or more tanks, and an unlined "sludge pit," allegedly resulted in the release of volatile organic compounds (VOCs), primarily chlorinated VOCs, identified in soil and groundwater at the site.

This FS Report has been prepared by Blasland, Bouck, & Lee, Inc. (BBL) in accordance with an Order on Consent (Consent Order) between the New York State Department of Environmental Conservation (NYSDEC) and the HWD Respondents to the Consent Order (the "HWD Group"), which became effective in August 1999 (Index No. W1-0728-95-05). The Consent Order required the Respondents to conduct a Remedial Investigation/ Feasibility Study (RI/FS) for the site consistent with a *Remedial Investigation/Feasibility Study Work Plan* (BBL, 1997), which was approved by the NYSDEC during 1997 and attached to the Consent Order. RI activities completed at the site are summarized in the *Remedial Investigation Report* (BBL, 2002). NYSDEC approval of the amended report was provided in a May 30, 2002 letter to the HWD Group.

This FS Report summarizes relevant background information, identifies remedial action objectives (RAOs), identifies and screens various potential remedial technologies, presents a detailed and comparative analysis of retained technologies to address the RAOs, and recommends a site-wide remedial alternative. The FS Report is based on the results of the:

- information compiled by Fanning, Phillips, and Molnar (FPM) and presented in the *Summary of History and Sampling at the Former Hazardous Waste Disposal, Inc. Site* (FPM, 1995);

- Phase I and II investigations conducted by Gibbs & Hill, Inc. (as a contractor to the NYSDEC) between July 1988 and December 1990. Both investigations are summarized in the *Engineering Investigations at Inactive Hazardous Waste Sites in the State of New York, Phase II Investigation, Hazardous Waste Disposal Site, Site No. 152113, Town of Babylon, Suffolk County, New York* (Gibbs & Hill, 1991);

- RI and supplemental RI activities conducted by BBL on behalf of the HWD Group between November 1999 and February 2001, which are summarized in the NYSDEC-approved *Remedial Investigation Report* (BBL, 2002);

- supplemental soil investigation and soil vapor survey/air pathway evaluation conducted by BBL during August 2002, which are summarized in an October 2, 2002 letter from BBL to the NYSDEC; and

- additional groundwater investigation activities conducted by BBL in support of this FS during April 2003. The results of the additional groundwater investigation activities are summarized in this FS Report.

This FS Report has been prepared in general accordance with the following guidance, directives, and other publications, where appropriate:

- NYSDEC Technical and Administrative Guidance Memorandum (TAGM) #4025 titled, *Guidelines for Remedial Investigations/Feasibility Studies* (NYSDEC, 1989);
- NYSDEC TAGM #4030 titled, *Selection of Remedial Actions at Inactive Hazardous Waste Sites* (NYSDEC, 1990);
- applicable provisions of the New York State Environmental Conservation Law (ECL) and associated regulations, including Title 6 of the New York Code of Rules and Regulations (6 NYCRR) Part 375;
- United States Environmental Protection Agency (USEPA) guidance document titled, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA),* Interim Final (USEPA, 1988); and
- applicable provisions of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) regulations contained in Title 40 of the Code of Federal Regulations (CFR) Part 300.

The NYSDEC provided an initial round of comments on the FS Report (see version submitted in September 2003) in a letter dated November 18, 2003. A response to the NYSDEC's initial round of comments is presented in a letter from BBL to the NYSDEC dated December 19, 2003. The NYSDEC provided a second round of comments on the FS Report in a letter dated January 30, 2004. A response to the NYSDEC's second round of comments is presented in a letter from BBL to the NYSDEC dated March 19, 2004. The NYSDEC provided a third round of comments on the FS Report in a letter dated March 26, 2004, which provided conditional approval of the report for purposes of public review. This second version of the FS Report addresses the three rounds of NYSDEC comments.

Based on the previous investigation activities conducted at the HWD site, tetrachloroethene (PCE) has been identified in subsurface soil at concentrations exceeding NYSDEC guidance, including the guidance values presented in the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) #4046 titled, *Determination of Soil Cleanup Objectives and Cleanup Levels*, HWR-94-4046, dated January 24, 1994 (NYSDEC, 1994). Five other VOCs, including trichloroethylene (TCE) and benzene, ethylbenzene, toluene, and xylenes (BTEX compounds), were detected in selected subsurface soil samples at concentrations exceeding the TAGM 4046 guidance values, but below the soil action levels presented in NYSDEC TAGM #3028 titled, *"Contained-In Criteria" for Environmental Media* (NYSDEC, 1997), the United States Environmental Protection Agency (USEPA) Region 3 Risk-Based Concentrations (RBCs) for commercial/industrial soil, and the USEPA Region 9 Preliminary Remediation Goals (PRGs) for industrial soil. VOCs have also been detected in groundwater at the site at concentrations exceeding guidance values presented in the NYSDEC Division of Water, Technical and Operational Guidance Series (TOGS 1.1.1) document titled, *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations*, (NYSDEC, 2000).

The RAOs presented in this FS Report have been developed considering the findings of the previous investigation activities and results obtained from an exposure assessment completed as part of the RI. RAOs were originally presented in a November 14, 2002 letter from BBL to the NYSDEC, and have been revised to include one additional RAO as requested by the NYSDEC in a November 26, 2002 letter.

Following NYSDEC review and approval of this FS Report, a *Proposed Remedial Action Plan* (PRAP) will be developed that will identify the preferred remedial alternative, summarize the alternatives considered, and provide the reasons for proposing the preferred remedy. The PRAP will be subject to a 30-day public comment period. Following the public comment period, the NYSDEC will prepare a Record of Decision (ROD), which will identify the site remedy and include a responsiveness summary to public comments and concerns raised during the public comment period.

1.2 Purpose and Objective

The purpose of this FS Report is to identify and evaluate remedial alternatives that are appropriate for site-specific conditions, protective of human health and the environment, and consistent with the aforementioned laws, regulations, and guidance documents. The overall objective of this FS Report is to recommend a remedial alternative for soil and groundwater that eliminates significant threats to human health and the environment arising from the disposal of hazardous waste at the site and is consistent with the RAOs for the site.

1.3 Report Organization

This FS Report has been organized into the following sections:

Section		Purpose
Section 1 -	Introduction	Provides background information relevant to the development of the FS Report and remedial alternatives evaluated.
Section 2 -	Standards, Criteria, and Guidelines	Identifies the standards, criteria, and guidelines (SCGs) that guide the development and selection of remedial alternatives.
Section 3 -	Remedial Action Objectives	Develops and presents RAOs for the site that are protective of human health and the environment.
Section 4 -	Technology Screening Summary and Development of Remedial Alternatives	Presents the results of the identification and screening of remedial technologies and the development of remedial alternatives that have the potential to meet the RAOs.
Section 5 -	Detailed Analysis of Remedial Alternatives	Presents a detailed description and screening of remedial alternatives using 6 NYCRR Part 375 evaluation criteria.
Section 6 -	Comparative Analysis of Remedial Alternatives	Presents a comparative analysis of each remedial alternative and the recommended remedial alternative.
Section 7 -	References	Provides a list of references cited in the FS Report.

1.4 Background Information

This section presents relevant background information used to develop and evaluate the remedial alternatives for the site. A description of the site is presented below, followed by a summary of relevant historical information, the topography and drainage features in the vicinity of the site, the geologic and hydrogeologic setting of the site, and groundwater usage in the vicinity of the site. This section also summarizes results obtained from previous investigation activities and the results of a qualitative exposure assessment for potential human and ecological receptors. In addition, an overview of activities completed to address the detection of PCE above a

New York State Department of Health (NYSDOH) residential indoor air quality guideline in indoor air within a commercial building immediately south of the site is presented in this section.

1.4.1 Site Location and Description

The HWD site is located at 11A Picone Boulevard in the Village of Farmingdale, Suffolk County, New York and is identified as part of Tax Lot 31.004 in the Suffolk County, New York tax maps. A site location map is presented as Figure 1. The site is approximately 0.5 acres in size and includes an approximately 10,000 square foot area where hazardous waste storage, transfer, and recycling operations were historically conducted. The site is currently owned by Little Joseph Realty, Inc. Guaranteed Overnight Delivery, Inc., an overnight delivery service, currently leases the property from Little Joseph Realty for use as a truck/tractor-trailer parking lot. The site is covered by a concrete slab that is approximately 6- to 8-inches thick. Select areas of the slab have been repaired/replaced with bituminous asphalt pavement. The approximate boundaries of the site are shown on Figure 2.

Access to the site is limited by a chain-link fence to the north, east, and south of the site, and a concrete wall associated with a storage yard west of the site. The site is accessible from Picone Boulevard through a gate along the southern site boundary, and from a paved driveway that enters the northwestern portion of the site.

1.4.2 Site Surroundings

Land use in the vicinity of the site is predominantly commercial/industrial. South of the site, across Picone Boulevard, is a one-story commercial building occupied by R&D Carpet and Tile (R&D) and Ryder Truck. The R&D side of the building includes a garage area used to store new carpet and various adhesives, coatings/sealers, base fillers, cleaners, paints/stains, etc., and an office area/showroom. Ryder Truck operations make up the west side of the R&D building. The Ryder Truck portion of the building is primarily used as a service garage for medium and heavy-duty trucks. A one-story building occupied by Fort Brand Service is located west of the HWD site, immediately west of the storage yard. The Fort Brand Service building is primarily used as a service garage for heavy equipment used in connection with the aviation industry. A furniture warehouse is located west of the Fort Brand Service building. Parking lots for trucking companies/commercial facilities border the HWD site to the north, east, and southeast.

Based on review of historical information, including documents submitted to the NYSDEC and Suffolk County Health Department (SCHD) in connection with previous investigation activities at nearby properties, releases to the subsurface were previously reported from underground storage tanks (USTs)/dispensing systems located at three properties adjacent to the HWD site, including:

- a UST dispensing system at the property west of the HWD site (formerly Ronnie's Truck Repair, now occupied by Fort Brand Service). Groundwater in the vicinity of the dispensing system was found to be impacted by BTEX compounds;

- a UST at an abandoned gasoline station located at an active trucking company property east of the HWD site. The approximate location of the UST is shown on Figure 2. Groundwater at a monitoring well hydraulically downgradient from this UST (monitoring well MW-3, as shown on Figure 2) was found to contain BTEX compounds, naphthalene, 2,4-dimethylphenol, chlorobenzene, and cis-1,2-dichloroethene; and

- a UST “tank field” located at a property south of the HWD site across Picone Boulevard, approximately 150 feet south of the HWD site boundary. The approximate location of the tank field is shown on Figure 2. UST removal activities were conducted and free-phase light non-aqueous phase liquid (LNAPL) was apparently removed. Groundwater quality impacts from BTEX compounds were assessed by the technical consultant, Tyree Brothers Environmental Services, Inc.

As a result of the database search conducted during the RI, several additional contaminated sites were identified within 1-mile of the HWD site that contain leaking USTs and are included on the NYSDEC spills listing. A copy of the report generated by the database search is included in the *Remedial Investigation Report* (BBL, 2002). In addition to the above-mentioned UST/spill sites, two NYSDEC-listed inactive hazardous waste disposal sites are located within a ½ mile radius of the HWD site, including:

- the Circuitron Corporation site (NYSDEC Site No. 152082) located approximately ½ mile north and hydraulically upgradient from the HWD site. The Circuitron Corporation site is also included on the National Priorities List (NPL) established under CERCLA. The site was formerly used for the manufacture of electronic circuit boards. Solvents and heavy metals used in connection with manufacturing operations were previously discharged to the ground through leaching pools. Chlorinated VOCs, including 1,1,1-trichloroethane (1,1,1-TCA), TCE, PCE, 1,1-dichloroethene (1,1-DCE), and 1,1,-dichloroethane (1,1-DCA) were identified as constituents of interest for the site. 1,1,1-TCA was identified in groundwater at the highest concentration of the individual VOC constituents (up to 5,800 parts per billion [ppb]). Four heavy metals, including arsenic, chromium, copper, and lead were also identified as constituents of interest. Two RODs for the site have been signed by the USEPA, including one during March 1991 and a second during September 1994. The first ROD called for source control, and the second ROD called for cleanup of groundwater within the upper 40 feet of the shallow aquifer, extending approximately 700 feet downgradient from the Circuitron property. The USEPA selected a soil vapor extraction (SVE) system to address VOC-impacted soil, excavation of impacted sediment, and groundwater extraction and treatment via air stripping; and

- the Fairchild Republic Aircraft Main Plant (Fairchild) site (NYSDEC Site No. 152130) located approximately ? to ¼-mile south of the HWD site. This site was formerly used for the manufacture of aircraft and related parts. Chlorinated VOCs, mainly TCE and PCE, are the constituents of interest for the site. TCE and PCE were previously identified in soil at concentrations up to 4.4 parts per million (ppm) and 4.0 ppm, respectively, and in groundwater at concentrations up to 1,659 ppb and 5,100 ppb, respectively. Interim remedial measures (IRMs) activities at the site included the construction/operation of an SVE system to address VOC-impacted soil beneath a building, the connection of private wells downgradient from the site to the public water supply, and excavation of soil containing elevated concentrations of chromium. A ROD for the site was signed by the NYSDEC during March 1998. The NYSDEC selected a groundwater extraction and treatment remedy designed to intercept a groundwater plume of VOCs with a total VOC concentration of 1,000 ppb. The NYSDEC also selected a public supply wellhead treatment contingency.

Both the Circuitron Corporation site and Fairchild site are currently undergoing remediation. According to the NYSDEC, at least 97 aboveground and underground storage tanks were removed from the Fairchild site.

Based on review of a drawing prepared by Eder Associates in connection with the investigation/remedial activities at the Fairchild site titled, *Groundwater Quality, Main Plant Site Vicinity,* Drawing No. 4, (dated March 1995), PCE and/or TCE have been identified in groundwater at several other locations (besides the Circuitron Corporation site and Fairchild site) within approximately two miles of the HWD site, including:

- the Target Rock and Claremont Poly Chemical facilities approximately 1½ and 2 miles, respectively, northwest of the HWD site;

- two wells approximately 1¼ to 1½ miles northwest of the HWD site that appear to be hydraulically downgradient from the Bablyon Landfill;
- the Astro Electroplating, Tronic Plating, and Minmilt Reality facilities approximately 1½ miles northeast of the site; and
- the Brandt Airflex, Kenmark Textiles, and Fire Station sites approximately ½ mile southwest of the HWD site.

The information presented above illustrates the commercial/industrial nature of the area and confirms that groundwater quality impacts have been identified in several areas surrounding the HWD site. The approximate locations of these sites and groundwater quality information for locations at and in the vicinity of these sites (groundwater analytical results for PCE, TCE, and 1,1,1-TCA) are shown on Figure 3.

1.4.3 Site History

This subsection provides a brief summary of historic site operations and general environmental information that was previously discussed in the *Remedial Investigation Report* (BBL, 2002). HWD, Inc. operated a hazardous waste storage, transfer, and recycling facility at the site from approximately 1979 to 1982. Information about the site history prior to 1979 was unavailable. Hazardous wastes (primarily spent solvents and acidic wastes) were collected from offsite generators, transported to the site by HWD, Inc., and stored onsite prior to offsite transport and disposal. HWD, Inc. also reportedly utilized the site to recycle spent solvents for resale. Hazardous wastes stored at the site were managed in 55-gallon drums, one or more aboveground storage tanks, and a "sludge pit." The approximate locations of former site features, including the former sludge pit, a former shed, a former hazardous waste storage and treatment area, a former drum storage area, and a former hazardous waste handling and aboveground storage tank area, are shown on a copy of an April 7, 1980 aerial photograph included as Figure 4.

In March 1981, HWD, Inc. reported a vapor discharge from the site to the SCHD. The incident reportedly produced a 150- to 200-foot high visible vapor plume. The USEPA inspected the HWD facility in September 1981. At the time of the inspection, the USEPA noted the presence of 1,900 55-gallon drums of spent solvent and a 2,500-gallon acid tank. The USEPA noted that the majority of the drums stored at the site were leaking at the time of the inspection. The USEPA also noted that HWD, Inc. was operating an ammonium hydroxide scrubbing process on the acid storage tank without a required permit. In addition, USEPA noted that two storm drains were located onsite, and that potentially impacted surface water runoff could conceivably be collected by the storm drains and conveyed to other areas of the site.

SCHD prepared a site visit report sketch, during a June 1982 site visit, which shows a diked storage area, a neutralization tank and associated pump, and a waste sludge pit covered with plastic. During a followup site visit conducted by SCHD during September 1982, approximately 840 55-gallon drums containing wastes and 420 empty 55-gallon drums were observed at the site. The SCHD noted the presence of spills in the storage area at the time of the 1982 inspection.

In November 1982, HWD, Inc. entered into a Consent Order with the NYSDEC that required HWD to cease hazardous waste management operations at the site. All remaining wastes and waste management tanks were reportedly removed from the site during 1984. As the result of a 1985 property inspection by the NYSDEC, the site was listed on the New York State Registry of Inactive Hazardous Waste Sites as a Class 2a site, which is a temporary classification assigned by the NYSDEC for sites that have inadequate and/or insufficient data for inclusion in any of the other site classifications.

At the time of a site reconnaissance in May 1990, the site was being used as a parking lot by J.S. Trucking Company, who was leasing the property from Little Joseph Realty. There were no remaining onsite structures or evidence of equipment or materials used during the previous business activities of HWD, Inc. The site area where historical activities were conducted was observed to be covered with concrete.

1.4.4 Topography and Drainage

Surface topography in the vicinity of the HWD site is shown on Figure 2. As shown on Figure 2, the majority of the site and areas east, south, and west of the site are relatively level with an average elevation of approximately 65 feet above mean sea level (MSL). The concrete-covered portion of the HWD site slopes gently downward from the north-northwest to the south-southeast. The elevation change across the concrete-covered portion of the site is less than approximately 1-foot. An approximately 10- to 12-foot high earthen embankment is located along the northern site boundary. The embankment meets a relatively level area to the north-northwest at an elevation of approximately 80 feet above MSL.

A recharge basin, which was apparently designed to manage storm water runoff from nearby properties, is located approximately 80 to 100 feet north-northeast of the HWD site. Three manholes/catch basins in the central portion of the HWD site convey storm water runoff from the concrete and paved portions of the site to the recharge basin. In addition, a catch basin in the southeastern portion of the HWD site and a series of manholes/catch basins located in Picone Boulevard immediately southeast of the site convey storm water runoff collected from the surrounding area to the recharge basin. The bottom elevation of the recharge basin was not measured as part of the previous investigation activities, but is lower than 50 feet above MSL. The rim of the recharge basin is at approximately 64 feet above MSL. Earthen sidewalls slope inward toward the basin at a slope of up to approximately 2:1 (horizontal: vertical). The surface water elevation in the basin was measured at 54 feet above MSL during the RI (April 11, 2001) and approximately 53 feet above MSL during additional groundwater investigation activities conducted in support of this FS (April 22, 2003).

As indicated in a November 30, 2001 letter from BBL to the NYSDEC, the recharge basin apparently manages storm water runoff by collecting runoff during periods of significant precipitation and allowing the collected runoff to infiltrate into the shallow aquifer over time. This storm water management system is common in this area of Long Island. The surface water elevation in the recharge basin varies depending on precipitation. During significant precipitation events, the recharge basin apparently acts as a groundwater discharge feature which recharges the shallow aquifer. At such times, the recharge basin may locally influence groundwater flow directions and create conditions of radial groundwater flow. However, existing site data suggests that the influence of the basin on groundwater flow is temporal and localized.

1.4.5 Geologic Setting

The site is located on the Northern Atlantic Coastal Plain physiographic province. The Coastal Plain is a seaward-dipping wedge of unconsolidated sediment that ranges in age from Cretaceous to Holocene (Zapecza, 1984). Overburden geology in the vicinity of the site consists of sediments of Late Pleistocene Age overlying Cretaceous Age sediments.

The Upper Pleistocene deposits are reported to be approximately 100 feet thick in the vicinity of the site and up to approximately 700 feet thick in the province. This unit is referred to as the Upper Glacial Unit, and consists of glacial till and outwash deposits. Till deposits characteristically contain clay, sand, gravel, and boulders. Outwash deposits consist of fine to very coarse, quartzose sand, and pebble to boulder size gravel. Characteristically, the till is poorly permeable while the outwash deposits are moderately to highly permeable (Smolensky, Buxton, and Shernoff, 1989). This unconfined Upper Glacial unit lies unconformably on the Cretaceous Age sediments.

The Cretaceous Age sediments in the vicinity of the site are approximately 1,700 feet in thickness as depicted in geologic cross sections by Smolensky, Buxton, and Shernoff. These deposits are composed of two distinct formations, including the Magothy Formation and the underlying Raritan Formation. The Magothy Formation (approximately 1,000 feet in thickness) consists of fine to medium sand (clayey in part) interbedded with lenses and layers of coarse sand, and sandy and solid clay. Colors are gray, white, red, brown, and yellow. This unit lies unconformably on the Raritan Formation. The Raritan Formation (approximately 700 feet in thickness) consists of clay, solid and silty with few lenses and layers of sand in the upper 200 feet of the formation. Colors include gray, red, and white, commonly variegated. The remainder of the formation consists of fine to coarse sand and gravel commonly with clayey matrix and some lenses and layers of solid and silty clay. Colors are yellow, gray, and white; clay is red locally. The upper 200 feet is poorly to very poorly permeable. The remainder of the formation is poorly to moderately permeable (Smolensky, Buxton, and Shernoff, 1989).

The physical and geotechnical properties of the unconsolidated materials in the subsurface at and in the vicinity of the site have been characterized based on observations made during the completion of soil borings as part of the previous investigation activities. Based on the observations, the sequence of unconsolidated materials in the subsurface underlying the site typically consists of:

- approximately 6- to 8-inches of concrete;
- construction debris, described as brick and concrete fragments;
- fill material, consisting of dark brown, fine to coarse sand and medium to coarse gravel, with concrete fragments;
- dark brown, medium to coarse sand and gravel in localized areas; and
- tan, fine to coarse, subangular to subrounded sand and gravel.

Grain size analyses performed on soil samples collected from the soil borings confirmed that the subsurface material beneath the site consists primarily of sand and gravel.

1.4.6 Hydrogeologic Setting

Based on information obtained from the *Hydrogeologic Framework of Long Island, New York* (Smolensky, Buxton, and Shernoff, 1989), groundwater in the vicinity of the HWD site occurs in two major aquifers within the unconsolidated sediments, the Upper Glacial Aquifer and the Magothy Aquifer. The Upper Glacial Aquifer is located within the Pleistocene deposits and regionally is up to approximately 700 feet in thickness. The clay deposits are mostly poorly permeable, but locally have thin moderately permeable layers of sand and gravel. The average horizontal hydraulic conductivity is approximately 270 feet per day (Smolensky, Buxton, and

Shernoff, 1989). The Upper Glacial Aquifer in the vicinity of the HWD site is reported to be approximately 100 feet in thickness.

The Magothy Aquifer is regionally separated from the overlying Upper Glacial Aquifer by the Gardiner's Clay Unit, and is the thickest hydrogeologic unit on Long Island (approximately 1,100 feet in thickness). The Magothy Aquifer is separated from the Upper Glacial Aquifer by two low-permeability lenses of silt and clay (the Gardiner's Clay) that unconformably overly the Magothy Formation. Most layers are poorly to moderately permeable. However, there are some localized highly permeable layers. Groundwater is unconfined in the uppermost parts of this aquifer. The Magothy Aquifer serves as the predominant aquifer for public water supply in the region. The average horizontal hydraulic conductivity of the Magothy Aquifer is 50 feet per day (Smolensky, Buxton, and Shernoff, 1989).

Five rounds of water level measurements have been obtained from the permanent monitoring wells at the HWD site between January 2000 and April 2003. Based on these measurements, groundwater has been encountered at depths ranging from approximately 10.1 to 13.4 feet beneath the concrete/paved portions of the site, which corresponds to approximately 55 to 52 feet above MSL. Groundwater contour maps presented in the *Remedial Investigation Report* (BBL, 2002) indicate that groundwater flow beneath the site is generally toward the southeast. However, east-southeast of the HWD site, there is a prominent component of groundwater flow to the west and southwest.

Based on results obtained for specific capacity testing (i.e., pump testing) performed during April 2003 as part of the additional groundwater investigation activities, the average hydraulic conductivity of saturated soil in the vicinity of the monitoring wells at and near the HWD site was calculated as 272 feet per day, which is consistent with the 270 feet/day regional conductivity value calculated by the United States Geological Survey (USGS, 1972). As summarized in the Remedial Investigation Report (BBL, 2002), the average linear groundwater flow velocity in saturated soil beneath the HWD site is approximated using Darcy's Law as 0.96 feet/day (approximately 350 feet/year) to 1.93 feet/day (approximately 704 feet/year).

Based on BBL's understanding of the regional hydrogeologic setting, groundwater in the Upper Glacial Aquifer in the vicinity of the site flows generally toward the southeast and ultimately discharges to the Massapequa Creek, located approximately 2¼ miles southeast of the site.

1.4.7 Groundwater Usage

As summarized in the *Remedial Investigation Report* (BBL, 2002), the HWD site and surrounding area are industrial in nature and are served with potable water by the East Farmingdale Water District. The source of potable water supplied by the water district is five supply wells located in four separate wellfields (East Farmingdale Water District, 1998-2002). Approximately 6,000 people are served by the East Farmingdale Water District. According to the Suffolk County Department of Health Services Bureau of Drinking Water, private wells exist within the Village of Farmingdale. However, the department has no record of their uses (potable versus non-potable) or locations. There are no private wells used for potable water onsite, and no private well locations have been reported in the site vicinity. All residences in the area reportedly use the community water system (Gibbs & Hill, Inc., 1991). All municipal supply wells draw water from the Magothy Aquifer beneath Long Island, which is considered a sole source aquifer by the USGS (USGS, 1987).

Three of the four wellfields in the East Farmingdale Water District are located north (hydraulically upgradient) of the HWD site. The fourth wellfield, which includes two supply wells (Wells 4-1 and 4-2), is located approximately 1.75 miles southeast of the HWD site, adjacent to the Republic Airport. Wells 4-1 and 4-2 are screened at great depths (up to 1,500 feet deep) in the Magothy Formation, which is a different aquifer than the Upper Glacial Aquifer studied as part of the RI for the HWD site. The East Farmingdale Water District reports pumping rates of 1,340 gallons per minute (gpm) for Well 4-1 and 1,300 gpm for Well 4-2 (East Farmingdale Water District, 2000a). The pH is adjusted and chlorine treatment is performed in water withdrawn from each well. Water samples from the wells are routinely analyzed for principle organic contaminants, inorganics, bacteria, and physical parameters. Based on *Annual Drinking Water Quality Reports* provided by the East Farmingdale Water District covering the period between 1998 and 2002, none of these constituents/parameters were detected above regulatory limits in samples collected from 1998 through 2002.

1.5 Previous Investigations

Previous investigations conducted to evaluate conditions at and in the immediate vicinity of the HWD site include:

- Phase I and II investigations conducted by Gibbs & Hill, Inc. (as a contractor to the NYSDEC) between July 1988 and December 1990;
- RI and supplemental RI activities conducted by BBL on behalf of the HWD Group between November 1999 and February 2001;
- a supplemental soil investigation and soil vapor survey/air pathway evaluation conducted by BBL during August 2002; and
- additional groundwater investigation activities conducted by BBL in support of this FS during April 2003.

Work activities performed and results obtained for these investigations are summarized below.

1.5.1 Phase I Investigation

A Phase I Investigation was conducted for the NYSDEC by Roux Associates, Inc. (as a subcontractor to Gibbs & Hill) in July 1988. The purpose of the Phase I Investigation was to evaluate the site using the Hazard Ranking System (HRS). The Phase I Investigation involved a data/records search and assessment, interviews, and a site inspection. The investigation provided a preliminary assessment and characterization of the site, including site history, topography, hydrogeology, potentially hazardous substances, and migration pathways and receptors. However, information obtained as part of the investigation was insufficient to develop an HRS score.

1.5.2 Phase II Investigation

A Phase II Investigation was completed for the NYSDEC by Gibbs & Hill between May 1990 and December 1990. The purpose of the Phase II Investigation was to collect sufficient information to complete an HRS score and determine if site-related constituents had been released to the environment. Work activities completed as part of the Phase II Investigation included the following:

- collecting soil samples from five soil borings at the site (borings B1 through B5) and one boring north of the site (B6);

- collecting two surface water/sediment sample pairs from the recharge basin northeast of the site (samples SW-1/SD-1 and SW-2/SD-2); and
- installing four shallow groundwater monitoring wells (wells MW-1 through MW-4) and collecting groundwater samples from each well.

The Phase II investigation sampling locations are shown on Figures 5 and 6. Samples collected as part of the Phase II investigation were submitted for laboratory analysis for Target Compound List (TCL) VOCs, TCL semi-volatile organic compounds (SVOCs), Target Analyte List (TAL) inorganics, polychlorinated biphenyls (PCBs), and pesticides.

Laboratory analytical results indicate that low concentrations of chlorinated VOCs (namely PCE, TCE, and 1,2-DCE) were identified in soil samples collected from selected sampling locations at the site. The highest concentration of an individual VOC constituent identified in soil was 0.58 ppm (PCE at sampling location B-1). None of the VOC constituent concentrations identified in soil exceed the TAGM 4046 soil guidance values. Inorganics were identified in the Phase II Investigation soil samples at concentrations that appeared to be consistent with typical background concentrations in the vicinity of the site. PCBs and pesticides were not identified at concentrations exceeding laboratory detection limits in any of the Phase II Investigation soil samples.

TCE, ethylbenzene, toluene, and xylenes were identified in groundwater hydraulically upgradient from the HWD site (at monitoring well MW-1) at concentrations between 5 ppb and 91 ppb, which are equal to or exceed the 5 ppb NYSDEC groundwater quality standard established for each constituent. Chlorinated VOCs, including PCE, TCE, 1,2-DCE, and 1,1,1-TCA, were identified in groundwater beneath the HWD site (at monitoring well MW-2) at concentrations of 790 ppb, 130 ppb, 59 ppb, and 6 ppb, respectively, which exceed the 5 ppb NYSDEC groundwater quality standard established for each constituent. Lower concentrations of chlorinated VOCs and a suite of other VOCs not identified in groundwater beneath the HWD site (ethylbenzene, toluene, xylenes, chloroethane, chlorobenzene, 1,1-DCA, and vinyl chloride) were identified in groundwater at monitoring well MW-3, located hydraulically sidegradient to the HWD site. The VOC concentrations identified at monitoring well MW-3 exceed NYSDEC groundwater quality standards. Only one VOC constituent, methylene chloride (a common laboratory artifact), was identified in groundwater at monitoring well MW-4 northeast of the site.

Three SVOCs (phenol, naphthalene, and 2-methylnaphthalene) were identified in groundwater at monitoring well MW-3 at concentrations of 32 ppb, 65 ppb, and 32 ppb, respectively, which exceed NYSDEC groundwater quality standards. SVOCs were not identified above laboratory detection limits in groundwater at the other monitoring well locations. Inorganic concentrations identified in the Phase II Investigation groundwater samples appeared to be consistent with typical background concentrations in the vicinity of the site. PCBs and pesticides were not identified at concentrations exceeding laboratory detection limits in any of the Phase II Investigation groundwater samples. Site-related constituents of interest were not detected in surface water or sediment samples collected from the recharge basin northeast of the site.

Based on the results of the Phase II Investigation, the NYSDEC reclassified the site on the Inactive Hazardous Waste Site Registry from Class 2a to Class 2. The Class 2 designation indicates "a significant threat to pubic health or the environment and that action is required."

Subsequent to the Phase II Investigation, FPM (representing Little Joseph Realty) installed two upgradient groundwater monitoring wells (monitoring wells MW-5 and MW-6) to evaluate whether chemical constituents were migrating onto the HWD site. PCE was detected in a groundwater sample collected from monitoring well MW-6 at a concentration of 9 ppb, which exceeded the 5 ppb NYSDEC groundwater quality standard. 1,1-DCA and 1,1,1-TCA were detected in the groundwater samples collected from monitoring wells MW-5 and MW-6 at concentrations exceeding laboratory detection limits, but less than the NYSDEC groundwater quality standards. The analytical data indicated that there were sources of VOCs hydraulically upgradient from the HWD site.

1.5.3 Remedial Investigation

An RI was completed by BBL on behalf of the HWD Group between November 1999 and February 2000 and included a:

- ground-penetrating radar (GPR) geophysical survey to determine the presence and location of subsurface drainage structures and other subsurface structures;

- soil investigation to further evaluate the potential presence, concentration, and extent of chemical constituents in soil at the site;

- groundwater water investigation to vertically and horizontally profile the presence and concentration of chemical constituents in groundwater at and surrounding the site; and

- qualitative exposure assessment to determine potentially complete pathways of exposure for both current and hypothetical future receptors that may come in contact with site-related constituents of interest.

Supplemental RI soil and groundwater investigation activities were completed by BBL between January 2001 and April 2001 primarily to further evaluate the extent of VOCs in soil near the suspected location of the former sludge pit, to further evaluate groundwater quality hydraulically downgradient from the pit, and to evaluate whether a confining unit (Gardiner's Clay) is present beneath the site. Work activities completed as part of the RI and supplemental RI soil and groundwater investigations included the following:

- completing soil borings at 11 locations at/directly east of the site (locations SB-4 through SB-12, SB-16, and SB-17, as shown on Figures 5 and 6) using a conventional drill rig and hollow-stem auger drilling techniques. Each soil boring was advanced to the apparent groundwater table. Two soil samples collected from each soil boring were submitted for laboratory analysis for TCL VOCs. The samples from each boring, except SB-17, were also analyzed for TCL SVOCs, TAL inorganics, PCBs, total organic carbon (TOC), and grain size distribution. Sampling intervals were selected by field personnel based on visual characterization and results obtained for headspace screening using a photoionization detector (PID). At each soil boring location, one sample was collected from the interval that exhibited the highest PID headspace screening measurement or where the soil was observed to be stained or discolored. At boring locations where no impacts were observed, one sample was collected from the 2-foot interval halfway between the ground surface and the groundwater table. The second sample was collected from the 2-foot interval directly above the groundwater table;

- completing soil borings at 12 locations around the suspected location of the former sludge pit (locations GP-1 through GP-12, as shown on Figure 5) using a Geoprobe® drill rig and direct-push sampling techniques. Each soil boring was advanced to the apparent groundwater table. Two soil samples collected from each soil boring were submitted for laboratory analysis for TCL VOCs based on visual characterization and field screening results, using the approach described above;

- collecting groundwater grab samples from Hydropunch™ borings completed at 16 locations (locations HP-1 through HP-15 and HP-17, as shown on Figures 5 and 6). As shown on Figure 5, Hydropunch™ sampling locations HP-4 through HP-12 coincided with soil boring locations SB-4 through SB-12, and Hydropunch™ sampling location HP-17 coincided with soil boring location SB-17. The Hydropunch™ sampling was performed as a field screening tool to identify groundwater quality at specific depth intervals within the Upper Glacial Aquifer, to vertically and horizontally evaluate potential impacts to groundwater from site-related constituents in the Upper Glacial Aquifer, and to guide the vertical placement of well screens for deep permanent monitoring wells. At each Hydropunch™ sampling location (except location HP-17), a total of four groundwater samples were collected, including one sample just below the groundwater table and three samples from correspondingly deeper intervals, each approximately 30 vertical feet apart. At Hydropunch™ sampling location HP-17, groundwater samples were collected at 80, 90, 100, 110, and 120 feet below ground surface (bgs). Field measurements of groundwater pH, conductivity, dissolved oxygen, oxidation-reduction potential, temperature, and turbidity were measured during sampling. Each groundwater sample was submitted for laboratory analysis for TCL VOCs. The Gardiner's Clay unit was not identified in any of the Hydropunch™ borings, which were advanced to depths of between 95 and 120 feet bgs;

- installing three deep groundwater monitoring wells (monitoring wells MW-1D, MW-2D, and MW-3D, as shown on Figure 2) near existing shallow groundwater monitoring wells to better define the vertical extent of VOCs in groundwater. Monitoring well screen intervals were selected based on expedited analytical results for the Hydropunch™ groundwater samples collected from locations HP-13, HP-14, and HP-15. The top of each 10-foot long well screen was placed nearly 30 feet below the groundwater table. One shallow groundwater monitoring well (monitoring well MW-7, as shown on Figure 2) was also installed to further evaluate groundwater quality hydraulically downgradient from the former sludge pit. Well development and surveying activities were conducted following installation of the monitoring wells;

- collecting groundwater samples from the permanent monitoring wells in the vicinity of the site during an initial sampling event in January 2000 and a second sampling event in February 2001. Groundwater samples were collected from monitoring wells MW-1 through MW-6 and MW-1D through MW-3D during each sampling event. During the February 2001 sampling event, groundwater samples were also collected from monitoring well MW-7. Field measurements of groundwater pH, conductivity, dissolved oxygen, oxidation-reduction potential, temperature, and turbidity were measured during each sampling event. The groundwater samples collected during each event were submitted for laboratory analysis for TCL VOCs. In addition, groundwater samples collected during the January 2000 sampling event were also submitted for laboratory analysis for TCL SVOCs, PCBs, TAL inorganics, total suspended solids (TSS), total dissolved solids (TDS), and diesel range organics; and

- obtaining four rounds of water level measurements from groundwater monitoring wells in the vicinity of the site (January 2000, July 2000, February 2001, and April 2001) and from a staff gauge installed in the recharge basin northeast of the site (April 2001). Based on the water level measurements, the groundwater flow direction across the HWD site is toward the southeast. However, east of the site, there is a prominent component of groundwater flow to the west/southwest.

The RI soil and groundwater investigation results are summarized below, followed by results obtained for the qualitative exposure assessment.

1.5.3.1 Soil Investigation Results

Based on the validated laboratory analytical results obtained for the RI, PCE is the primary constituent of concern in soil at the site. PCE was identified at concentrations exceeding the NYSDEC TAGM 4046 guidance value of 1.4 ppm in soil at 13 RI sampling locations, including locations GP-1 through GP-9 and SB-5, SB-8, SB-16, and SB-17, as shown on Figure 7. The concentrations of PCE identified in soil above the TAGM 4046 guidance value were between 13 ppm and 190 ppm, with one exception: PCE was identified at soil sampling location GP-9 (in the former hazardous waste storage and treatment area) at a concentration of 440 ppm. PCE was not identified at concentrations exceeding the 1.4 ppm TAGM 4046 guidance value at soil sampling locations more than approximately 15 feet north, 12 feet south, 25 feet east, and 15 feet west of a "reinforced concrete pad" identified during the GPR geophysical survey and shown on Figure 5. The area of soil where PCE was identified at concentrations above the TAGM 4046 guidance value is shown on Figure 7 and appears to coincide with the former hazardous waste storage area and former drum storage area. At each sampling location where PCE was identified, the PCE concentration diminished with depth. The vertical extent of soil containing PCE at concentrations exceeding the 1.4 ppm TAGM 4046 guidance value is between approximately 6 and 13 feet bgs.

TCE and BTEX compounds were detected in subsurface soil at concentrations exceeding the TAGM 4046 guidance values, but below the soil action levels presented in NYSDEC TAGM #3028 titled, *"Contained-In Criteria" for Environmental Media*, the USEPA Region 3 RBCs for commercial/industrial soil, and the USEPA Region 9 PRGs for industrial soil. The RI soil analytical results for TCE and BTEX compounds are summarized below. The sampling depths referenced below are relative to the bottom of the concrete slab/ asphalt pavement that covers the HWD site/adjacent area.

- TCE was identified at concentrations exceeding the 0.7 ppm TAGM 4046 guidance value at only two of the RI soil sampling locations, including locations SB-5 (0-2') and GP-9 (0-2'). These are the same locations where the highest PCE concentrations were identified in soil. The TCE concentrations identified at these locations were "estimated" at 0.98 ppm and 3.5 ppm, respectively. A concentration is referred to as "estimated" when laboratory mass spectral data indicates the presence of the compound with a result less than the laboratory detection limit.

- BTEX compounds were identified at concentrations exceeding the TAGM 4046 guidance values at only two of the RI soil sampling locations, including SB-9 (in the southeastern portion of the site) and SB-11 (approximately 65 feet southeast of SB-9). Benzene was identified at sampling location SB-9 (12-14') at an estimated concentration of 0.31 ppm, above the 0.06 ppm TAGM 4046 guidance value. Ethylbenzene, toluene, and xylenes were identified at sampling location SB-11 (12-14') at concentrations of 31 ppm, 12 ppm (estimated), and 110 ppm, which exceed the TAGM 4046 guidance values of 5.5 ppm, 1.5 ppm, and 1.2 ppm, respectively. No other individual VOC constituents were identified above the TAGM 4046 guidance values at locations SB-9 and SB-11.

Phenol was identified at soil sampling locations SB-5 (0-2'), SB-7 (8-10'), and SB-16 (0-2') at estimated concentrations of 0.12 ppm, 0.18 ppm, and 0.031 ppm, which exceed the 0.030 ppm TAGM 4046 guidance value. Benzo(a)pyrene was identified at soil sampling location SB-12 (4-6') at an estimated concentration of 0.080 ppm, which is slightly exceeds the 0.061 ppm TAGM 4046 soil guidance values. No other SVOCs besides phenol and benzo(a)pyrene were identified in the RI soil samples at concentrations exceeding the TAGM 4046 guidance values.

Phenol is not considered a constituent of interest associated with the HWD site because it was identified at only three locations (locations SB-5, SB-7, and SB-16) and the validated concentrations are estimated values that only slightly exceed the 0.03 ppm TAGM 4046 soil guidance value. TAGM 4046 indicates that the method detection limit (MDL) may be used as an alternative to the 0.03 ppm guidance value listed for phenol. The estimated phenol concentrations identified at sampling locations SB-5, SB-7, and SB-16 are less than reported detection limits. As indicated in TAGM 4046, the tabulated guidance values for organic compounds (including phenol) are the lower of either a conservative human health risk-based value or a value calculated via soil/groundwater partitioning methods to protect groundwater quality. The phenol concentrations do not exceed the 50,000 ppm value established for protection of human health from systemic effects. In addition, phenol was not detected above the TAGM 4046 soil guidance value in underlying intervals at each above-identified sampling location.

BTEX compounds and benzo(a)pyrene are also not considered to be constituents of interest because: 1) the constituent concentrations were generally estimated values that only slightly exceed the TAGM 4046 soil guidance values; 2) each constituent was identified above its respective TAGM 4046 soil guidance value at one location only; and 3) the constituents were identified at depths that make them inaccessible for direct human contact at or near this site.

Inorganic concentrations identified in the RFI soil samples appeared to be consistent with typical background concentrations in the vicinity of the site. PCBs were identified in 11 RFI soil sampling locations at concentrations ranging from 0.24 ppm at sampling location SB-6 (12-14') to 5.7 ppm at sampling location SB-11 (12-14'). The PCB concentrations identified in the soil samples are below the 10 ppm TAGM 4046 subsurface soil guidance value. Trace levels of pesticides were detected at two RFI soil sampling locations (SB-5 and SB-9). The pesticide concentrations did not exceed available TAGM 4046 guidance values.

1.5.3.2 Groundwater Investigation Results

Based on the validated laboratory analytical results obtained for the RI, PCE is the primary constituent of concern in groundwater at the site. PCE was identified at concentrations exceeding the 5 ppb NYSDEC groundwater quality standard presented in TOGS 1.1.1 in groundwater samples collected from two shallow onsite groundwater monitoring wells located downgradient from former site operations, including monitoring wells MW-2 and MW-7. PCE was identified in the samples from these wells at concentrations up to 360 ppb and 1,100 ppb, respectively. PCE was also identified in groundwater samples collected from shallow groundwater monitoring wells located hydraulically upgradient from the site, including MW-1 and MW-6, at estimated maximum concentrations of 6 ppb and 16 ppb (respectively). The detection of PCE in wells MW-1 and MW-6 and the previous detection of PCE in other wells that appear to be hydraulically upgradient from the HWD site (i.e., wells at the Target Rock and Claremont Poly Chemical facilities that were installed/sampled by others as part of various site investigations), indicates that there are other past or present sources of PCE to groundwater in the area other than the HWD site.

Breakdown products of PCE, including TCE and 1,2-DCE, were identified in the groundwater samples collected from monitoring wells MW-2 and MW-7 at concentrations exceeding the NYSDEC groundwater quality standard of 5 ppb for both constituents, but the concentrations were one to two orders of magnitude lower than the PCE concentrations. Specifically, TCE was identified in RI groundwater samples collected from monitoring well MW-2 and MW-7 at estimated concentrations up to 14 ppb and 22 ppb, respectively, and 1,2-DCE was identified in RI groundwater samples collected from these wells at estimated concentrations up to 8 ppb and 9 ppb, respectively. Similar concentrations of TCE above the 5 ppb NYSDEC groundwater quality standard have also been identified in groundwater at other sites located hydraulically upgradient from the HWD site.

PCE and TCE were not detected in the groundwater samples collected from monitoring well MW-3 at concentrations exceeding laboratory detection limits. However, 1,2-DCE and a suite of other VOCs and SVOCs not identified in groundwater beneath the HWD site (i.e., three BTEX compounds, chlorobenzene, 2,4-dimethylphenol, and naphthalene) were identified in the groundwater samples collected from monitoring well MW-3 at concentrations exceeding the NYSDEC groundwater quality standards. Based on groundwater potentiometric surface maps developed for the RI/FS, monitoring well MW-3 is located hydraulically sidegradient to the HWD site. The detection of VOCs and SVOCs in groundwater at monitoring well MW-3 appears to be unrelated to the HWD site, and is likely related to historical groundwater quality impacts from leaking USTs located nearby.

VOCs were not detected at concentrations exceeding NYSDEC groundwater quality standards in any of the RI groundwater samples collected from the deep permanent monitoring wells located at and in the vicinity of the site (monitoring wells MW-1D, MW-2D, and MW-3D) or from shallow monitoring wells MW-4 and MW-5. Aside from two SVOCs identified in the groundwater samples collected from monitoring well MW-3 (2,4-dimethylphenol and naphthalene), SVOCs were not identified at concentrations exceeding NYSDEC groundwater quality standards in any of the RI groundwater samples. Inorganic concentrations identified in the RI groundwater samples appeared to be consistent with typical background concentrations in the vicinity of the site. PCBs were not detected in any of the RI groundwater samples at concentrations exceeding laboratory detection limits, which ranged from 0.51 to 0.53 ppb. Diesel range organics were identified only in the groundwater samples collected from monitoring well MW-3.

VOCs were identified in several of the groundwater grab samples collected from the Hydropunch™ soil borings at concentrations exceeding the NYSDEC groundwater quality standards. However, the Hydropunch™ sampling approach provided field screening level results only. Analytical results from Hydropunch™ boring groundwater samples did not correlate to analytical results from adjacent shallow and deep permanent groundwater monitoring wells. The differences in analytical results between the groundwater samples collected from the Hydropunch™ borings and permanent monitoring wells were attributed to the methodology used to collect the samples resulting in differences in the amount of suspended particulates in the samples. The turbidity levels in the groundwater samples collected from the Hydropunch™ borings were on the order of 1,000 nephelometric turbidity units (NTUs) while the turbidity levels in the groundwater samples collected via low-flow methods from the permanent wells ranged from 0.0 to 22.4 NTUs. Review of the groundwater turbidity data and VOC soil and groundwater analytical results suggests that the VOC concentrations identified in the Hydropunch™ groundwater samples were biased high due to VOCs adsorbed onto particulates in the samples. Based on available data, the Hydropunch™ sample results do not appear to accurately depict the amount of VOC constituents dissolved in groundwater.

1.5.3.3 Qualitative Exposure Assessment Results

The qualitative exposure assessment evaluated potential exposures to site-related constituents of interest under current and hypothetical future site conditions. Based on site-specific information and results obtained for the RI, no complete exposure pathways were identified for human or ecological receptors within the boundaries of the HWD site. A supplemental soil/air pathway evaluation was later performed to evaluate potential offsite exposures and is discussed in Subsection 1.5.4, including Subsection 1.5.4.2.

The assessment concluded that complete exposure pathways could exist in the future, if the HWD site were developed for residential use and/or private water supply wells were installed at the site under a “no-action” scenario. If the concrete surface cover is removed, the potential for complete exposure pathways may exist for excavation workers, commercial/industrial workers, trespassers, and ecological receptors. Under this hypothetical future scenario, receptors could potentially be exposed to soil via incidental ingestion, dermal contact, and inhalation of particulates. In the unlikely event that a private well is installed at the site, hypothetical commercial/industrial workers or residents may be exposed to site-related constituents in groundwater via ingestion, dermal contact, and inhalation of vapors.

Data presented in the *Remedial Investigation Report* (BBL, 2002) confirms that it is highly unlikely that site-related constituents of interest would ever affect the municipal supply wells of the East Farmingdale Water District, and analytical results for these wells do not indicate the potential for future complete groundwater exposure pathways for district customers. As discussed in Subsection 1.4.7 of this FS Report, *Annual Drinking Water Quality Reports* provided by the East Farmingdale Water District for the period between 1998 and 2002 indicate that constituents of interest related to the HWD site have not been detected above regulatory limits in water samples collected from the municipal supply wells. In addition, as summarized in the *Remedial Investigation Report* (BBL, 2002), all wastes were removed from the HWD site in 1984, there is a significant distance between the site and the municipal supply wells (1.75 miles), the wells are screened at great depths (up to 1,500 feet) in a different aquifer to that studied at the HWD site, and constituents detected in groundwater at the HWD site tend to attenuate in the aquifer materials naturally over time. Also, site-related constituents of interest were not identified at concentrations exceeding NYSDEC groundwater quality standards in groundwater samples collected from the deeper monitoring wells installed during the RI.

It was concluded that potentially compete exposure pathways exist for commercial/industrial workers or hypothetical future residents at the site if exposed to VOCs originating from groundwater beneath the site. Under this scenario, VOCs from groundwater could infiltrate to indoor air within future onsite and nearby offsite buildings. To determine whether hypothetical exposures via soil gas migration into indoor air would be significant, the *Remedial Investigation Report* (BBL, 2002) compared VOC constituent concentrations detected in shallow onsite groundwater monitoring well MW-2 during the RI and supplemental RI to "Method 1 GW-2" groundwater standards derived by the Massachusetts Department of Environmental Protection (MDEP) to be protective of indoor air exposures. The MDEP numeric standards were used as a basis for comparison because they were formally promulgated and represent regulatory risk-based standards specifically developed for this potential exposure pathway that are conservative. The NYSDOH has not developed standards for this exposure pathway and has not recognized the MDEP standards. As indicated in the *Remedial Investigation Report* (BBL, 2002), VOC concentrations detected in groundwater at monitoring well MW-2 did not exceed MDEP "Method 1 GW-2" standards. The comparison suggested that constituents in onsite groundwater would not pose a significant risk to hypothetical future residents via the indoor air inhalation pathway.

During January 2002, the NYSDOH conducted air monitoring to evaluate the potential presence of PCE in indoor air at three nearby offsite buildings, including the R&D, Fort Brand Service, and Ryder Truck buildings located along Picone Boulevard south and west of the HWD site. The NYSDOH used organic vapor monitoring badges to collect two indoor air samples from each building via passive diffusion over a 24-hour period. Laboratory analytical results indicated that PCE was detected at concentrations of 22 micrograms per cubic meter ($\mu g/m^3$) and 23 $\mu g/m^3$ in the middle and southern sections of the Ryder Truck garage area, respectively, 170 $\mu g/m^3$ and 180 $\mu g/m^3$ in the lobby and secretary area of the Fort Brand Service Building, and 890 $\mu g/m^3$ and 780 $\mu g/m^3$ in the lobby and secretary area of the R&D building. Based on the air monitoring data and the results of a soil vapor survey/air pathway evaluation conducted following review of the data (as summarized in Subsection 1.5.4 below), the NYSDOH concluded that VOCs in indoor air represented a completed exposure pathway.

1.5.4 Supplemental Soil Investigation and Soil Vapor Survey/Air Pathway Evaluation

Based on the results of the January 2002 air monitoring activities, the NYSDEC requested that a soil vapor survey/air pathway evaluation be conducted to evaluate the potential connection between the VOCs in soil/groundwater at the HWD site and PCE detected by the NYSDOH in indoor air samples noted above. The NYSDEC also requested that a supplemental soil investigation be completed based on review of an undistorted aerial photograph showing former site operations (included as Figure 4) and a field reconnaissance conducted on

January 15, 2002. The objectives of the supplemental soil investigation and soil vapor survey/air pathway evaluation were as follows:

- complete the delineation of VOCs in soil at the HWD site; and
- evaluate the potential for VOCs identified in soil and groundwater at the HWD site to migrate via soil vapor to the R&D, Fort Brand Service, and Ryder Truck buildings to the south and west of the HWD site.

The supplemental soil investigation and soil vapor survey/air pathway evaluation were completed by BBL during August 2002 in accordance with a work plan submitted to the NYSDEC via e-mail on July 19, 2002. NYSDEC approval to implement the activities was presented in a July 22, 2002 letter.

Detailed summaries of the work activities performed and results obtained for the supplemental soil investigation and soil vapor survey/air pathway evaluation are presented in an October 2, 2002 letter from BBL to the NYSDEC, which is included in Appendix A of this report. The work activities and results are briefly summarized below.

1.5.4.1 Supplemental Soil Investigation

The supplemental soil investigation included the completion of seven direct-push soil borings (borings GP-13 through GP-19, as shown on Figure 5) near the former hazardous waste storage and the former sludge pit at the site. Each soil boring was advanced to the depth of groundwater. Two soil samples collected from each soil boring were submitted for laboratory analysis for TCL VOCs based on visual characterization and field screening results, consistent with the approach used for the RI and supplemental RI.

Laboratory analytical results indicate that PCE was detected in soil sample GP-15 (6-6.5’) at a concentration of 2.3 ppm, which exceeds the 1.4 ppm TAGM 4046 soil guidance value. This analytical result does not exceed the 12 ppm soil action level presented in TAGM 3028, the 19 ppm USEPA Region 9 PRG for industrial soil, and the 110 ppm USEPA Region 3 RBC for commercial/industrial soil. VOCs were not detected in any of the other supplemental soil investigation samples at concentrations exceeding TAGM 4046 soil guidance values or other criteria referenced above. Based on the supplemental soil investigation activities, the extent of VOCs in soil at the HWD site was adequately delineated for purposes of this FS Report. The NYSDEC provided concurrence in an October 22, 2002 letter to BBL.

1.5.4.2 Soil Vapor Survey/Air Pathway Evaluation

Work activities performed as part of the soil vapor survey/air pathway evaluation included:

- a building integrity survey to evaluate the potential for VOCs to enter the R&D, Fort Brand Service, and Ryder Truck buildings to the south and west of the HWD site. BBL visually observed the inside of each building to evaluate the physical condition of the buildings and identify potential preferential pathways (sumps, cracks, etc.) for VOC vapors to migrate from the area of impacted soil/groundwater at the HWD site into the buildings;
- a building VOC inventory to identify potential sources of PCE unrelated to the HWD site that may contribute to the PCE levels identified in indoor air at the above-mentioned buildings. BBL developed a list

of products potentially containing VOCs (including PCE) that were observed to be in use, handled, and/or stored in the buildings;

- an air handling system evaluation to provide a qualitative understanding of the ability of the air handling systems in the above-mentioned buildings to adequately ventilate the indoor air. The types of air handling systems at the buildings were identified. However, information pertaining to operating speeds of fans and number of air exchanges provided by the heating and cooling systems was unavailable; and

- soil vapor sampling to evaluate the potential presence of VOC soil vapor in subsurface soil between the HWD site and the three above-mentioned buildings. Soil vapor samples were collected at a depth of approximately 2.5 to 3.0 feet bgs from seven direct-push soil borings located along/near Picone Boulevard to the south and west of the HWD site (borings SV-1 through SV-7, as shown on Figure 6). Each soil vapor sample was submitted for laboratory analysis for PCE, TCE, and degradation daughter products of PCE and TCE, including cis-1,2-DCE, 1,1-DCE, 1,1,-DCA, chloroethane, and vinyl chloride.

The NYSDOH conducted additional air monitoring at the R&D building during August 2002 in connection with the soil vapor survey/air pathway evaluation. PCE was identified in indoor air samples collected from the secretary area and lobby of the R&D building at concentrations of 190 µg/m^3 and 200 µg/m^3, respectively, which were lower than concentrations identified during the previous January 2002 monitoring event.

Based on the evaluation activities described above, BBL observed that the R&D, Fort Brand Service, and Ryder Truck buildings were each constructed with a concrete slab on grade and no basement. No significant cracks were observed in exposed sections of the cinderblock walls or concrete floors inside the buildings. Sumps were not identified inside any of the buildings. BBL identified products within the Fort Brand Service and Ryder Truck buildings that contained PCE, including brake cleaner in the Fort Brand Service building and degreaser/ parts washer fluid and battery corrosion inhibitor in the Ryder Truck building. BBL identified numerous adhesives, coatings/sealers, base fillers, cleaners, paints/stains, and paint strippers/thinners in the garage area of the R&D building that could potentially contain PCE. However, PCE was not listed as a chemical component on material safety data sheets (MSDS sheets) obtained for the products observed R&D. The composition of several products was listed as proprietary materials. BBL noted that old septic tanks, drainlines, etc. could potentially exist and contribute the presence of PCE to indoor air in these buildings. Later, during an August 2003 site visit, BBL observed a can of PCE-containing parts cleaning product in the R&D facility. An R&D employee subsequently interviewed by BBL verified the use of the PCE-containing parts cleaning product at the R&D facility. However, on more than one occasion, the NYSDEC and NYSDOH questioned R&D employees about PCE usage and they indicated that they were unaware of any PCE use at the facility.

Based on the laboratory analytical results obtained from the soil vapor survey, five VOCs (PCE, TCE, cis-1,2-DCE, 1,1-DCA, and vinyl chloride) were identified in the soil vapor samples. The highest VOC concentrations in soil vapor were identified at sampling location SV-2, located south of the HWD site. In general, PCE was identified in the soil vapor samples at higher concentrations than other individual VOC constituents. PCE was identified in each soil vapor sample at concentrations ranging from 0.012 parts per million on a volume basis (ppmv) in sample SV-1 to 97 ppmv in sample SV-2.

Based on the inventory activities completed within the buildings, a number of potential sources besides the HWD site were identified for the PCE identified by the NYSDOH in ambient air samples collected inside the R&D, Ryder Truck, and Fort Brand Service buildings. The maximum indoor air concentration of PCE identified by the NYSDOH (890 µg/m^3 during January 2002) was three orders of magnitude below applicable occupational exposure criteria for PCE established by the Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental and Industrial Hygienists (ACGIH), including the 685 milligrams per cubic meter (mg/m^3) OSHA permissible exposure limit (PEL), the 685 mg/m^3 ACGIH short-term exposure limit (STEL), and the 170 mg/m^3 ACGIH threshold limit value (TLV). The OSHA/ACGIH criteria were designed to protect commercial/industrial workers from unacceptable occupational exposures.

The NYSDOH stated that commercial use of PCE at the Ryder Truck and Fort Brand Service buildings rendered the OSHA/ACGIH standards applicable. Based on the finding of PCE-containing parts cleaning product at R&D during the August 2003 site visit, the HWD Group and BBL concluded that the OSHA/ACGIH standards also applied to the R&D facility. The NYSDEC and NYSDOH disagreed with that conclusion. The agencies maintained that PCE use in the R&D building is not routine and does not appear to be significant. The agencies believe that the primary source of PCE within the building is from subsurface vapor intrusion. Therefore, the NYSDEC and NYSDOH applied a more stringent, residential guideline to the facility (100 µg/m^3 as presented at www.health.state.ny.us/nysdoh/environ/btsa/fs_perc.htm, updated September 2003) rather than the OSHA/ ACGIH standards.

1.5.5 Additional Groundwater Investigation

In order to provide site-specific information for the FS, additional groundwater investigation activities were conducted at the HWD site during April 2003. The goal of the additional groundwater investigation activities was to provide data to evaluate the effectiveness of biodegradation as a groundwater remedial alternative. Particular emphasis was placed on evaluating the degradation of PCE and TCE, which had previously been identified at concentrations up to approximately 1 ppm. The groundwater investigation activities were conducted in accordance with:

- a January 31, 2003 work plan letter from BBL to the NYSDEC;
- a March 10, 2003 letter from BBL that responds to comments on the work plan presented in a February 25, 2003 letter from the NYSDEC;
- e-mail letters from BBL to the NYSDEC dated March 26, 2003 and March 28, 2003 that addressed additional NYSDEC comments on the groundwater investigation activities.

NYSDEC approval to implement the additional groundwater investigation activities was provided in a March 28, 2003 letter to BBL.

As indicated in the work plan letter, both PCE and TCE can be transformed and biodegraded in-situ in groundwater by a variety of naturally-occurring microbial-mediated reactions. The additional groundwater investigation activities focused on collecting data to evaluate the presence and extent of biodegradation via *reductive dechlorination* under natural conditions. Reductive dechlorination is a naturally occurring, microbially-mediated process that transforms and ultimately can destroy PCE and TCE in groundwater (at comparatively fast rates). During reductive dechlorination, naturally occurring groundwater micro-organisms sequentially remove chlorine atoms from PCE and TCE molecules, which results in the formation of less chlorinated intermediate byproducts (such as cis-1,2-DCE and vinyl chloride [VC]) until the non-chlorinated ethene molecule is produced. Chloride ions (Cl^-) are also formed as a result of reductive dechlorination. The resulting DCE, VC, and ethene can be oxidized by naturally occurring microorganisms in groundwater. Oxidation of these molecules forms the innocuous byproducts carbon dioxide (CO_2) and chloride. These processes can be represented as follows:

$$\text{PCE} \rightarrow \text{TCE} \rightarrow \text{DCE} \rightarrow \text{VC} \rightarrow \text{Ethene, Cl}^-$$

$$DCE \rightarrow CO_2 + Cl^-$$

$$VC \rightarrow CO_2 + Cl^-$$

$$Ethene \rightarrow CO_2$$

These biodegradation reactions require the presence of appropriate microorganisms and nutrients, as well as appropriate environmental conditions (circumneutral pH, adequate temperature, reducing geochemical conditions). Reductive dechlorination also requires an alternate supply of organic carbon, such as natural organic matter, DCE, VC, and ethene.

The additional groundwater investigation activities are summarized below, followed by the investigation results.

1.5.5.1 Additional Groundwater Investigation Activities

Work activities performed as part of the additional groundwater investigation included the following:

- installing and developing an additional shallow groundwater monitoring well hydraulically downgradient from the HWD site as requested by the NYSDEC (monitoring well MW-8, as shown on Figure 2). The well installation and development activities were completed on April 10, 2003. A groundwater monitoring well completion log for monitoring well MW-8 is included in Appendix B. The well location and top-of-casing elevation were surveyed following completion of the well installation/development activities;

- collecting groundwater samples from a subset of the existing monitoring wells at/near the site, including wells MW-1D, MW-1 through MW-3, and MW-6 through MW-8, on April 22 and 23, 2003. Specific capacity testing was performed in conjunction with the groundwater sampling (as described in Walton, W.C., 1962) to further evaluate the transmissivity and hydraulic conductivity of the geologic formation surrounding the screened interval of each well;

- obtaining a complete round of groundwater level measurements from each above-listed monitoring well and monitoring wells MW-2D, W-1, and W-3, prior to sampling on April 22, 2003. BBL also obtained a surface water level measurement in the recharge basin northeast of the site (at an existing staff gauge). Groundwater elevations and a surface water elevation were calculated by subtracting the water level measurements obtained at each well and the staff gauge from surveyed reference points. The water level measurements/elevations are summarized in Table 1. Interpreted contour lines from the April 2003 water table elevations and groundwater flow direction beneath the HWD site are shown on Figure 8.

Groundwater samples were collected using low-flow techniques (a peristaltic pump) for laboratory analysis for key indicator parameters of in-situ bioremediation. Groundwater samples were collected using dedicated bailers for laboratory analysis for TCL VOCs (to minimize the potential loss of VOCs through peristaltic pumping agitation). Various indicator parameters were measured during well purging prior to sampling.

The indicator parameters selected for field measurement and laboratory analysis were focused on the in-situ biodegradation processes discussed above. A complete listing of the indicator parameters that were field-measured and submitted for laboratory analysis, and the rationale for selecting each parameter, is presented below.

Parameter	Rationale	Method
Field Parameters		
Dissolved oxygen	Electron acceptor	Flow through cell
pH	Environmental indicator	Flow through cell
Redox potential	Geochemical indicator	Flow through cell
Conductivity	General water quality	Flow through cell
Temperature	Environmental indicator	Flow through cell
Laboratory Parameters		
VOCs	Delineation/initial concentration	USEPA Method 8260
Alkalinty	Buffering capacity	USEPA Method 310.1
Dissolved iron (filtered)	Metabolic byproduct	USEPA Method 6010B
Dissolved organic carbon (filtered)	Alternate electron donor	USEPA Method 9060
Ammonia	Metabolic byproduct	USEPA Method 350.2
Nitrate	Alternate electron acceptor	USEPA Method 9056
Nitrite	Alternate electron acceptor	USEPA Method 9056
Phosphate	Macronutrient	USEPA Method 9056
Chloride	Final byproduct	USEPA Method 9056
Sulfate	Alternate electron acceptor	USEPA Method 9056
Sulfide	Metabolic byproduct	USEPA Method 376.1
Carbon dioxide, ethane, ethene, methane	Metabolic byproducts	Gas chromatography (GC)
Phospholipid fatty acids	Biomass, community structure, and metabolic status of anaerobic microorganisms	Gas chromatography/ Mass Spectrometry (GC/MS)
Dehalococcoides Ethenogenes	Microorganism known to reductively dechlorinate PCE, TCE, DCE, and VC	Polymerase chain-reaction (PCR)

Filtering of the groundwater samples for analysis of dissolved iron and dissolved organic carbon was performed in the field using disposable 0.45 micron glass-fiber filters. Quality assurance/quality control (QA/QC) samples (including blind duplicate, matrix spike, matrix spike duplicate, and trip blank samples) were collected in support of the VOC analyses, as required by the NYSDEC 2000 Analytical Services Protocol (ASP). The blind duplicate sample (sample BD042203) was collected from monitoring well MW-3. Field parameter measurements obtained during the well purging activities prior to sampling are presented on the groundwater sampling logs included in Appendix C.

1.5.5.2 Additional Groundwater Investigation Results

Analytical results obtained from the laboratory analysis of the April 2003 groundwater samples for TCL VOCs are presented in Table 2. Groundwater field/laboratory analytical results for key indicator parameters of in-situ biodegradation are presented in Table 3. Laboratory analytical data reports (Form 1 results) are presented in Appendix D. VOC groundwater analytical results for the April 2003 and previous groundwater sampling events are shown on Figure 9.

Laboratory analytical results for VOCs are discussed below, followed by results obtained for the key indicator parameters of in-situ biodegradation.

VOCs

Laboratory analytical results indicate that PCE, TCE, and cis-1,2-DCE were detected at concentrations exceeding the 5 ppb NYSDEC groundwater quality standard (for each constituent) in each groundwater sample collected at and hydraulically downgradient from the site during April 2003, as summarized below.

Constituent	Concentration (ppb)		
	MW-2	MW-7	MW-8
PCE	1,200	2,600	970
TCE	34	48	25
cis-1,2-DCE	21	38	27

PCE was also identified in the April 2003 groundwater samples collected from upgradient monitoring wells MW-1 and MW-6 at concentrations of 50 and 120 ppb, which exceed the 5 ppb NYSDEC groundwater quality standard. The approximate 1,000 ppb isoconcentration line for PCE is shown on Figure 9.

BTEX compounds and chlorobenzene were identified at concentrations exceeding NYSDEC groundwater quality standards in the April 2003 groundwater sample collected from monitoring well MW-3, located hydraulically sidegradient to the HWD site. VOCs were not identified at concentrations exceeding the NYSDEC groundwater quality standards in the April 2003 groundwater sample collected from monitoring well MW-1D.

Key Indicator Parameters of In-Situ Biodegradation

Based on review of the field/laboratory results for key indicator parameters of in-situ biodegradation, there is evidence that in-situ biodegradation and complete reductive dechlorination of chlorinated solvents was occurring in shallow groundwater near monitoring well MW-8 (in the downgradient portion of the site-related VOC plume) and at monitoring well MW-3 (located sidegradient to the HWD site) during the April 2003 sampling event.

The phospholipid fatty acid (PLFA) analytical results indicate that the maximum biomass concentrations were detected at monitoring wells MW-1D, MW-3, and MW-8. PLFA are found within the membranes of all living cells, but decompose quickly upon cell death. Therefore, measurement of PLFA content in groundwater provides a quantitative measure of the viable microbial biomass present. PLFA structural group interpretation is used to relate the complex mixture of PLFA to the organisms present. The PLFA results indicate that the groundwater samples collected from monitoring wells MW-1D, MW-3 and MW-8 contained relatively high proportions of terminally-branched saturated PLFAs (which indicate the presence of anaerobic microorganisms) and branched monoenoic PLFAs (which indicate the presence of metal-reducing microorganisms such as sulfate- and iron-reducing bacteria). These trends correlate well with the relatively high concentrations of carbon dioxide, methane, ethane, and ethene (i.e., metabolic byproducts associated with in-situ biodegradation) at monitoring wells MW-3 and MW-8 and the presence of petroleum chemicals (which can provide organic carbon used for microbiologic growth) at monitoring well MW-3.

The analytical results indicate that *Dehalococcoides Ethenogenes* (*D. Ethenogenes)* was identified in the groundwater at monitoring wells MW-3 and MW-8. *D. Ethenogenes* is the only microorganism species isolated to date capable of complete reductive dechlorination of PCE, TCE, DCE isomers, and vinyl chloride. The presence of *D. Ethenogenes* provides support that reductive dechlorination reactions are causing the increased concentrations of metabolic byproducts identified in groundwater at monitoring wells MW-3 and MW-8. Although *D. Ethenogenes* was not detected above the laboratory detection limit in the groundwater samples collected from the other wells that were sampled, the non-detect results do not indicate that microorganisms are not present in the samples, but only that microorganisms were not present above the laboratory detection limit.

A detailed evaluation of the natural attenuation of VOCs in groundwater at and downgradient from the site, including the framework for evaluating the site-specific data, is presented in Appendix E.

1.6 Activities to Address Indoor Air/Additional Air Monitoring

Based on the results obtained for the indoor air monitoring conducted during August 2002 and NYSDEC comments presented in an October 22, 2003 letter to BBL, various upgrades were made to the existing heating, ventilating, and air conditioning (HVAC) system at the R&D building and additional (follow-up) monitoring activities were conducted. These upgrades and additional monitoring activities are summarized below.

During November 2002, the owner of the R&D building (who is part of the HWD Group), retained a local HVAC contractor who installed the following measures to increase the amount of outdoor air supplied to the R&D building and reduce PCE concentrations:

- a new outdoor air intake connected to the existing HVAC system to increase the amount of outside air supplied to the office space; and
- two exhaust fans with motorized dampers on the roof of the garage to increase the amount of outside air provided in the garage.

The installation activities were completed during mid-November 2002. During December 2002, BBL and the NYSDOH conducted air monitoring to further evaluate the presence and potential sources of PCE in indoor air at the R&D building. In addition, BBL's mechanical/HVAC engineering subcontractor, Lynch Engineering, P.C., conducted an evaluation of the air handling system at the R&D building to:

- evaluate whether the HVAC system at R&D had the capability of providing the correct air exchange volume to reduce indoor air PCE concentrations to below the NYSDOH residential indoor air quality guideline of 100 µg/m^3 (www.health.state.ny.us/nysdoh/environ/btsa/fs_perc.htm, September 2003); and

- identify feasible alternatives for further upgrading the HVAC system to improve air flow/ventilation and reduce indoor air PCE concentrations to below 100 µg/m^3.

The evaluation activities were conducted in accordance with a December 3, 2002 work plan letter from BBL to the NYSDEC. The results of the indoor December 2002 indoor air monitoring activities indicated that PCE was present above the NYSDOH residential indoor air quality guideline of 100 µg/m^3. Based on the results obtained for the December 2002 air monitoring activities, which after additional review activities, did not identify a specific source of PCE within the R&D building (but did not rule out the Ryder Truck degreaser as a potential source for PCE to migrate to R&D), the HWD Group agreed to implement activities in a phased approach to address PCE in indoor air at the R&D building. However, as discussed in Subsection 1.5.4.2, a can of PCE-containing parts cleaning product was later identified in the R&D facility during an August 2003 site visit. A BBL interview with an R&D employee verified the use of PCE at the facility. The HWD Group and BBL interpreted this information to mean that OSHA/ACGIH standards were applicable. The NYSDEC maintained that the lower NYSDOH residential indoor air quality guideline was applicable to the R&D building because PCE use in the building is not routine and does not appear to be significant. The NYSDEC indicated that they believe the primary source of PCE within the R&D building is from subsurface vapor intrusion.

An approach for addressing PCE in indoor air of the R&D building was presented in a January 16, 2003 letter from BBL to the NYSDEC. Comments on the approach were presented in a January 27, 2003 letter from the NYSDOH to the NYSDEC and included a request for collecting indoor air samples monthly for six months to evaluate the effectiveness of proposed HVAC system upgrades at reducing the concentration of PCE in the indoor air. The approach implemented to address PCE in the indoor air of the R&D building is summarized below.

Two free-standing portable high-efficiency particulate air (HEPA)/carbon filtration units were installed in the R&D office during January 2003 as an interim measure until permanent upgrades to the HVAC system were designed, installed, and operational. Each unit had 36 pounds of granular-activated vapor-phase carbon arranged in a 4-inch thick bed. Both units were turned on for continuous operation on the ‘high’ setting and filtered re-circulated air within the office area at a rate of 207 cubic feet per minute (CFM). Two additional filtration units were installed in the office area during February 2003 in accordance with a February 24, 2003 letter from BBL to the NYSDEC.

The design of the HVAC system upgrades was completed during late March 2003. Design drawings stamped by a professional engineer licensed in the State of New York were submitted to the NYSDEC during early April 2003. The new HVAC system heating and cooling units were operational by the end of April 2003, and the four existing HEPA/carbon filtration units were shut off in early May 2003. The upgraded HVAC system consists of:

- a new, nominal 5-ton split system with a ducted gas-fired furnace and a cooling coil piped to a roof-mounted air-cooled condenser system (which is 1-ton larger than the previous system). The new system supplies approximately 2,000 CFM to the office area, of which 350 to 400 CFM (nearly 20% of the re-circulated air supply) is outside air. The previous system supplied approximately 1,600 CFM to the office area, including approximately 150 CFM of outside air. While the old HVAC system fan ran only in connection with a heating/cooling cycle, the new fan runs continuously to maintain positive pressure across the office area (as practical) to minimize potential vapor intrusion through the building floor slab;

- new 24-inch by 12-inch louvers installed in the bottom panel of each overhead door in the garage area (one louver per door). The louvers allow outside air to sweep across the occupied garage area when the overhead doors are closed and existing roof-mounted exhaust fans are operated; and

- a new, larger gas line from the service main to the new furnace. The size of the gas line servicing the R&D building, which was undersized for the original HVAC system, was increased to supply the correct amount of gas to the new furnace and three existing gas-fired unit heaters in the garage area.

Air monitoring was conducted on a monthly basis from January 2003 through October 2003, and response actions were completed to address conditions affecting results. Results for air monitoring conducted during August 2003, September 2003, and October 2003 indicated that the HVAC system upgrades were operating as designed.

During late December 2003, the NYSDOH conducted air monitoring to further evaluate the potential presence of PCE in indoor air at the R&D building. The NYSDEC verbally reported that PCE was identified in the samples collected by the NYSDOH from the lobby and secretary area at concentrations of 140 to 160 $\mu g/m^3$.

BBL performed additional air monitoring at R&D in late February 2004 pursuant to a request from the NYSDEC in a January 27, 2004 telephone conference call with representatives from the HWD Group and BBL. The additional monitoring was performed in accordance with a February 20, 2004 letter from BBL to the NYSDEC and included: (1) sampling to further evaluate the concentration of PCE in indoor air; and (2) installation of an inclined-vertical manometer to measure the differential air pressure between the office space and the area immediately below the concrete floor slab of the building. Analytical results obtained for the February 2004 monitoring were similar to results obtained for the December 2003 monitoring performed by the NYSDOH. However, based on observations made while obtaining manometer readings, and based on follow-up conversations with an R&D manager, it was apparent that R&D had not been leaving the HVAC system fan on for continuous operation, as they had been instructed. Manometer readings indicated, however, that there was positive air pressure within the R&D building to mitigate potential subsurface vapor intrusion (even when the HVAC system fan was not running). The data, as earlier noted because of observation of contaminant sources within the building, suggested that PCE identified in the indoor air may be related to sources inside the building that were not being ventilated due to intermittent HVAC system fan operation.

BBL performed additional indoor air sampling at R&D during April 2004 and June 2004 in accordance with the February 20, 2004 letter from BBL to the NYSDEC. The June 2004 sampling was also performed as discussed in a June 4, 2004 conference call with the NYSDEC. Analytical results obtained for the April 2004 monitoring indicate PCE detections ranging from 8.0 $\mu g/m^3$ to 12 $\mu g/m^3$. Analytical results obtained for the June 2004 monitoring indicate PCE detections ranging from 19 $\mu g/m^3$ to 29 $\mu g/m^3$. During both sampling events, the HVAC system fan was observed to be operating continuously when sample badges were placed and retrieved, and controls to change the fan setting were inaccessible because a previously-installed locking cover was secured over the controls. Manometer readings obtained during the April and June 2004 sampling events, unlike the February 2004 event, indicate that operation of the HVAC system does not continuously maintain positive pressure within the R&D building. As a precaution, the HEPA/carbon filtration units have been placed back on line.

In order to completely eliminate any concern over the previous detection of PCE in indoor air at the commercial building, the R&D operation will be relocated from the building, thereby eliminating any potential for exposure to the PCE regardless of the source. R&D's operations will be moved to an alternate location by early August 2004, if possible, not to extend beyond the term of R&D's lease, which ends in October 2004. Little Joseph Realty, who leases the building at 20 Picone Boulevard to R&D, is working with R&D to find a suitable larger facility to support R&D's growing business. Sampling will be performed in late July 2004 and early October 2004 (if needed) to further evaluate baseline indoor air conditions during the time period prior to the building becoming vacant.

The R&D building will be reoccupied once the PCE vapor issues have been addressed as part of the HWD site remedial action, or sooner, if other measures (such as a subslab depressurization system) are installed and demonstrated to be effective. Installation, operation, maintenance, and monitoring of a subslab system and other measures to address potential subsurface vapor intrusion into the R&D building are included in the remedial alternatives evaluated in Section 5 of this report, where appropriate. Post-remedial monitoring of VOCs in indoor air will be performed, as appropriate, in accordance with an Operation, Maintenance, and Monitoring Plan (OM&M Plan).

2. Standards, Criteria & Guidance

2.1 General

This section of the FS Report discusses potential standards, criteria, and guidelines (SCGs) that may apply to the HWD site or apply to certain remedial alternatives evaluated for the HWD site. The identification of SCGs was conducted as set forth in NYSDEC TAGM #4030 titled, *Selection of Remedial Actions at Inactive Hazardous Waste Sites* (NYSDEC, 1990). The potential SCGs are also used to aid in the identification of RAOs but do not dictate a particular alternative and do not establish remedial cleanup levels.

2.1.1 Definition of SCGs

Definitions of the SCGs are presented below.

- *Standards and Criteria* – are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances.

- *Guidelines* – are non-promulgated criteria that are not legal requirements. However, remedial programs should be designed with consideration given to guidelines that, based on professional judgment, are determined to be applicable to the site [6 NYCRR Part 375-1.10(c)(1)(ii)].

2.1.2 Types of SCGs

The NYSDEC has provided guidance on the application of SCGs in the RI/FS process. The potential SCGs considered for the potential remedial alternatives identified in this FS were categorized into the following NYSDEC-recommended classifications:

- *Chemical-Specific SCGs* – These SCGs are usually health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values for each constituent of concern. These values establish the acceptable amount or concentration of constituents that may be found in, or discharged to, the ambient environment.

- *Action-Specific SCGs* – These SCGs are usually technology - or activity-based requirements or limitations on actions taken with respect to hazardous waste management and site cleanup.

- *Location-Specific SCGs* – These SCGs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur in specific locations.

The SCGs identified for the site are summarized below.

2.2 SCGs

The identification of federal and state SCGs for the evaluation of remedial alternatives at the site was a multi-step process that included a review of conditions identified by the RI, including results from the qualitative exposure assessment as summarized in the NYSDEC-approved *Remedial Investigation Report* (BBL, 2002). The SCGs that have been identified for this FS Report are presented in Table 4 and summarized below.

2.2.1 Chemical-Specific SCGs

One set of chemical-specific SCGs that potentially apply to site soil if the soil is to be excavated (and then considered under the Resource Conservation and Recovery Act [RCRA] to be a "waste" that is generated) are the RCRA-regulated levels for Toxicity Characteristic Leaching Procedure (TCLP) constituents, as outlined in 40 CFR Part 261 and 6 NYCRR Part 371. The TCLP constituent levels are a set of numerical criteria at which a solid waste is considered a hazardous waste by the characteristic of toxicity. In addition, the hazardous waste characteristics of ignitability, corrosivity, and reactivity may also apply depending on the results of waste characterization activities.

Another set of chemical-specific SCGs that may apply to the site (e.g., soils that are excavated and determined to be a hazardous waste) are the USEPA Universal Treatment Standards/Land Disposal Restrictions (UTS/ LDRs), as listed in 40 CFR Part 268. These standards and restrictions identify those hazardous wastes for which land disposal is restricted and define acceptable treatment technologies or concentration limits for those hazardous wastes on the basis of their waste code characteristics. The UTS/LDRs also provide a set of numerical criteria at which a hazardous waste is restricted from land disposal, based on the concentration of select constituents present. In addition, the UTS/LDRs define hazardous waste soil and hazardous waste debris and specify alternative treatment standards and treatment methods required to treat or destroy hazardous constituents on or in hazardous waste debris.

Pursuant to the USEPA's "Contained-in Policy," environmental media (soil, groundwater, and sediment) and debris impacted by a hazardous waste are subject to RCRA hazardous waste management requirements until they no longer contain the hazardous waste. Specifically, environmental media/debris that has been impacted by a release of characteristic hazardous waste must be managed as hazardous waste until the media/debris no longer exhibits that characteristic (based on laboratory testing). UTS/LDR requirements would continue to apply for the waste in accordance with 40 CFR Part 268. In addition, environmental media/debris containing a listed hazardous waste must be managed as hazardous waste until the media/debris no longer contains the listed hazardous waste at concentrations exceeding health-based levels. Under certain circumstances, the UTS/LDR requirements might continue to apply. Although the USEPA has not established generic health-based "contained-in" levels for listed hazardous wastes, they authorized individual states to establish their own levels. The NYSDEC has established "contained-in" criteria for environmental media and debris, which are presented in TAGM #3028 titled, *"Contained-In Criteria" for Environmental Media* (NYSDEC, 1997).

Groundwater beneath the site is classified as Class GA and, as such, the New York State Groundwater Quality Standards (6 NYCRR Parts 700-705) are potentially-applicable chemical-specific standards even though groundwater at the site is not currently, and will not likely in the future, be used as a potable water supply. These standards identify acceptable levels of constituents in groundwater based on potable use.

The soil guidance values presented in NYSDEC TAGM #4046 titled, *Determination of Soil Cleanup Objectives and Cleanup Levels,* (NYSDEC, 1994) are another set of chemical-specific SCGs that are potentially applicable to the site. These guidance values are considered in developing remedial performance goals for soil at the site.

2.2.2 Action-Specific SCGs

The general health and safety requirements established by OSHA for general industry under 29 CFR Part 1910, and for construction under 29 CFR Part 1926, are action-specific SCGs that may be potentially applicable to each active remedial alternative evaluated in this FS Report.

The New York State regulations contained in 6 NYCRR Parts 364, 370, and 372 for the collection and transportation of regulated waste within New York State are applicable action-specific SCGs for remedial alternatives that involve the offsite transportation of regulated wastes. In addition, the LDRs, which regulate land disposal of RCRA hazardous wastes, are applicable action-specific SCGs for remedial alternatives that involve the offsite disposal of hazardous wastes. In 1998, the USEPA promulgated Phase IV, Part 2 regulations that present alternative LDR treatment standards for hazardous waste soil. The alternative LDR treatment standard for hazardous waste soil is a 90% reduction in constituent concentrations capped at 10 times the UTS (10 x UTS). If concentrations of constituents in excavated soil that is a hazardous waste exceed 10 x UTS, the soil would have to be treated to reduce constituent concentrations to below the 10 x UTS prior to land disposal in a RCRA Subtitle C facility.

Other potentially applicable action-specific SCGs pertain to protecting water and air quality. The National Pollution Discharge Elimination System (NPDES) and the New York State Pollution Discharge Elimination System (SPDES) regulations contained in 40 CFR Part 122 and 6 NYCRR Parts 750-758, respectively, which detail specific requirements for the discharge of chemical constituents to United States and New York State waters, are also potentially applicable action-specific SCGs for remedial alternatives that involve the discharge of treated water to the environment. NYSDEC Air Guide 1, which incorporates applicable federal and New York State regulations and requirements pertaining to air emissions, may be applicable for soil or groundwater alternatives that result in certain air emissions.

2.2.3 Location-Specific SCGs

Location-specific SCGs for the HWD site include local requirements such as local building permit conditions for permanent or semi-permanent facilities constructed during the remedial activities (if any), and influent requirements of publicly owned treatment works (POTW) if water is treated at the site and discharged to a POTW. No floodplains, wetlands, or historic areas were identified at the site. Therefore, location-specific SCGs pertaining to floodplains, wetlands, and historic areas are not applicable to the potential remedial alternatives.

Other potential location-specific SCGs are regulations pertaining to the protection of endangered plant and animal species. In support of the qualitative exposure assessment completed as part of the RI, information regarding the presence of rare, threatened, or endangered plant and animal species within ½ mile of the site was requested and received from the New York State Natural Heritage Program and the U. S. Fish and Wildlife Service (USFWS). According to the Natural Heritage Program (letter to BBL dated March 2, 2000), there are two rare vascular plants (Hyssop-Skullcap and Southern Yellow Flax), a rare moth species (Coastal Barrens Buckmouth), and a rare butterfly species (Edwards' Hairstreak), in the vicinity of the site. The March 2, 2000 letter from the Natural Heritage Program did not identify any endangered species in the vicinity of the site. The USFWS reported to BBL in a March 21, 2000 letter that there are no federally-listed or proposed endangered or threatened species known to exist in the vicinity of the site. As indicated in the *Remedial Investigation Report* (BBL, 2002), the HWD site is a relatively small (0.5 acre) industrial site, and the entire site is covered with concrete and asphalt. Natural vegetative communities do not exist on site, and as such the site does not currently contain habitat required to support ecological receptors (including threatened/endangered species). Therefore, regulations pertaining to the protection of endangered species are not applicable for remedial activities at the HWD site.

3. Remedial Action Objectives

3.1 General

This section presents remedial action objectives (RAOs) developed for the HWD site to address constituents of interest in soil at the site and constituents of interest in groundwater beneath the site. The RAOs represent media-specific goals that result in the protection of human health and the environment. These objectives are, in general, developed by considering the results of the qualitative exposure assessment and the SCGs identified for the site. The RAOs developed for soil and groundwater are discussed below, followed by a description of the areas to be addressed to achieve the RAOs.

3.2 RAO Development Analysis

Based on the results of the previous investigation activities, PCE is the primary constituent of interest in soil and groundwater at the site. As summarized in Subsection 1.1, PCE has been identified in subsurface soil at concentrations exceeding potentially applicable guidance, including the guidance values presented in NYSDEC TAGM #4046. Five other VOCs, including trichloroethylene (TCE) and BTEX compounds, were detected in subsurface soil at concentrations exceeding the TAGM 4046 guidance values, but below the soil action levels presented in NYSDEC TAGM #3028 titled, *"Contained-In Criteria" for Environmental Media* (NYSDEC, 1997), the USEPA Region 3 RBCs for commercial/industrial soil, and the USEPA Region 9 PRGs for industrial soil. VOCs have also been identified in groundwater at the site at concentrations exceeding the standards/ guidance values presented in the NYSDEC TOGS 1.1.1 document titled, *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations*, (NYSDEC, 2000). Site-related constituents of interest at the HWD site were not detected in surface water or sediment samples collected in the vicinity of the site.

As summarized in Subsection 1.4.1, the current land use at the HWD site is light industrial, and access to the site is limited by chain-link fencing and lockable gates. The site is covered with a concrete surface, and there is no use of groundwater at the site. Due to current site conditions, there are currently no exposure points present within the site property, and therefore no complete exposure pathways have been identified under current conditions at the site.

Given the commercial/industrial setting and small size of the HWD site, the lack of vegetation, and the traffic associated with current trucking activities at and in the vicinity of the site, the qualitative exposure assessment concluded that the site does not contain habitat capable of supporting ecological populations or communities. While potential ecological receptors typical of urban environs (rodents, common small birds) may occasionally be present at the site, the existing concrete pavement prevents any potential exposures to site soil. Therefore, no complete exposure pathways were identified for potential ecological receptors at or in the vicinity of the site.

As summarized in Subsection 1.5.3.3, under future conditions, complete exposure pathways could exist if the HWD site were developed for residential use and/or private water supply wells were installed at the site under a "no-action" scenario. If the concrete surface cover is removed, potentially complete exposure pathways may exist for excavation workers, commercial/industrial workers, trespassers, and ecological receptors. Under both unlikely hypothetical future scenarios, receptors could potentially be exposed to soil via incidental ingestion, dermal contact, and inhalation of particulates. In the unlikely event that a private well is installed at the site, hypothetical commercial/industrial workers or residents may be exposed to site-related constituents in groundwater via ingestion, dermal contact, and inhalation of vapors. Data presented in the *Remedial*

Investigation Report (BBL, 2002) suggests that it is highly unlikely that site-related constituents of interest would ever affect the municipal supply wells of the East Farmingdale Water District.

The potentially complete exposure pathway for commercial/industrial workers at the R&D building south of the HWD site (via VOCs originating from activities within the building or via migration of VOCs through soil vapor to indoor air) is being addressed by vacating the building. As indicated in Section 2, after the R&D business has been moved from the premises, additional activities are planned to mitigate PCE vapor impacts at the building and may include the further evaluation of PCE indoor air sources, modification of the HVAC system, and a testing program to comply with applicable exposure criteria. In the future, the building will be reoccupied after testing shows that PCE concentrations in indoor air are controlled and/or that the source of any such detections are not related to subsurface conditions. Potentially complete exposure pathways exist for commercial/industrial workers or hypothetical future residents at the HWD site if exposed to VOCs originating from groundwater beneath the site.

3.3 Soil and Groundwater RAOs

Based on the results of the previous investigation activities and qualitative exposure assessment, the overall goal of the remedial alternatives will be to mitigate potential future human exposure to PCE associated with the soil at the site and groundwater beneath the site. Therefore, the RAOs established for soil/groundwater include:

- minimize potential future exposure of workers at the site to soil containing VOCs;
- minimize potential migration of chemical constituents in onsite soil to stormwater at the site and groundwater beneath the site;
- control offsite migration of VOCs through soil vapor;
- mitigate potential groundwater quality impacts from the site; and
- minimize potential human exposure to VOCs in groundwater at concentrations exceeding groundwater quality standards/guidance values.

These RAOs are used as the basis for identifying remedial technologies and for developing remedial action alternatives to address the constituents of interest identified in soil and groundwater at the HWD site.

The remedial performance goals for the alternatives identified in Section 4.0 that include soil removal or in-situ treatment are summarized below.

- *Excavation:* Soil would be removed from the area where VOCs have been identified at concentrations exceeding the 1.4 ppm NYSDEC soil guidance value for PCE as presented in TAGM #4046. Due to soil conditions (presence of sand and gravel materials), sheetpiling needed to support excavation sidewalls would prevent the collection of verification soil samples following excavation.
- *In-Situ Treatment (by In-Situ Soil Chemical Oxidation):* Verification soil samples would be collected following treatment (oxidant injection) events to compare VOC concentrations to one of the following performance standards, which are evaluated in Sections 5 and 6 of this FS Report:

1. 10 ppm total VOCs. This performance standard is consistent with the “cap-value” identified in TAGM #4046 that the NYSDEC uses in conjunction with compound-specific guidance values when a wide range of VOC constituents are present on a particular site; or

2. the compound-specific TAGM 4046 soil guidance values of 1.4 ppm for PCE and 0.7 ppm for TCE.

If the verification soil analytical results are not consistent with the selected performance standard (as identified in the ROD), then additional treatment events would be considered and, if appropriate and necessary, conducted. The chemical oxidation concentrations, flow rates, delivery systems, etc., would be adjusted/modified, as appropriate, for any such necessary additional treatments. No further treatments would be made, or considered appropriate and necessary, after VOC concentrations in the treatment area were generally consistent with the performance standard or if there is no discernible change in soil concentrations during repeat verification soil sampling events.

- *In-Situ Treatment (by Soil Vapor Extraction):* Field screening would be performed to evaluate the concentration of total VOCs in the extracted air conveyed to an SVE treatment system. When a point of no discernible change in VOC air concentrations is observed after an extended period of treatment (e.g., the concentration of VOCs in extracted air no longer decreases over time), then this asymptotic remedial performance result would be the remedial performance standard. Verification soil samples would also be collected following treatment to compare VOC concentrations to one of the following performance standards:

1. 10 ppm total VOCs; or

2. the compound-specific TAGM 4046 soil guidance values of 1.4 ppm for PCE and 0.7 ppm for TCE.

If the verification soil analytical results are not consistent with the selected performance standard (as identified in the ROD), then additional adjustments would be considered, and, if appropriate and necessary, made to the SVE system and treatment, if appropriate and necessary, would continue. Operation of the SVE system would be discontinued after VOC concentrations in the treatment area were generally consistent with the performance standard or if there is no discernible change in soil concentrations during repeat verification soil sampling events or no increase in the rate of removal via SVE.

Phenol at soil sampling locations SB-5, SB-7, and SB-16 will be actively addressed by the alternatives that involve chemical oxidation, capping, or excavation, but not soil vapor extraction. The alternative evaluated in Section 5 that includes soil excavation, will include removal of the soil containing phenol at concentrations above the TAGM 4046 soil guidance value. In addition, the alternative evaluated in Section 5 that includes in-situ soil chemical oxidation, will treat the soil at each location where phenol was identified at a concentration above the TAGM 4046 soil guidance value. Concentrations of phenol in soil would be unchanged by the alternative in Section 5 that includes SVE.

The remedial performance goal for groundwater would be achieved when groundwater total VOC concentrations (for site-related constituents of interest, including PCE, TCE, 1,2-DCE, and 1,1,1-TCA) beneath and hydraulically downgradient from the HWD site are:

- at or below 200 ppb, which is now the performance goal for the Fairchild site, located hydraulically downgradient from the HWD site. The March 1998 ROD for the Fairchild site identified a 1 ppm total VOC groundwater cleanup goal. However, based on pre-design investigation data and modeling efforts, the groundwater remedy for the Fairchild site now includes intercepting the groundwater plume of VOCs with a total VOC concentration of 200 ppb, as summarized in a July 31, 2003 letter from the NYSDEC. The 200 ppb goal is strictly predicated on the assumption that VOCs concentrations in groundwater migrating onto the HWD site will not exceed 200 ppb; or

- generally consistent with background concentrations, as identified in upgradient monitoring wells. Based on laboratory analytical results for groundwater samples previously collected from monitoring wells MW-1 and MW-6 (which are located hydraulically upgradient from the HWD site), groundwater flowing onto the HWD site contains PCE from an upgradient source at concentrations one to two orders of magnitude above the NYS drinking water standards (Class GA groundwater quality standards). PCE was identified in the most-recent (May 2003) groundwater samples collected from monitoring wells MW-1 and MW-6 at concentrations of 50 and 120 ppb, respectively. The above information suggests that it would likely be infeasible to treat groundwater flowing beneath the HWD site to the Class GA groundwater quality standards due to the continuing contribution of impacted upgradient groundwater.

Both of the above groundwater performance standards are considered for each action alternative evaluated in Section 5 of this FS Report.

3.4 Areas to be Addressed

The anticipated areas of soil and groundwater to be addressed in order to achieve the RAOs established for the site are summarized below.

- The area of soil to be addressed extends approximately 15 feet north, 12 feet south, 25 feet east, and 15 feet west of the reinforced concrete pad shown on Figure 5. The proposed area encompasses approximately 4,500 square feet and includes sampling locations SB-5, SB-8, SB-17, GP-1 through GP-10, and GP-15. The vertical extent of soil to be addressed in this area is in the vadose zone between approximately 6 and 13 feet bgs, depending on location and total VOC concentrations. This translates into a soil volume of approximately 1,300 cubic yards (CY).

- The area of groundwater to be addressed is approximately 100 feet wide (perpendicular to the groundwater flow direction) by at least 150 feet long (in the direction of groundwater flow), and extends from the northern limit of the former hazardous waste storage and treatment area (shown on Figure 5) southward approximately to monitoring well MW-8, eastward to the fenceline on the eastern property boundary, and westward beyond monitoring well MW-2. The alternatives assume that the groundwater zone to be addressed extends from the water table (approximately 10 to 13 feet bgs) to the top of the screened interval for the deep groundwater monitoring wells (approximately 40 feet bgs), where constituents of interest have not been identified at concentrations exceeding NYSDEC groundwater quality standards.

The above-described areas are illustrated in figures that support the discussions within the detailed analysis of remedial alternatives in Section 5.0. Under each action alternative proposed in this FS Report, one or more additional monitoring wells (screened at different depth intervals, as appropriate) would be installed hydraulically downgradient from the HWD site to further evaluate the horizontal and vertical extent of site-related VOCs in groundwater and to monitor groundwater quality. Monitoring well locations will be identified during design.

4. Technology Screening Summary and Development of Remedial Alternatives

4.1 General

This section of the FS Report presents the identification and screening of remedial technologies and the development of remedial alternatives for soil and groundwater. Each identified remedial technology is briefly described and evaluated against preliminary and secondary screening criteria, considering the characteristics of the HWD site. This approach is used to determine if a particular technology is appropriate for the remediation of the impacted soil and groundwater. Based on the preliminary and secondary screening, remedial technologies are eliminated or retained and subsequently combined into remedial alternatives for further evaluation in the detailed analysis of remedial alternatives presented in Section 5 of this FS Report.

4.2 Identification of Remedial Technologies

The identification of remedial technologies involved a focused review of available literature, including the following documents:

- NYSDEC TAGM #4030 titled, *Selection of Remedial Actions at Inactive Hazardous Waste Sites,* (NYSDEC, 1990);
- *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,* (USEPA, 1988);
- *Presumptive Remedies: Policy and Procedures,* (USEPA, 1993a);
- *Presumptive Remedies: Site Characterization with Technology Selection of CERCLA Sites with Volatile Organic Compounds in Soils,* (USEPA, 1993b);
- *Treatment Technologies,* (USEPA, 1991);
- *Technology Screening Guide for Treatment of CERCLA Soils and Sludges,* (USEPA, 1988b);
- *Technology Briefs – Data Requirements for Selecting Remedial Action Technologies,* (USEPA, 1987); and
- *Remediation Technologies Screening Matrix and Reference Guide, Version 3* (Federal Remedial Technologies Roundtable [FRTR], 1997).

These documents, along with remedial technology vendor information and other available information, were reviewed to identify technologies that are potentially applicable for addressing VOC-impacted soil and groundwater at the site.

4.3 Technology Screening

Potentially applicable technologies and technology processes underwent preliminary and secondary screening to select the technologies that would most-effectively achieve the RAOs identified for the site. Technology refers to a general category of technologies, such as capping or immobilization, while the technology process is a specific process within each technology type. A "no-action" general response has been included and retained through the screening evaluation in accordance with 6 NYCRR Part 375, which incorporates the NCP by reference. The no-action response will serve as a baseline for comparing the potential overall effectiveness of the other technologies.

4.3.1 Preliminary Screening

The preliminary screening was performed to reduce the number of potentially applicable technologies and technology processes based on technical implementability. The results of the preliminary screening of soil and groundwater technologies/technology processes are presented in Tables 5 and 6, respectively. The technology processes are briefly described and screened in these tables.

4.3.2 Secondary Screening

A number of potentially applicable technologies and technology processes were retained through the preliminary screening for soil and groundwater. To further reduce the technology processes to be assembled into remedial alternatives, the technology processes retained through the preliminary screening were subjected to a secondary screening. The objective of the secondary screening was to choose, when possible, one representative remedial technology process for each remedial technology category to simplify the subsequent development and evaluation of the remedial alternatives. A description of the screening criteria is presented below.

- *Effectiveness* – This criterion evaluates the extent that the technology will mitigate potential threats to public health and the environment through the reduction in toxicity, mobility, and/or volume of constituents in the impacted soil and groundwater.

- *Implementability* – This criterion evaluates the ability to construct, reliably operate, and meet technical specifications or criteria associated with each technology. This evaluation also considers the operation and maintenance (O&M) required in the future, following completion of remedial construction.

The remedial technologies for soil and groundwater that were retained through secondary screening using the above-listed criteria are summarized in Tables 7 and 8, respectively, and identified below.

Soil

- No Action;
- Deed Restrictions;
- Asphalt/Concrete Cap;
- Soil Vapor Extraction;
- In-Situ Soil Chemical Oxidation;
- Soil Excavation;
- Offsite Incineration; and

- Offsite Disposal (RCRA Subtitle C Landfill and Subtitle D Landfill).

Groundwater

- No Action;
- Deed Restrictions/Groundwater Use Restrictions;
- Asphalt/Concrete Cap;
- In-Situ Chemical Oxidation (Focused Application);
- Air Sparging;
- Monitored Natural Attenuation;
- Vertical Extraction Wells;
- Carbon Adsorption;
- Air Stripping;
- Discharge to a POTW;
- Discharge to Surface Water via Storm Sewer; and
- Reinsertion (Discharge to Groundwater).

The potential remedial technologies identified and screened above have been combined, as appropriate, to form comprehensive remedial alternatives capable of addressing the RAOs for the site. Consistent with the NCP (40 CFR Part 300.430), the following range of alternatives was developed to the extent practical:

- the no-action alternative;

- alternatives that remove constituents of interest to the maximum extent possible, thereby eliminating or minimizing the need for long-term management;

- alternatives that treat the constituents of interest but vary in the degree of treatment employed and long-term management needed; and

- alternatives that involve little or no treatment but provide protection of human health and the environment by preventing or minimizing exposure to the constituents of interest through the use of containment options and/or institutional controls.

The assembly and development of remedial activities is presented below.

4.4 Development of Remedial Alternatives

A total of six remedial alternatives have been assembled for further evaluation in the detailed analysis of remedial alternatives presented in Section 5.0. Each of the alternatives consists of one or more of the above-listed remedial technologies. The six remedial alternatives developed to address the soil and groundwater RAOs for the site are as follows:

- Alternative 1 – No-Action;

- Alternative 2 – In-Situ Soil Chemical Oxidation, In-Situ Groundwater Chemical Oxidation (Focused Application), Subslab Depressurization, Institutional Controls, Maintenance of Concrete/Pavement Cover, Natural Attenuation, and Long-Term Monitoring (these last four response actions are hereinafter listed as *"Site Controls and Monitoring"*);

- Alternative 3 – Soil Vapor Extraction, In-Situ Groundwater Chemical Oxidation (Focused Application), and Site Controls and Monitoring;

- Alternative 4 – Soil Vapor Extraction, Groundwater Air Sparging, and Site Controls and Monitoring;

- Alternative 5 – Asphalt Cap/Institutional Controls, Groundwater Extraction/Onsite Treatment, and Subslab Depressurization; and

- Alternative 6 – Soil Excavation and Offsite Incineration/Disposal and Groundwater Extraction/Onsite Treatment.

A brief description of each remedial alternative developed to address the soil and groundwater RAOs is presented below.

Alternative 1 – No-Action

This alternative involves no remedial actions to address impacted soil or groundwater at the site. This alternative relies on natural attenuation processes to potentially attain the RAOs.

Alternative 2 – In-Situ Soil Chemical Oxidation, In-Situ Groundwater Chemical Oxidation (Focused Application), Subslab Depressurization, and Site Controls and Monitoring

This alternative includes the same active treatment technology for both soil and groundwater (chemical oxidation). Chemical oxidation involves delivering oxidizing agents, such as potassium permanganate, hydrogen peroxide, ozone, etc., to impacted media to degrade organic constituents in the media to non-toxic byproducts. This alternative involves the construction of an oxidant delivery system, such as an infiltration gallery and groundwater injection well network, followed by oxidant application to treat VOCs in unsaturated/ saturated soil and groundwater. Components of the alternative include:

- Completing pre-design activities to further evaluate oxidant demand, potential infiltration/oxidant injection rates, and other parameters related to the design;

- Installing an oxidant delivery system. For example, an infiltration gallery consisting of parallel runs of perforated piping could be used to deliver oxidant solution to the unsaturated soil. A network of vertical injection wells at and hydraulically downgradient from the site could be used to deliver oxidant solution to groundwater;

- Injecting oxidant solution into the infiltration gallery and injection wells;

- Conducting verification sampling and analysis activities to evaluate the reduction of VOC concentrations in unsaturated soil;

- Conducting groundwater sampling for VOCs to evaluate the reduction of VOC concentrations in groundwater;

- Operating, maintaining, and monitoring a subslab depressurization system to be installed to maintain a favorable pressure differential between the R&D building interior and the subsurface to further mitigate potential subsurface vapor intrusion;

- Maintaining and repairing the concrete/pavement materials covering the majority of the site during remediation;

- Implementing use restrictions as to site groundwater;

- Implementing restrictions limiting property use to commercial/industrial (unless soil values for unrestricted use are achieved); and

- Implementing a periodic groundwater monitoring program.

Alternative 3 – Soil Vapor Extraction, In-Situ Groundwater Chemical Oxidation (Focused Application), and Site Controls and Monitoring

This alternative also includes active treatment remedies for both soil and groundwater. The soil remedy, in-situ SVE, is a proven technology that efficiently removes VOCs from unsaturated soil. The SVE process involves inducing a negative pressure gradient within the soil matrix through vapor extraction wells. As the induced vacuum propagates through the soil, VOCs in the soil volatilize. The VOC vapors are drawn to the extraction wells and through conveyance piping into a treatment system. Typically, the extracted vapors are treated by vapor-phase granular-activated carbon (GAC) prior to being discharged through an exhaust stack. Typical equipment used for implementation of SVE includes horizontal or vertical extraction wells, a vacuum unit (blower), a liquid/vapor separator (knock-out pot), a vapor treatment system, and system controls and instrumentation. The groundwater remedy, in-situ chemical oxidation (as discussed above) involves delivering an oxidizing agent to degrade organic constituents in the groundwater to non-toxic byproducts. Components of this alternative include:

- Completing a pilot study to further evaluate soil permeability, porosity, moisture content, and VOC mass removal rate;

- Installing vapor extraction wells, conveyance piping, and a skid-mounted treatment system at the site. The system would include one or more extraction wells to capture subsurface vapors potentially migrating beneath the R&D building floor slab;

- Performing SVE system startup and operation and maintenance (O&M) activities;

- Conducting air monitoring activities to evaluate the reduction of total VOC concentrations in the influent air to the SVE system;

- Completing pre-design activities to further evaluate oxidant demand in groundwater and potential oxidant injection rates;

- Installing a network of vertical injection wells at and hydraulically downgradient from the site, and injecting oxidant into the wells;

- Conducting sampling to evaluate the reduction of VOC concentrations in soil and groundwater;

- Maintaining and repairing the concrete/pavement materials covering the majority of the site during remediation;

- Implementing use restrictions as to site groundwater;

- Implementing restrictions limiting property use to commercial/industrial (unless soil values for unrestricted use are achieved); and

- Implementing a periodic groundwater monitoring program.

Alternative 4 – Soil Vapor Extraction, Groundwater Air Sparging, and Site Controls and Monitoring

This alternative also includes active treatment remedies for both soil and groundwater. The soil remedy, in-situ SVE, is the same as described for Alternative 3. The groundwater remedy, air sparging, involves the injection of air into the subsurface below the water table under controlled pressure through a series of injection wells. VOCs that are dissolved in groundwater and adsorbed onto saturated soil are volatilized (stripped) when in contact with the injected air. The resulting VOC vapors migrate upward through the groundwater and unsaturated zone, where they are drawn to SVE wells and then directed through conveyance piping into a treatment system. Typically, the extracted vapors are treated by vapor-phase GAC prior to discharge through an exhaust stack. Components of this alternative include:

- Completing a pilot study to further evaluate soil permeability, porosity, moisture content, and VOC mass removal rate;

- Installing air sparge and vapor extraction wells, conveyance piping, and a skid-mounted treatment system at the site. The system would include one or more extraction wells to capture subsurface vapors potentially migrating beneath the R&D building floor slab;

- Performing system startup and operation and maintenance (O&M) activities;

- Conducting air monitoring activities to evaluate the reduction of total VOC concentrations in the influent air to the treatment system;

- Conducting sampling to evaluate the reduction of VOC concentrations in soil and groundwater;

- Maintaining and repairing the concrete/pavement materials covering the majority of the site during remediation;

- Implementing use restrictions as to site groundwater;

- Implementing restrictions limiting property use to commercial/industrial (unless soil values for unrestricted use are achieved); and

- Implementing a periodic groundwater monitoring program.

Alternative 5 – Asphalt Cap/Institutional Controls, Subslab Depressurization, and Groundwater Extraction/Onsite Treatment

This alternative includes an engineering control/containment remedy for soil and an active treatment remedy for groundwater. This alternative involves the construction of an engineered cap extending over the majority of the site, the construction/operation of a groundwater extraction and treatment system, and implementation of deed restrictions to limit future site activities. Although the existing concrete slab at the site currently isolates the underlying VOC-impacted soil from direct human contact, this surface is expected to continue to deteriorate. In addition, cracks in the slab allow precipitation to infiltrate into the underlying soil. The infiltration could result in the release of VOCs from soil to groundwater. Components of this alternative include:

- Constructing and maintaining a low-permeability engineered cap over an approximately 12,000 square foot area of the site. For purposes of this FS Report, it is assumed that the engineered cap would consist of asphalt top/base courses overlying a layer of dense-graded aggregate, a geosynthetic drainage composite, and a high-density polyethylene (HDPE) geomembrane with welded seams;

- Establishing a deed restriction to notify future property owners of the presence of VOCs in soil at the site and the need to inspect and maintain the cap over the soil, and the need for health and safety provisions/cap repairs in the event that excavation activities had to occur;

- Installing groundwater extraction wells in the shallow groundwater zone to remove groundwater containing VOCs at concentrations exceeding the remedial goal;

- Treating the groundwater onsite and subsequently discharging the treated water to the nearby POTW or storm water recharge basin. Alternatively, the treated water could potentially be re-injected into the groundwater at the site;

- Implementing a periodic groundwater monitoring program to confirm that RAOs are being achieved; and

- Operating, maintaining, and monitoring a subslab depressurization system to be installed to maintain a favorable pressure differential between the R&D building interior and the subsurface to further mitigate potential subsurface vapor intrusion.

Alternative 6 – Soil Excavation and Offsite Incineration/Disposal and Groundwater Extraction/Onsite Treatment

This alternative is presented in response to the NYSDEC's request in a November 26, 2002 letter to BBL for a conventional alternative that could meet both the NYSDEC-recommended cleanup objectives for soil and New York State water quality standards for groundwater. Components of this alternative include:

- Removing the portion of the existing approximately 8-inch thick concrete slab at the site that overlies the area of soil to be excavated;

- Installing a sheetpile wall around the proposed excavation limits to stabilize excavation sidewalls (and to comply with OSHA requirements) and permit soil removal to a maximum depth of approximately 13 feet or the groundwater table (whichever is encountered first) in selected areas;

- Excavating approximately 1,300 CY of soil containing VOCs. The excavated soil would be transferred to a material staging area for characterization or would be direct-loaded for offsite transportation;

- Transporting the excavated soil offsite for incineration (if needed) and land disposal in accordance with applicable rules and regulations;

- Providing, placing, and grading a sand and gravel backfill material following completion of the excavation activities. The sheetpile wall would be removed and decontaminated in connection with the backfill placement;

- Installing groundwater extraction wells in the shallow groundwater zone to remove groundwater containing VOCs at concentrations exceeding the remedial goal;

- Treating the groundwater onsite and subsequently discharging the treated water to the nearby POTW or storm water recharge basin. Alternatively the treated water could potentially be re-injected into the groundwater at the site; and

- Implementing a periodic groundwater monitoring program to confirm that RAOs are being achieved.

5. Detailed Analysis of Remedial Alternatives

5.1 General

This section presents a detailed description and analysis of remedial alternatives developed to address VOCs in soil and groundwater related to the HWD site. The evaluation criteria used for analysis of the remedial alternatives are based on criteria specified in NYSDEC TAGM #4025, which incorporates the NCP by reference, and the USEPA guidance document titled, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988). The evaluation criteria are arranged in the order specified in NYSDEC TAGM #4030 titled *Selection of Remedial Actions at Inactive Hazardous Waste Disposal Sites* (NYSDEC, 1990). These criteria encompass statutory requirements and include other gauges of overall feasibility and acceptability of remedial options.

The detailed evaluation of each remedial alternative presented in this section consists of an assessment of the following seven criteria:

- Compliance with SCGs;
- Overall Protection of Human Health and the Environment;
- Short-Term Effectiveness;
- Long-Term Effectiveness and Permanence;
- Reduction of Toxicity, Mobility, or Volume through Treatment;
- Implementability; and
- Cost.

According to 6 NYCRR Part 375-1.109(c), another criterion to be considered when determining appropriate remedial alternatives is community acceptance. The community acceptance assessment will be completed by the NYSDEC after community comments on the PRAP are received. The results of the evaluation are typically considered when the NYSDEC selects a preferred remedial alternative and are typically presented in a Responsiveness Summary completed by the NYSDEC. The Responsiveness Summary is part of the ROD for the project and responds to all comments and questions raised during a public meeting associated with the PRAP, as well as comments received during the associated public comment period.

In addition to assessing each potential remedial alternative against the seven criteria presented above, the detailed analysis of the remedial alternatives presented in this section also includes a detailed technical description of each remedial alternative. In addition, unique engineering aspects (if any) of the physical components of the remedial alternative are discussed.

5.2 Description of Evaluation Criteria

A description of each of evaluation criterion used in this FS Report is presented below.

5.2.1 Compliance with SCGs

This criterion evaluates the compliance of the remedial alternative with appropriate SCGs. The evaluation will be based on compliance with:

- chemical-specific SCGs;
- action-specific SCGs; and
- location-specific SCGs.

5.2.2 Overall Protection of Human Health and the Environment

This criterion evaluates whether the remedial alternative provides adequate protection of human health and the environment. This evaluation relies on the assessment of other evaluation criteria, including long-term and short-term effectiveness and compliance with SCGs.

5.2.3 Short-Term Effectiveness

The short-term effectiveness of the remedial alternative is evaluated relative to its effect on human health and the environment during implementation of the alternative. The evaluation of each remedial alternative with respect to its short-term effectiveness will consider the following:

- short-term impacts to which the community may be exposed during implementation of the alternative;
- potential impacts to workers during implementation of the remedial alternative, and the effectiveness and reliability of protective measures;
- potential environmental impacts of the remedial alternative and the effectiveness of mitigative measures to be used during implementation; and
- amount of time until environmental concerns are mitigated.

5.2.4 Long-Term Effectiveness and Permanence

The evaluation of each remedial alternative relative to its long-term effectiveness and permanence is made by considering the risks that may remain following completion of the remedial alternative. The following factors will be assessed in the evaluation of the alternative's long-term effectiveness and permanence:

- potential environmental impacts from untreated waste or treatment residuals remaining at the completion of the remedial alternative;
- the adequacy and reliability of controls (if any) that will be used to manage treatment residuals or untreated waste remaining after the completion of the remedial alternative; and

- the ability of the remedial alternative to meet RAOs established for the site.

5.2.5 Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion evaluates the degree to which remedial actions will permanently and significantly reduce the toxicity, mobility, or volume of the constituents present in the site media. The evaluation will be based on the:

- treatment process and the volume of materials to be treated;
- anticipated ability of the treatment process to reduce the toxicity, mobility, or volume of chemical constituents of interest;
- nature and quantity of treatment residuals that will remain after treatment;
- relative amount of hazardous substances and/or chemical constituents that will be destroyed, treated, or recycled; and
- degree to which the treatment is irreversible.

5.2.6 Implementability

This criterion evaluates the technical and administrative feasibility of implementing the remedial alternative, including the availability of the various services and materials required for implementation. The evaluation of implementability will be based on two factors, as described below.

- *Technical Feasibility* – This refers to the relative ease of implementing the remedial alternative based on site-specific constraints. In addition, the ease of construction, operational reliability, and ability to monitor the effectiveness of the remedial alternative are considered.
- *Administrative Feasibility* – This refers to the feasibility/time required to obtain necessary permits and approvals to implement the remedial alternative.

5.2.7 Cost

This criterion evaluates the estimated total cost to implement the remedial alternative. The total cost of each alternative represents the sum of the direct capital costs (materials, equipment, and labor), indirect capital costs (engineering, licenses/permits, and contingency allowances), and operation and maintenance (O&M) costs. O&M costs may include operating labor, energy, chemicals, and sampling and analysis. These costs will be estimated with an anticipated accuracy between -30% to +50% in accordance with the USEPA document titled *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988). A 25% contingency factor is included to cover unforeseen costs incurred during implementation of the remedial alternative. Present-worth costs are calculated for alternatives expected to last more than 2 years. In accordance with USEPA guidance presented in OSWER Directive 9355.3-20 as superseded by OSWER 9355.0-75, a 7% discount rate (before taxes and after inflation) is used to determine the present-worth factor.

5.3 Detailed Description and Analysis of Remedial Alternatives

This subsection presents the detailed description and analysis of each remedial alternative identified in Subsection 4.4 against the seven criteria described above in Subsection 5.2. The remedial alternatives to be evaluated include:

- Alternative 1 – No-Action;
- Alternative 2 – In-Situ Soil Chemical Oxidation, In-Situ Groundwater Chemical Oxidation (Focused Application), Subslab Depressurization, and Site Controls and Monitoring;
- Alternative 3 – Soil Vapor Extraction, In-Situ Groundwater Chemical Oxidation (Focused Application), and Site Controls and Monitoring;
- Alternative 4 – Soil Vapor Extraction, Groundwater Air Sparging, and Site Controls and Monitoring;
- Alternative 5 – Asphalt Cap/Institutional Controls, Groundwater Extraction/Onsite Treatment, and Subslab Depressurization; and
- Alternative 6 – Soil Excavation and Offsite Incineration/Disposal and Groundwater Extraction/Onsite Treatment.

The results of the detailed evaluation of remedial alternatives against the seven criteria will be used to aid in the recommendation of the appropriate alternative for implementation at the site.

5.3.1 Alternative 1 – No Action

Technical Description

The no-action alternative serves as a baseline for comparison of the overall effectiveness of the other remedial alternatives. The no-action alternative would not involve the implementation of any remedial activities to remove, treat, or contain the VOCs in soil and groundwater related to the HWD site. The alternative relies on natural attenuation processes to reduce the concentrations of VOCs in soil and groundwater. The site would be allowed to remain in its current condition, and no activities would be undertaken to change the current conditions.

Compliance with SCGs

Chemical-Specific SCGs

The Class GA groundwater quality standards presented in 6NYCRR Parts 700-705 and in the NYSDEC TOGS 1.1.1 document titled, *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations* (NYSDEC 2000) are applicable chemical-specific SCGs for this alternative. Because this alternative does not include any remedial actions associated with groundwater, natural attenuation processes are relied on to meet the requirement of these standards. However, this alternative does not include any monitoring to document groundwater quality and to confirm that VOCs at concentrations exceeding the NYSDEC Class GA Groundwater Quality Standards are migrating further south of the site.

Chemical-specific guidelines that are to be considered under this alternative are the soil guidance values presented in NYSDEC TAGM #4046 titled, *Determination of Soil Cleanup Objectives and Cleanup Levels* (NYSDEC, 1994). TAGM #4046 presents separate guidance values for protecting human health and groundwater quality at sites where cleanup to predisposal conditions is not practical or possible. TAGM #4046 also presents a 10 ppm guidance value for total VOCs in soil. Natural degradation processes would not likely reduce VOC concentrations in soil at the site to below the TAGM #4046 guidance values.

The no-action alternative does not include the handling of any materials containing VOCs. Therefore, chemical-specific SCGs that regulate the subsequent management and disposal of these materials (and related residuals) are not applicable.

Action-Specific SCGs

Action-specific SCGs are not applicable because this alternative does not include any remedial actions.

Location-Specific SCGs

Location-specific SCGs are not applicable because this alternative does not include any remedial actions.

Overall Protection of Human Health and the Environment

Based on the RI results, the no-action alternative would be ineffective and would not meet the soil and groundwater RAOs for the HWD site. The alternative does not remove, treat, or contain VOCs in soil and groundwater. Although appropriate microorganisms for natural degradation of VOCs have been identified in groundwater hydraulically downgradient from the site, the historical VOC groundwater analytical data does not show an overall discernible decrease in VOC concentrations. Therefore, long-term environmental risks associated with the VOCs in groundwater would not likely be reduced under this alternative.

Short-Term Effectiveness

No remedial action would be implemented for the site. Therefore, there would be no short-term environmental impacts or risks posed to the community associated with implementation of this alternative.

Long-Term Effectiveness and Permanence

Under the no-action alternative, the VOCs identified in soil and groundwater would not be addressed. As a result, this alternative would not meet the RAOs identified for the site.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Under the no-action alternative, impacted soil and groundwater would not be removed, treated, recycled, contained, or destroyed. Therefore, the toxicity, mobility, and volume of the VOCs in the soil and groundwater would not be reduced (other than by natural passive in-situ processes).

Implementability

The no-action alternative does not involve any active remedial response and poses no technical or administrative implementability concerns.

Cost

There are no capital or O&M costs associated with implementation of the no-action alternative.

5.3.2 Alternative 2 – In-Situ Soil Chemical Oxidation, In-Situ Groundwater Chemical Oxidation (Focused Application), Subslab Depressurization, and Site Controls and Monitoring

Technical Description

In-situ chemical oxidation involves the subsurface introduction of oxidizing agents to degrade organic constituents present in soil or groundwater to less-toxic byproducts. This alternative includes the construction of an oxidant delivery system (such as an infiltration gallery and groundwater injection well network), followed by oxidant application to treat VOCs in unsaturated/saturated soil and groundwater.

Oxidant Selection

For cost estimation and remedial evaluation purposes in this FS Report, it has been assumed that potassium permanganate ($KMnO_4$) would be used as the oxidizing agent to address VOCs in soil and groundwater. Potassium permanganate has been shown effective at treating organic chemicals in laboratory, pilot, and full-scale applications in unconsolidated formations. Potassium permanganate is preferred for its relative stability, safety, ease of handling, and effectiveness over a wide range of pH. It is also more long-lived than other oxidants (persists in the subsurface for a longer period) and can be delivered over a larger area in the subsurface. Other oxidants such as hydrogen peroxide (Fenton's reagent) and ozone gas were also considered, but were not evaluated further because of a variety of concerns. Fenton's reagent is not preferred because of concerns regarding health and safety issues, chemical instability (explosion potential), limited pH applicability range (requiring acidification of the formation), substantial subsurface heat generation, and potential for pressure build-up and fugitive VOC emissions. Ozone gas was not evaluated further because of the difficulty in injecting the gas into the groundwater (ozone injection into the saturated zone involves the gas flow mechanisms of in-situ sparging). For instance, subsurface heterogeneity could lead to preferential gas flow, and ozone transport could be limited by mass transfer and aqueous-phase diffusions in areas that are water-saturated. Offgases generated from chemical oxidation via Fenton's reagent or ozone would likely need to be controlled by an SVE system.

Sodium permanganate was also considered, but was not favored because it is supplied in a highly concentrated solution (approximately 40% by weight) that would pose unnecessary health and safety concerns. Commercially-available potassium permanganate is supplied in the form of a powder that is relatively safe for handling. Potassium permanganate is generally delivered to the subsurface as a 1 to 6% solution during field applications.

Chemical Oxidation Using Permanganate

Permanganate has been used for over 50 years to oxidize organic chemicals in drinking water and wastewater treatment, including removal of iron and manganese, phenols, and more recently, chlorinated hydrocarbons related to industrial solvents (Schnarr, *et al*., 1998; DOE, 1999). There has been considerable recent interest and use of permanganate for in-situ destruction of chlorinated solvents in the subsurface. During in-situ applications, oxidants are delivered to the subsurface to contact and react with target chemicals, which are either commonly oxidized to carbon dioxide or converted into innocuous compounds found in nature (Yin and Allen, 1999).

Potassium permanganate reacts with and oxidizes a wide range of common organic chemicals relatively quickly and completely. In particular, potassium permanganate reacts rapidly with the non-conjugated (non-aromatic) double bonds in chlorinated ethenes, such as PCE, TCE, DCE isomers, and vinyl chloride. The balanced chemical equations for potassium permanganate oxidation of PCE (C_2Cl_4) and TCE (C_2HCl_3) are as follows:

$$4KMnO_4 + 3C_2Cl_4 + 4H_2O \rightarrow 6CO_2 + 4MnO_2 + 4K^+ + 12Cl^- + 8H^+$$

$$2KMnO_4 + C_2HCl_3 \rightarrow 2CO_2 + 2MnO_2 + 2K^+ + 3Cl^- + H^+$$

Oxidation using potassium permanganate cleaves the carbon-carbon bonds of the ethenes and produces carbon dioxide, manganese dioxide solids, potassium, and chloride at non-toxic levels (DOE, 1999). Target compounds such as dissolved solvents react rapidly with permanganate. Half-lives for PCE and TCE are approximately 4.3 hours and 18 minutes, respectively, in the presence of excess permanganate ion (Yan and Schwartz, 1999).

Fate of Permanganate in the Subsurface

Permanganate would be injected into the subsurface at depths above and below the groundwater table. It is currently envisioned that subsurface delivery would be accomplished via an infiltration gallery (for soils) and vertical injection wells (for groundwater). Permaganate would be delivered in the aqueous phase (dissolved in water) and would infiltrate through the unsaturated soil and move through groundwater via advection and dispersion. Refer to the Interstate Technology and Regulatory Cooperation (ITRC) Work Group report titled *Technical/Regulatory Guidelines, Technical and Regulatory Guidance for In Situ Chemical Oxidation of Contaminated Soil and Groundwater* (ITRC, June 2001) for additional detailed information regarding oxidation of PCE and TCE by potassium permanganate.

In addition to reacting with target substances such as chlorinated VOCs, potassium permanganate also reacts with a wide variety of organic and inorganic materials commonly present in the subsurface, such as:

- natural organic carbon;
- iron-bearing minerals;
- manganese-containing minerals; and
- other minerals.

Reaction with these non-target substances also consumes the oxidant. The mass of oxidant consumed per unit of geologic material is commonly expressed in terms of grams of oxidant per kilogram dry weight of soil (g/kg). Potassium permanganate consumption by target analytes follows the stoichiometry indicated in the balanced chemical equations listed above. The stoichiometric mass ratio of $KMnO_4$ to PCE is approximately 1.3:1 and the ratio of $KMnO_4$ to TCE is approximately 2.4:1. Potassium permanganate consumption in dry soil typically ranges from approximately 3 g/kg for relatively "clean" sand and gravel to 14 g/kg for clayey, organic soil and sediment.

MnO_4^- consumption by target compounds, organic carbon, and minerals follows second-order kinetics, in which the rate of a given reaction depends on the concentrations of both reactants. However, several studies have indicated that pseudo-first-order kinetics prevail for the less concentrated reactant when the other reactant is present in excess. MnO_4^- can react very quickly with organic carbon. Yan and Schwartz (1999) reported a half-life of approximately 5.5 hours for MnO_4^- consumption in the presence of excess dissolved total organic carbon. Seol, *et al.* (2000) reported half-lives ranging from 6 minutes to approximately 10 hours for MnO_4^- consumption in the presence of TCE or PCE, respectively.

Conceptual Approach for In-Situ Soil and Groundwater Chemical Oxidation

Under this alternative, pre-design activities would be performed to further evaluate oxidant demand, potential infiltration/oxidant injection rates, offgas generation, potential impacts on the biogeochemical environment, and the potential permeability reduction by manganese dioxide (MnO_2) colloids. Based on the findings of the pre-design activities, the remedial design would be prepared and implementation of in-situ oxidation would proceed on a full-scale application.

During full-scale implementation, a delivery system would be constructed to distribute oxidant solution to impacted soil and groundwater. For the purposes of cost estimating in this FS, it is assumed that the delivery system would include:

- an infiltration gallery consisting of parallel runs of perforated piping to deliver oxidant solution to the unsaturated soil. It is assumed that each run of piping would be no more than 100 feet long, and individual piping runs would be spaced evenly apart. It is also assumed that the piping would be installed just below grade; and

- a network of vertical injection wells at and hydraulically downgradient from the site to deliver oxidant solution to a focused area of the saturated zone. It is assumed that injection well clusters (two wells per cluster) would be installed within an approximately 150-foot-wide by 100-foot-long area, and clusters would be spaced routine intervals apart. As the oxidant solution is denser than groundwater, a significant depth of treatment could be realized by delivering oxidant into the upper 10 to 15 feet of the saturated zone, allowing the oxidant to descend as it migrates with groundwater flow. Delivery via wells straddling the water table would also aggressively treat the water table zone. Therefore, for cost estimating purposes, it is assumed that one of the two wells in each cluster would be screened across the groundwater table and the other well would be screened at a deeper interval.

The areas of soil and groundwater to be addressed by this alternative are shown on Figure 10. In order for in-situ chemical oxidation to be effective, it is necessary to deliver the oxidizing agents in a manner that promotes contact with the VOCs in the subsurface soil and groundwater. The radius of influence surrounding the infiltration gallery piping and individual injection wells would be evaluated during the pre-design phase. Results obtained for pre-design activities would be used to properly design the oxidant delivery parameters (e.g., oxidant concentration, injection rate, etc.) and spacing of oxidant injection locations. Groundwater oxidant injection wells would not need to extend over the full length of the groundwater VOC plume to be remediated since unconsumed oxidant will migrate with groundwater flow and natural attenuation processes will also address VOCs throughout the area.

Design of the delivery system will take into consideration that the highest PCE concentrations in soil at the HWD site are found just below the concrete pavement, at the 0 to 2 foot depth interval. Based on discussions with chemical oxidation vendors, the flow rate and pressure of oxidant delivered through an infiltration gallery could be adjusted to “flood” the entire unsaturated zone beneath the pavement to achieve treatment.

At this time, for the purpose of developing a cost estimate for this alternative, it is assumed that a potassium permanganate solution would be injected into the infiltration gallery and injection wells on a quarterly basis. The number of injection events would be determined based on soil and groundwater sampling activities, as discussed further below. The oxidant would be batched from dry powder to concentrated stock solution, and subsequently mixed, diluted, filtered, and delivered to the individual injection points.

The total amount of oxidant needed under this alternative is dependent on the selected performance standard. For cost estimating purposes, the total amount of oxidant needed under this alternative is assumed as follows:

- *Performance Standard 1 – Achieve 10 ppm Concentration for Total VOCs in Soil and 200 ppb Concentration for Total VOCs in Groundwater:* Approximately 15 tons would be required for soil treatment and approximately 50 tons would be required for groundwater treatment. Assuming the oxidant is delivered in a 3.5% solution, the total amount of oxidant solution would be 120,000 gallons for soil treatment and 350,000 gallons for groundwater treatment; and

- *Performance Standard 2 – Achieve TAGM 4046 Compound-Specific Soil Guidance Values for PCE and TCE in Soil, and Background Concentrations for VOCs in Groundwater:* Approximately 20 tons would be required for soil treatment and approximately 63 tons would be required for groundwater treatment. Assuming the oxidant is delivered in a 3.5% solution, the total amount of oxidant solution would be 160,000 gallons for soil treatment and 430,000 gallons for groundwater treatment.

The total amount of oxidant identified above for Performance Standard 1 was calculated based on the estimated total mass of VOCs in the subsurface areas to be addressed as part of the HWD site remedy and the stoichiometric relationship for the amount of oxidant required to destroy the estimated total mass of VOCs, taking into account potential oxidant demands by organic carbon and minerals. The total amount of oxidant identified above for Performance Standard 2 assumes that, in practice, one additional quarterly treatment event would be required to reduce soil and groundwater concentrations from Performance Standard 1to Performance Standard 2. However, it is difficult to predict exactly what the additional amount of oxidant (and additional cost) would be to treat from Performance Standard 1 to 2. Based on experience, the economy of chemical oxidation treatment often improves over time with subsequent applications. However, depending on site factors, it is also possible that VOC soil and groundwater degradation could follow an exponential decay pattern, resulting in asymptotic conditions over continued treatment applications. The volumes presented above are preliminary estimates only and may change based on results obtained for the pre-design activities and initial full-scale treatment. It is possible that treatment could be completed in a one year timeframe.

As permanganate would likely be used as the oxidant, offgas recovery and treatment would not likely be required as part of this alternative. As stated in the U.S. Department of Energy summary report titled "In-Situ Chemical Oxidation Using Potassium Permanganate," (DOE/EM-0496, September 1999), under the heading "Community Safety" on page 20: *In Situ Chemical Oxidation Using* $KMnO_4$ *does not produce release of volatile organic compounds*.

Given the small size of the needed treatment area (approximately 4,500 square feet) and comparatively large amount of existing physical and chemical soil characterization data, pilot testing is not technically required to effectively design the program. Parameters such as oxidant demand, potential infiltration/oxidant injection rates, and offgas generation would be evaluated through bench-scale testing of samples of soils collected from the site. Based on extensive testing to be performed during the initial full-scale treatment application, adjustments would be made (as appropriate) to the in-situ chemical oxidation delivery system, application rates, and/or oxidant dosing to increase the effectiveness of subsequent treatment applications. The distribution and retention time of the oxidant and changes in soil vapor concentrations/potential gas migration would be monitored during the initial oxidant injection. Real-time air monitoring with a PID would be performed during treatment in accordance with the NYSDOH's Community Air Monitoring Plan (CAMP) guidance, dated June 2000. Monitoring would be performed both at the HWD site and the nearby R&D Carpet and Tile building, as appropriate. An appropriate response would be made if air monitoring results exceed action levels and discussions would be held with the NYSDEC under such a circumstance.

Soil sampling would be conducted in connection with the soil treatment to evaluate the reduction of VOC concentrations in unsaturated soil and consistency with remedial goals. Additional injections would be performed, if appropriate and necessary, to treat the soil. Groundwater sampling for VOCs would be conducted prior to each injection event and after the final injection event is completed to evaluate the reduction of VOC concentrations in groundwater and consistency with remedial goals. Post-remedial groundwater monitoring would be performed on a quarterly basis (for a period of up to two years) to show a statistical trend to evaluate the effectiveness of the alternative. This groundwater monitoring approach is presented for cost estimating purposes to compare potential remedial alternatives. The groundwater monitoring frequency will be more fully evaluated during design, when a detailed pre- and post-injection groundwater monitoring plan will be developed to monitor the effectiveness of the remedy. Additional injections would be performed, if appropriate and necessary, to treat the saturated zone. Existing groundwater use restrictions in place in Suffolk County Sanitary Code, Article 4 – Water Supply, Section 406.4, would continue to minimize potential human exposure to VOCs in groundwater at concentrations exceeding groundwater quality standards. Use restrictions would also be put in place as to site groundwater.

As part of this alternative, a subslab depressurization system would be installed to maintain a favorable pressure differential between the R&D building interior and the subsurface to mitigate potential subsurface vapor intrusion. The system would include two or more suction points, conveyance piping, and a high-suction fan to create a positive pressure differential across the R&D floor slab. The system would be operated, maintained, and monitored in accordance with an OM&M Plan.

During remediation, the existing concrete/pavement materials covering the majority of the site would be maintained. Deed restrictions limiting property use to commercial/industrial would also be implemented, unless soil values for unrestricted use are achieved.

Compliance with SCGs

Chemical-Specific SCGs

The Class GA groundwater quality standards presented in 6NYCRR Parts 700-705 and in the NYSDEC TOGS 1.1.1 document titled, *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations* (NYSDEC 2000) are applicable chemical-specific SCGs for this alternative. Groundwater quality would be assessed in connection with the in-situ soil and groundwater chemical oxidation treatment. In-situ groundwater chemical oxidation at other sites has been successful at reducing groundwater VOC concentrations to federal maximum contaminant levels (MCLs). It is anticipated that the concentrations of VOCs identified in groundwater at and downgradient from the HWD site will be reduced by this alternative. The ability of this alternative to result in attainment of groundwater quality standards is dependent on the amount of oxidant injected, the number of treatment applications, and the effect of other VOC sources in the vicinity of the HWD site. Groundwater monitoring would be performed to evaluate the reduction in groundwater VOC concentrations and provide data on concentration re-bounds (if any) following oxidant delivery.

Chemical-specific guidelines that are to be considered under this alternative are the soil guidance values presented in NYSDEC TAGM #4046 titled, *Determination of Soil Cleanup Objectives and Cleanup Levels* (NYSDEC, 1994).

The constituent values in TAGM #4046 are the lower of either a conservative human health risk-based value or a value calculated via soil/groundwater partitioning relationships to protect groundwater quality. Attainment of the TAGM 4046 values in soil allows for unrestricted use of a site. The proposed 10 ppm soil remedial performance goal for total VOCs is less than the human health risk-based values for the two primary constituents of interest at the HWD site, PCE and TCE (14 ppm and 64 ppm, respectively). The TAGM values for protection of groundwater quality are 1.4 ppm for PCE and 0.7 ppm for TCE and are based on infiltration of precipitation through soils to groundwater. The HWD site is currently, and will continue to be, covered with concrete/pavement materials, which can reduce infiltration into the treated soils. In addition, considering that background concentrations of VOCs in groundwater flowing onto the HWD site (from offsite sources) exceed NYS groundwater quality standards by one to two orders of magnitude, Performance Standard 1 is being considered. The TAGM 4046 compound-specific guidelines, while considered, are neither applicable nor appropriate given the industrial/commercial zoning and use of the site and the presence of concrete/pavement materials on the ground surface.

Under proposed Performance Standard 1, VOCs in soil would be chemically oxidized, lowering VOC concentrations an order of magnitude and approaching the 10 ppm total VOC value. Under proposed Performance Standard 2, the goal of in-situ chemical oxidation soil treatment would be to achieve the compound-specific TAGM 4046 soil guidance values for PCE and TCE.

Action-Specific SCGs

Action-specific SCGs that apply to this alternative are the OSHA construction standards and health and safety requirements associated with the construction of the delivery system, handling of oxidant, and performance of onsite monitoring activities. Workers and worker activities that occur during implementation of this alternative must comply with OSHA requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting as identified in 29 CFR Parts 1904, 1910, and 1926. Compliance with action-specific SCGs would be accomplished by following a NYSDEC-approved design and site-specific HASP.

NYSDEC Air Guide 1 will be evaluated during design to confirm that oxidation rates will not produce air emissions requiring restrictions.

Wastes generated by the installation of the infiltration gallery and injection wells (soil removed from trenching, soil cuttings, personal protective equipment [PPE], etc.) would be characterized to determine appropriate offsite disposal requirements. If any of the materials are characterized as a hazardous waste, then the RCRA, UTS/LDR, and United States Department of Transportation (USDOT) requirements for the packaging, labeling, transportation, and disposal of hazardous or regulated materials may be applicable. Compliance with these requirements would be achieved by utilizing licensed waste transporters and properly permitted disposal facilities.

Location-Specific SCGs

Remedial activities at the site would be conducted in accordance with local building/construction codes and ordinances, as appropriate, including those requirements at offsite disposal locations.

<u>Overall Protection of Human Health and the Environment</u>

The in-situ soil and groundwater chemical oxidation alternative would meet the RAOs established for the site. Potential human exposure to the impacted soil and groundwater would be reduced following remedial activities, as impacted soil and groundwater would be treated in place to degrade VOCs into innocuous substances found in nature. Soil treatment activities would also address the potential migration of VOCs in onsite soil to stormwater at the site and groundwater beneath the site. Groundwater treatment activities would address potential groundwater quality impacts from the site and help control the migration of VOCs from groundwater to soil vapor. Oxidant delivered to the vadose zone soil under the in-situ soil chemical oxidation component would also react with and destroy VOCs in soil vapor, which would help control potential offsite VOC migration via soil vapor. A subslab depressurization system would be installed to maintain positive pressure across the R&D building floor slab to further mitigate potential subsurface vapor intrusion.

Both remedial performance standards considered under this alternative are protective of human health and the environment. The HWD site is currently, and will continue to be, covered with concrete/pavement materials. These protective surfaces would be maintained and limit direct human exposure to soil. By preventing infiltration, the cover would also mitigate the potential for leaching of low VOC concentrations remaining following treatment. Existing groundwater use restrictions in place in Suffolk County Sanitary Code, Article 4 – Water Supply, Section 406.4, would continue to minimize potential human exposure to VOCs in groundwater at concentrations exceeding groundwater quality standards. It is also appropriate to recognize that groundwater from the HWD site will merge with the downgradient Fairchild plume containing higher VOC concentrations.

As a conservative measure, site use restrictions would be established if final post-remedial VOC soil concentrations are not generally consistent with the TAGM 4046 compound-specific guidance values.

Short-Term Effectiveness

As indicated above, the oxidant likely to be used under this alternative (potassium permanganate) reacts with and oxidizes PCE and TCE, the primary constituents of concern in soil and groundwater related to the HWD site, relatively quickly and completely. Reaction times for the destruction of these VOC constituents are on the order of minutes/hours. Treatment under this alternative can be completed in a relatively short timeframe without the need for significant construction activities or long-term maintenance/monitoring. Effective treatment is based on the ability to deliver the oxidant to the target constituents. A comprehensive infiltration gallery and injection well network is envisioned under this alternative to provide oxidant to the affected areas. It is possible that the subslab depressurization system could effectively mitigate potential subsurface migration of VOCs to indoor air at the R&D facility shortly upon operation, prior to completion of in-situ chemical oxidation treatment.

Under this alternative, onsite workers could be exposed to chemical constituents in soil during trenching activities to install the in-situ soil chemical oxidation infiltration gallery and during soil boring activities to install the in-situ groundwater chemical oxidation injection wells (via dermal contact, inhalation, and/or ingestion). However, this exposure would be of a relatively short duration and would be addressed via various health and safety precautions as discussed below. Onsite workers could also be exposed to potassium permanganate used for treatment. Inhalation of potassium permanganate can irritate the respiratory tract.

Potential exposure of onsite workers to chemical constituents and operational hazards would be mitigated by the use of PPE as specified in a site-specific HASP and through proper equipment and material handling procedures to be specified in the remedy design documents and site work plans. Air monitoring would be performed during implementation of this alternative to determine the need for engineering controls. Depending on the oxidant used, in-situ monitoring would be conducted during application of oxidizing agent to confirm that subsurface conditions do not become reactive or potentially explosive.

The community would not have access to the site during the remedial activities because the site is currently fenced and entry would be controlled through the main gate off Picone Boulevard. Potential risks to the community during treatment would also be mitigated by implementing an air monitoring plan and by implementing vapor control/dust control techniques to mitigate the offsite migration of unacceptable levels of VOC vapors and/or fugitive dust from the site.

Based on the remedial activities described herein, this remedial alternative may take up to 2 years to complete.

Long-Term Effectiveness and Permanence

Implementation of this alternative would be expected to permanently treat (via chemical oxidation) subsurface soil and groundwater containing VOCs. The soil and groundwater RAOs could be attained in a relatively short timeframe (e.g., as short as one year). However, additional treatment may be required to achieve the RAOs depending on the amount of oxidant consumed by natural organic material/minerals in both the unsaturated and saturated soil, and the total mass of VOCs present. Long-term operation, maintenance, and monitoring activities are not anticipated under this alternative.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Implementation of this alternative would reduce the toxicity, mobility, and volume of the VOC constituents in soil and groundwater. As indicated above, potassium permanganate reacts completely with (oxidizes) target chemicals to produce carbon dioxide and innocuous substances found in nature. This remedial alternative is an irreversible process because target VOCs would be permanently destroyed. Delivery of oxidant to the target VOCs is essential to achieve treatment goals.

Under this alternative, redox-sensitive metals (such as arsenic, chromium, and selenium) may potentially be oxidized to more mobile valence states. However, based on previous experience and as discussed in the ITRC report titled Work Group report titled *Technical/Regulatory Guidelines, Technical and Regulatory Guidance for In Situ Chemical Oxidation of Contaminated Soil and Groundwater* (ITRC, June 2001) [see Section 5.3 of that report], mobilization of metals from groundwater chemical oxidation treatment is a short-lived phenomenon. The metals typically attenuate back to their pre-oxidation state (background conditions) shortly following oxidant application. Based on review of the RI soil analytical results, naturally-occurring metals concentrations in soil at the HWD site do not appear to be elevated with respect to typical background concentrations in the vicinity of the site. Groundwater monitoring for metals will be included in the remedial design for this Alternative. Based on available data, it is highly unlikely that the East Farmingdale Water District wells, which are located approximately 1.75 miles southeast of the HWD site and screened at great depths (up to 1,500 feet) in a different aquifer than that studied as part of the RI, would be affected by in-situ groundwater chemical oxidation treatment activities at the HWD site.

In addition, post-treatment rebounds (temporary increases) in VOC concentrations may occur under this alternative. Potential oxidant demands and VOC concentration rebounds would be further evaluated during pre-design activities and full-scale implementation, and oxidant concentrations/volumes would be adjusted accordingly.

Implementability

In-situ chemical oxidation has undergone extensive laboratory and pilot-scale testing and has been implemented to treat soil and groundwater at an increasing number of sites. The critical element for effectively and efficiently implementing in-situ chemical oxidation is the delivery of oxidizing agent to the impacted media/ target constituents. Regardless of the delivery system selected, it would be difficult to obtain a uniform distribution of oxidant throughout the vadose zone as the oxidant would follow preferential (permeable) pathways due to heterogeneity in the soil and gravity drainage. However, it is likely that the heterogeneity and gravity drainage would have similarly influenced the migration of VOCs released during historic site operations and the migration of VOCs in the subsurface following such a release. Pre-design activities would be completed prior to full-scale implementation of this alternative to:

- design an appropriate delivery system (currently anticipated to include an infiltration gallery for soil treatment and injection wells for groundwater treatment);
- identify the oxidant (potassium permanganate) concentration, injection rates, and duration/number of applications needed;
- determine the need for offgas recovery/treatment; and
- evaluate the potential significance of precipitate build-up (if any) from the treatment process.

The equipment and materials necessary to implement this alternative are available, as are several capable remedial contractors. Installation of a typical delivery system consisting of an infiltration gallery and injection wells is technically feasible. Potassium permanganate could be readily batched from dry powder to concentrated stock solution, and subsequently mixed, diluted, filtered, and delivered at accurate concentrations and flow rates to the individual injection points. A monitoring program would be developed to evaluate the effectiveness of the alternative.

Implementation of chemical oxidation for in-situ treatment of both soil and groundwater under this alternative provides an economy of scale in that one treatment technology addresses the two impacted media. For instance, excess oxidant delivered to treat the unsaturated overburden soil would migrate to groundwater and further degrade VOCs in groundwater. Implementation of this alternative would not result in large volumes of waste to be treated/disposed.

The timeframe associated with successful implementation of this remedial alternative is anticipated to range from one to two years (excluding pre-design activities and commencing with field construction), depending on performance standard. Long-term operation and maintenance activities would not be required. It is anticipated that treatment could be completed with a moderate disruption to current site activities.

Cost

The estimated cost associated with the in-situ soil chemical oxidation and in-situ groundwater chemical oxidation (focused application) alternative is $1,600,000 to achieve Performance Standard 1 and $1,870,000 to achieve Performance Standard 2. Detailed breakdowns of the estimated costs to achieve Performance Standards 1 and 2 under this Alternative are presented in Tables 9A and 9B, respectively. There are additional costs associated with the maintenance of the concrete/pavement materials, institutional controls, and monitoring.

5.3.3 Alternative 3 – Soil Vapor Extraction, In-Situ Groundwater Chemical Oxidation (Focused Application), and Site Controls and Monitoring

Technical Description

This alternative involves the construction/operation of an SVE system to facilitate the removal and subsequent treatment of VOCs in soil, and the installation of an injection well network to inject oxidant into the saturated zone to facilitate in-situ treatment of VOCs in groundwater. As discussed above under Alternative 2, in-situ groundwater chemical oxidation involves delivering an oxidizing agent to degrade organic constituents in groundwater to non-toxic byproducts. SVE is a proven technology that has been successfully applied for VOC removal at numerous sites over a wide range of geologic and hydrogeologic conditions. The remainder of this technology description focuses on the soil remediation component of Alternative 3 – SVE. A summary of the groundwater remedial component (in-situ groundwater chemical oxidation) is also provided below, which references the detailed technical description and evaluation for chemical oxidation of VOCs in groundwater under Alternative 2.

Implementation of this alternative would continue until: (1) an asymptotic curve is reached and the concentration of VOCs in the air stream extracted by the SVE system does not appreciably diminish over time; and/or (2) the selected performance standard is achieved (same as under Alternative 2). The proposed performance standards are as follows:

- *Performance Standard 1* – Achieve 10 ppm Concentration for Total VOCs in Soil and 200 ppb Concentration for Total VOCs in Groundwater; and

- *Performance Standard 2* – Achieve TAGM 4046 Compound-Specific Guidance Values for PCE and TCE, and Background Concentrations for VOCs in Groundwater.

As discussed in Subsection 4.4, the SVE process involves inducing a negative pressure gradient within the soil matrix through vapor extraction wells. As the induced vacuum propagates through the soil, VOCs in the soil volatilize. The VOC vapors are drawn to the extraction wells and through conveyance piping into a treatment system. Typically, the extracted vapors are treated by vapor-phase GAC prior to being discharged through an exhaust stack. Typical equipment used for implementation of SVE includes horizontal or vertical extraction wells, a vacuum unit (blower), a liquid/vapor separator (knock-out pot), a vapor treatment system, and system controls and instrumentation.

In order for SVE to be an effective remedial technology, design of the SVE system must take into consideration a number of parameters, including soil permeability, porosity, moisture content, stratigraphy, depth to groundwater, and chemical properties of the VOCs. The soil must have a sufficient air-filled porosity to allow the SVE system to strip the VOCs from the soil matrix. The soil type at the HWD site (sand/gravel extending to the water table) has sufficient air-filled porosity to allow the SVE system to strip the VOCs from the soil matrix. PCE and TCE, the primary constituents of concern in soil at the HWD site, are well-suited to SVE because of their high Henry's law constants (which means that these constituents can readily partition to the atmosphere). These constituents have been successfully extracted via SVE at numerous sites.

Prior to designing the SVE system for this alternative, a pilot study would be performed to further evaluate soil permeability, porosity, moisture content, and VOC mass removal rate. Based on the results of the pilot study, the total number of extraction wells, spacing between wells, desired air flow rate, and treatment system specifications would be determined. The area of soil to be treated by SVE is shown on Figure 11. For purposes of cost estimating in this FS, it is assumed that six vertical SVE wells would be installed under this alternative. It is assumed that each well would have a radius of influence of greater than 20 feet with an induced vacuum of approximately 20-inches water column. Additionally, one or more wells would be installed to capture subsurface vapors potentially migrating through soil beneath the R&D building floor slab. Vapors extracted from the wells would be conveyed to an onsite treatment system through buried or aboveground piping. It is assumed that the treatment system would be constructed in the southwestern portion of the site and would consist of the following primary components:

- a blower to move an assumed 750 cubic feet per minute (CFM) of air. The air flow rate would be evaluated during design based on results of the pilot testing; and

- vapor-phase GAC filters/vessels equipped with piping/hoses.

Adjustments to the air flow rate from the individual extraction wells and troubleshooting (as needed) would be performed during treatment system startup. It is assumed that O&M activities would consist of routine site visits to inspect the treatment system components, evaluate the system performance (conduct field screening/ sampling for VOCs), and make necessary adjustments. The vapor-phase GAC would be changed out, as needed. The spent carbon would be transported for offsite regeneration (so that the VOCs adsorbed onto the carbon could be destroyed and the carbon could be reused) or for offsite incineration/disposal. It is also assumed that the air discharge from the SVE system would require a NYSDEC-issued air discharge permit (compliance with the substantive requirements of the permit).

Once VOC concentrations in the extracted air are below NYSDEC allowable criteria (to be specified in the ROD), the GAC filters could be removed. Once an asymptotic curve is reached and the concentration of VOCs in the extracted air stream does not appreciably diminish over time and/or soils and groundwater have been treated to the remedial goals under Performance Standard 1 or 2 (as appropriate), the SVE system would be decommissioned. Based on the sand/gravel soil type, VOC concentrations identified in the RI soil samples, and anticipated air flow rate, it is assumed for purposes of this FS (under Performance Standard 1) that the soil remedial goals could be attained in a five year timeframe and the treatment system would be decommissioned after five years of operation. One additional year of treatment system operation (six years total) is anticipated under Performance Standard 2.

Prior to preparing the design for the in-situ groundwater chemical oxidation component of this alternative, pre-design activities would be performed as described under Alternative 2 – In-Situ Soil Chemical Oxidation and In-Situ Groundwater Chemical Oxidation (Focused Application).

The remedial component for groundwater under Alternative 3 is the same as Alternative 2. As described under Alternative 2, it is assumed that a network of vertical injection wells would be installed at and hydraulically downgradient from the HWD site to deliver oxidant solution to a focused area of the saturated zone. Injection well clusters (two wells per cluster) would be installed within the approximately 150-foot-wide by 100-foot-long area shown on Figure 11. Well clusters would be spaced routine intervals apart. One of the two wells in each cluster would be screened across the groundwater table and the other well would be screened at a deeper interval. Groundwater oxidant injection wells would not need to extend over the full length of the groundwater VOC plume to be remediated since unconsumed oxidant will migrate with groundwater flow and natural attenuation processes will also address VOCs throughout the area.

At this time, for the purpose of developing a cost estimate for this alternative, it assumed that a potassium permanganate solution would be delivered to the injection wells on a quarterly basis. The number of injection events would be determined based on groundwater sampling activities, as discussed further below. The oxidant would be batched from dry powder to concentrated stock solution, and subsequently mixed, diluted, filtered, and delivered to the individual injection points. For cost estimating purposes, it is assumed that approximately 350,000 gallons of oxidant solution (50 tons of potassium permanganate) would potentially be used for groundwater treatment to achieve a 200 ppb total VOC performance standard under Performance Standard 1 and 430,000 gallons of oxidant solution (63 tons of potassium permanganate) would potentially be used for groundwater treatment to achieve background VOC groundwater concentrations under Performance Standard 2. The amount of oxidant to be used and number of injection events are preliminary estimates only and may change based on results obtained for pre-design activities and initial full-scale treatment.

Groundwater sampling for VOCs would be conducted prior to each injection event and after the final injection event is completed to evaluate the reduction of VOC concentrations in groundwater and consistency with remedial goals. Post-remedial groundwater monitoring would be performed on a quarterly basis (for a period of up to two years) to show a statistical trend to evaluate the effectiveness of the alternative. This groundwater monitoring approach is presented for cost estimating purposes to compare potential remedial alternatives. The groundwater monitoring frequency will be more fully evaluated during design. Additional injections would be performed, if appropriate and necessary, to treat the saturated zone. Existing groundwater use restrictions in place in Suffolk County Sanitary Code, Article 4 – Water Supply, Section 406.4, would continue to minimize potential human exposure to VOCs in groundwater at concentrations exceeding groundwater quality standards. Use restrictions would also be put in place as to site groundwater.

Under this alternative, the groundwater remedial goals could potentially be achieved within a one year timeframe following the start of groundwater treatment. As indicated above, the soil remedial goals could potentially be achieved in a five year timeframe. Based on the longer timeframe anticipated for soil treatment and the potential for constituents in soil to migrate to groundwater until the soil remedial goals are achieved, groundwater treatment would begin following completion of soil treatment. This approach would mitigate potential groundwater quality impacts that might otherwise occur if groundwater treatment were to be completed in advance of the soil treatment.

During remediation, the existing concrete/pavement materials covering the majority of the site would be maintained. Deed restrictions limiting property use to commercial/industrial would also be implemented, unless soil values for unrestricted use are achieved.

Compliance with SCGs

Chemical-Specific SCGs

The Class GA groundwater quality standards presented in 6NYCRR Parts 700-705 and in the NYSDEC TOGS 1.1.1 document titled, *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations* (NYSDEC 2000) are applicable chemical-specific SCGs for this alternative. Groundwater quality would be assessed in connection with the groundwater chemical oxidation treatment. In-situ groundwater chemical oxidation at other sites has been successful at reducing groundwater VOC concentrations to federal MCLs. It is anticipated that the concentrations of VOCs identified in groundwater at and downgradient from the HWD site would be reduced by this alternative. The ability of this alternative to result in attainment of groundwater quality standards is dependent on the amount of oxidant injected, number of treatment applications, and the effect of other VOC sources in the vicinity of the HWD site. Groundwater monitoring would be performed to evaluate the reduction in groundwater VOC concentrations and provide data on concentration re-bounds (if any) following oxidant delivery.

Another chemical-specific SCG that may apply to this alternative is related to air discharges from the SVE system. It is assumed that the air discharge from the SVE system would require a NYSDEC-issued air discharge permit (compliance with the substantive requirements of the permit).

Chemical-specific guidelines that are to be considered under this alternative are the soil guidance values presented in NYSDEC TAGM #4046 titled, *Determination of Soil Cleanup Objectives and Cleanup Levels* (NYSDEC, 1994). Under proposed Performance Standard 1, VOCs would be removed from the soil, lowering VOC concentrations an order of magnitude and approaching the 10 ppm total VOC value. Under proposed Performance Standard 2, the goal of SVE would be to achieve the compound-specific TAGM 4046 soil guidance values for PCE and TCE.

Action-Specific SCGs

Action-specific SCGs that apply to this alternative are the OSHA construction standards and health and safety requirements associated with the installation of the vapor extraction wells and conveyance piping, construction of the SVE treatment system, installation of the chemical oxidation injection wells, handling of oxidant, and performance of monitoring activities. Workers and worker activities that occur during implementation of this alternative must comply with OSHA requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting as identified in 29 CFR Parts 1904, 1910, and 1926. Compliance with action-specific SCGs would be accomplished by following a NYSDEC-approved design and site-specific HASP.

Operation of the SVE system would result in the generation of air emissions. NYSDEC Air Guide 1, which incorporates by reference applicable federal and New York State regulations and requirements pertaining to air emissions, is an action-specific SCG for the SVE system. Vapor phase GAC would be provided, as needed, to treat air emissions in a manner that would not exceed allowable discharge limits and would comply with state and federal air emission requirements.

Wastes generated during the implementation of this alternative (soil cuttings generated by installation of the SVE wells and injection wells, soil removed during trenching to install the SVE conveyance piping, activated carbon used in the SVE system, PPE, etc.) would be characterized to determine appropriate offsite recycling/ disposal requirements. If any of the materials are characterized as a hazardous waste, then the RCRA, UTS/LDR, and USDOT requirements for the packaging, labeling, transportation, and disposal of hazardous or regulated materials may be applicable. Compliance with these requirements would be achieved by utilizing licensed waste transporters and properly permitted disposal facilities.

Location-Specific SCGs

Remedial activities at the site would be conducted in accordance with local building/construction codes and ordinances, as appropriate, including those requirements at offsite disposal locations.

Overall Protection of Human Health and the Environment

The SVE and in-situ groundwater chemical oxidation alternative would meet the RAOs established for the site. The potential for unacceptable human exposure to site soil and groundwater would be reduced following remedial activities, as impacted soil and groundwater would be treated to remove VOCs. The SVE system operation would address the potential migration of VOCs in onsite soil to stormwater at the site and groundwater beneath the site by reducing the mass of VOCs in the soil. Groundwater treatment activities would address potential groundwater quality impacts from the site and help control the migration of VOCs from groundwater to soil vapor. The vacuum induced by the SVE system would create an induced soil vapor “zone” that would control soil vapor migration and reduce soil vapor concentrations toward neighboring properties before completion of SVE treatment.

Both remedial performance standards considered under this alternative are protective of human health and the environment. The HWD site is currently, and will continue to be, covered with concrete/pavement materials. These protective surfaces would be maintained and limit direct human exposure to soil. By preventing infiltration, the cover would also mitigate the potential for leaching of low VOC concentrations remaining following treatment. Existing groundwater use restrictions in place in Suffolk County Sanitary Code, Article 4 – Water Supply, Section 406.4, would continue to minimize potential human exposure to VOCs in groundwater at concentrations exceeding groundwater quality standards. It is also appropriate to recognize that groundwater from the HWD site will merge with the downgradient Fairchild plume containing higher VOC concentrations.

As a conservative measure, site use restrictions would be established if final post-remedial VOC soil concentrations are not generally consistent with the TAGM 4046 compound-specific guidance values.

Short-Term Effectiveness

The SVE system would result in a rapid decrease in VOC concentrations in soil following system startup. However, the rate of the decrease would likely become slower over time with continued operation of the SVE system. The decrease in VOC soil concentrations would coincide with the decrease in total VOC concentrations monitored in the influent air stream to the SVE treatment equipment, which would eventually reach an asymptotic level.

As previously discussed, the oxidant likely to be used for the groundwater treatment component of this alternative (potassium permanganate) reacts with and oxidizes PCE and TCE, the primary constituents of concern, relatively quickly and completely. Reaction times for the destruction of these VOC constituents are on the order of minutes/hours. Groundwater treatment under this alternative could be completed in a relatively short timeframe without the need for significant construction activities or long-term maintenance/monitoring. Effective treatment is based on the ability to deliver the oxidant to the target constituents. A comprehensive injection well network is envisioned under this alternative to provide oxidant to the affected areas. As discussed above, groundwater treatment would begin after the remedial performance goals for soil are achieved.

Under this alternative, onsite workers could be exposed to chemical constituents in soil during the soil boring/ trenching activities to install the SVE wells, conveyance piping, and groundwater injection wells. Exposure routes would include dermal contact, inhalation, and/or ingestion. However, the exposure would be of a relatively short duration and would be addressed via various health and safety precautions as discussed below. Onsite workers could also be exposed to potassium permanganate used for treatment. Inhalation of potassium permanganate can irritate the respiratory tract.

Potential exposure of onsite workers to chemical constituents and operational hazards would be mitigated by the use of PPE as specified in a site-specific HASP and through proper equipment and material handling procedures to be specified in the remedy design documents and site work plans. Air monitoring would be performed during soil boring/trenching activities to determine the need for additional engineering controls (e.g., using water sprays to suppress dust, modifying the trenching rate, etc.) to confirm that dust or VOC vapors are within acceptable levels, as specified in the site-specific HASP.

The community would not have access to the site during the remedial activities because the site is currently fenced and entry would be controlled through the main gate off Picone Boulevard. Potential risks to the community during treatment would also be mitigated by implementing an air monitoring plan and by implementing vapor control/dust control techniques to mitigate the offsite migration of unacceptable levels of VOC vapors and/or fugitive dust from the site.

Based on the remedial activities described above, this remedial alternative may take up to seven years to complete.

Long-Term Effectiveness and Permanence

Implementation of this alternative would permanently treat subsurface soil and groundwater containing VOCs. The soil and groundwater RAOs could potentially be attained in a relatively short timeframe following commencement of remedial construction (e.g., five years for soil, and then under two years for groundwater). However, additional treatment could be required to achieve the groundwater RAOs depending on the amount of oxidant consumed by natural organic material and minerals in the saturated soil and total mass of VOCs present. Operation, maintenance, and monitoring activities related to the SVE system would continue until the remedial goals are attained. Operation of the SVE system would generate additional noise at the nearby properties even if the system were to be equipped with sound abatement devices.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Implementation of this alternative would reduce the toxicity, mobility, and volume of the VOC constituents in soil and groundwater. VOCs would be extracted from soil and treated through vapor-phase GAC. VOCs adsorbed by the vapor-phase GAC would be destroyed during regeneration or incineration of the spent carbon. However, the VOCs would not be destroyed if the carbon were to be landfilled. The migration of VOCs through soil vapor would be controlled via the vacuum induced by the SVE system. VOCs in groundwater would react with potassium permanganate and be permanently destroyed via chemical oxidation. This remedial alternative consists of an irreversible process as target VOCs in soil would be permanently removed/destroyed and target VOCs in groundwater would be permanently destroyed.

Under this alternative, redox-sensitive metals in groundwater (such as arsenic, chromium, and selenium) may potentially be oxidized to more mobile valence states. However, the metals typically attenuate back to their reduced state (background conditions) shortly following oxidation application. Based on review of the RI soil analytical results, naturally-occurring metals concentrations in soil at the HWD site do not appear to be elevated with respect to background concentrations in the vicinity of the site. Groundwater monitoring for metals will be included in the remedial design for this alternative.

In addition, post-treatment rebounds (temporary increases) in VOC concentrations may occur under this alternative. Potential oxidant demands and VOC concentration rebounds would be further evaluated during pre-design activities and full-scale implementation, and oxidant concentrations/volumes would be adjusted accordingly.

Implementability

SVE is a proven technology that has been successfully implemented at numerous sites for VOC removal and could easily be implemented at the HWD site. SVE is technically feasible and could be completed over a relatively short period.

In-situ chemical oxidation has undergone extensive laboratory and pilot-scale testing and has been implemented to treat groundwater at an increasing number of sites. The critical element for effectively and efficiently implementing in-situ chemical oxidation is the delivery of oxidizing agent to the impacted media/target constituents. Oxidant delivery methods would be evaluated during bench-scale testing prior to design/full-scale implementation.

The equipment and materials necessary to implement this alternative are available, as are several capable remedial contractors. Installation of an SVE system and typical in-situ groundwater chemical oxidation delivery system (injection wells) is technically feasible. Potassium permanganate used for in-situ groundwater chemical oxidation could easily be batched from dry powder to concentrated stock solution, and subsequently mixed, diluted, filtered, and delivered at accurate concentrations and flow rates to the individual injection points. A monitoring program would be developed to evaluate the effectiveness of the alternative. Implementation of this alternative would not result in large volumes of waste to be treated/disposed.

The timeframe associated with successful implementation of this remedial alternative is anticipated to be approximately six to eight years (excluding pre-design activities and commencing with field construction), depending on performance standard. It is anticipated that treatment could be completed with a moderate disruption to current site activities.

Cost

The estimated cost associated with the SVE and in-situ groundwater chemical oxidation (focused application) alternative is $1,800,000 to achieve Performance Standard 1 and $2,010,000 to achieve Performance Standard 2. Detailed breakdowns of the estimated costs to achieve Performance Standards 1 and 2 under this Alternative are presented in Tables 10A and 10B, respectively. There are additional costs associated with the maintenance of the concrete/pavement materials, institutional controls, and monitoring.

5.3.4 Alternative 4 – Soil Vapor Extraction, Groundwater Air Sparging, and Site Controls and Monitoring

This alternative involves the construction/operation of an air sparge and SVE system (AS/SVE system) to facilitate the removal and subsequent treatment of VOCs in soil and groundwater originating from the site. As discussed above under Alternative 3, SVE involves inducing a negative pressure gradient within the soil matrix to volatilize VOCs and collect the extracted vapors for subsequent treatment. AS is a proven remedial technology that has been successfully applied for VOC removal at numerous sites. The remainder of this technology description focuses primarily on the groundwater remediation component of Alternative 4 – AS. A summary of the soil remediation component (SVE) is also provided below, which references the detailed technical description and evaluation for SVE of VOCs in soil under Alternative 3.

Implementation of this alternative would continue until: (1) an asymptotic curve is reached and the concentration of VOCs in the air stream extracted by the SVE system does not appreciably diminish over time; and/or (2) the selected performance standard is achieved (same as under Alternatives 2 and 3).

As summarized in Subsection 4.4, air sparging involves the injection of air into the subsurface below the groundwater table under controlled pressure through a series of injection wells. VOCs that are dissolved in groundwater and adsorbed onto saturated soil are volatilized (stripped) when in contact with the injected air. The resulting VOC vapors migrate upward through the groundwater and unsaturated zone, where they are ultimately drawn to SVE wells and then directed through conveyance piping into a treatment system. The extracted vapors would be treated by vapor-phase GAC prior to discharge through an exhaust stack.

Prior to designing the AS/SVE system for this alternative, a pilot study would be performed to further evaluate soil permeability, porosity, moisture content, and VOC mass removal rate. Based on the results of the pilot study, the total number of injection and extraction wells, spacing between wells, desired air flow rate/pressure, and treatment system specifications would be determined. The area of soil and groundwater to be treated by the AS/SVE system is the same as that for Alternative 3 (see Figure 12). For purposes of cost estimating in this FS, it is assumed that 12 vertical SVE wells and 22 AS wells would be installed under this alternative. It is assumed that the SVE wells would be placed in three rows spaced approximately 35 feet apart and the AS wells would be placed in four rows spaced approximately 25 feet apart. Additionally, one or more wells would be installed to capture subsurface vapors potentially migrating through soil beneath the R&D building floor slab.

Vapors extracted from the AS/SVE wells would be conveyed to an onsite treatment system through buried or aboveground piping, as appropriate. It is assumed that the treatment system would be constructed in the southwestern portion of the site and could consist of the following primary components:

- one or more two-stage stationary blowers/compressors to deliver an estimated air flow rate of 220 CFM total to the air sparge wells;

- a blower to move an assumed 1,200 CFM of air from the SVE wells; and

- vapor-phase GAC filters/vessels equipped with piping/hoses.

Air flow injection and extraction rates would be evaluated during design based on results of the pilot testing. Adjustments to the air flow rate supplied to the individual sparge wells and withdrawn from the individual extraction wells would be performed during treatment system startup. It is assumed that O&M activities would consist of routine site visits to inspect the treatment system components, evaluate the system performance (conduct field screening/sampling for VOCs), and make necessary adjustments. The vapor-phase GAC would be changed out, as needed. The spent carbon would be transported for offsite regeneration (so that the VOCs adsorbed onto the carbon could be destroyed and the carbon could be reused) or for offsite incineration/disposal. It is also assumed that the air discharge from the AS/SVE system would require a NYSDEC-issued air discharge permit (compliance with the substantive requirements of the permit).

Once VOC concentrations in the extracted air are below NYSDEC allowable criteria (to be specified in the ROD), the GAC filters could be removed. Once an asymptotic curve is reached and the concentration of VOCs in the extracted air stream does not appreciably diminish over time and/or soils and groundwater have been treated to the remedial goals under Performance Standard 1 or 2 (as appropriate), the AS/SVE system would be decommissioned. Based on the sand/gravel soil type, VOC concentrations identified in the RI soil/groundwater samples, and anticipated air flow rates, it is assumed for purposes of this FS (under Performance Standard 1) that the remedial goals could be attained in a ten year timeframe and the treatment system would be decommissioned after ten years of operation. Five additional years of treatment system operation (15 years total) are anticipated under Performance Standard 2.

Post-remedial groundwater monitoring would be performed on a quarterly basis (for a period of up to two years) to show a statistical trend to evaluate the effectiveness of the alternative. This groundwater monitoring approach is presented for cost estimating purposes to compare potential remedial alternatives. The groundwater monitoring frequency would be more fully evaluated during design, when a detailed pre- and post-injection groundwater monitoring plan would be developed to monitor the effectiveness of the remedy. Additional operation of the AS/SVE treatment system would occur, if appropriate and necessary, to treat the saturated zone. Existing groundwater use restrictions in place in Suffolk County Sanitary Code, Article 4 – Water Supply, Section 406.4, would continue to minimize potential human exposure to VOCs in groundwater at concentrations exceeding groundwater quality standards. Use restrictions would also be put in place as to site groundwater.

During remediation, the existing concrete/pavement materials covering the majority of the site would be maintained. Deed restrictions limiting property use to commercial/industrial would also be implemented, unless soil values for unrestricted use are achieved.

Compliance with SCGs

Chemical-Specific SCGs

The Class GA groundwater quality standards presented in 6NYCRR Parts 700-705 and in the NYSDEC TOGS 1.1.1 document titled, *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations* (NYSDEC 2000) are applicable chemical-specific SCGs for this alternative. Air sparging at other sites has been successful at reducing groundwater VOC concentrations to federal MCLs. It is anticipated that the concentrations of VOCs identified in groundwater at and downgradient from the HWD site would be reduced by this alternative. The ability of this alternative to result in attainment of groundwater quality standards is dependent on the air injection flow rate and pressure, number of sparging points, and the effect of other VOC sources in the vicinity of the HWD site. Groundwater monitoring would be performed to evaluate the reduction in groundwater VOC concentrations.

Another chemical-specific SCG that may apply to this alternative is related to air discharges from the AS/SVE system. It is assumed that the air discharge from the AS/SVE system would require a NYSDEC-issued air discharge permit (compliance with the substantive requirements of the permit).

Chemical-specific guidelines that are to be considered under this alternative are the soil guidance values presented in NYSDEC TAGM #4046 titled, *Determination of Soil Cleanup Objectives and Cleanup Levels* (NYSDEC, 1994). Under proposed Performance Standard 1, VOCs would be removed from the soil, lowering VOC concentrations an order of magnitude and approaching the 10 ppm total VOC value. Under proposed Performance Standard 2, the goal of SVE would be to achieve the compound-specific TAGM 4046 soil guidance values for PCE and TCE.

Action-Specific SCGs

Action-specific SCGs that apply to this alternative are the OSHA construction standards and health and safety requirements associated with the installation of the air sparging and vapor extraction wells, installation of conveyance piping, construction of the AS/SVE treatment system, and performance of monitoring activities. Workers and worker activities that occur during implementation of this alternative must comply with OSHA requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting as identified in 29 CFR Parts 1904, 1910, and 1926. Compliance with action-specific SCGs would be accomplished by following a NYSDEC-approved design and site-specific HASP.

Operation of the AS/SVE system would result in the generation of air emissions. NYSDEC Air Guide 1, which incorporates by reference applicable federal and New York State regulations and requirements pertaining to air emissions, is an action-specific SCG for the SVE system. Vapor phase GAC would be provided, as needed, to treat air emissions in a manner that would not exceed allowable discharge limits and would comply with state and federal air emission requirements.

Wastes generated during the implementation of this alternative (soil cuttings generated by installation of the sparging and extraction wells, soil removed during trenching to install the conveyance piping, activated carbon used in the AS/SVE system, PPE, etc.) would be characterized to determine appropriate offsite recycling/disposal requirements. If any of the materials are characterized as a hazardous waste, then the RCRA, UTS/LDR, and USDOT requirements for the packaging, labeling, transportation, and disposal of hazardous or regulated materials may be applicable. Compliance with these requirements would be achieved by utilizing licensed waste transporters and properly permitted disposal facilities.

Location-Specific SCGs

Remedial activities at the site would be conducted in accordance with local building/construction codes and ordinances, as appropriate, including those requirements at off-site disposal locations.

Overall Protection of Human Health and the Environment

The AS/SVE alternative would meet the RAOs established for the site. The potential for unacceptable human exposure to site soil and groundwater would be reduced following remedial activities, as impacted soil and groundwater would be treated to remove VOCs. The AS/SVE system operation would address the potential migration of VOCs in onsite soil to stormwater at the site and groundwater beneath the site by reducing the mass of VOCs in the soil. VOCs would be stripped from the groundwater by air sparging and resulting VOC vapors would be drawn toward the extraction wells, which would address potential groundwater quality impacts from the site and control the pathway for VOC migration from groundwater to soil vapor. An inducted soil vapor "zone" would be created that would reduce soil vapor concentrations toward neighboring properties before completion of SVE treatment.

Both remedial performance standards considered under this alternative are protective of human health and the environment. The HWD site is currently, and will continue to be covered with concrete/pavement materials. These protective surfaces would be maintained and limit direct human exposure to soil. By preventing infiltration, the cover would also mitigate the potential for leaching of low VOC concentrations remaining following treatment. Existing groundwater use restrictions in place in Suffolk County Sanitary Code, Article 4 – Water Supply, Section 406.4, would continue to minimize potential human exposure to VOCs in groundwater at concentrations exceeding groundwater quality standards. It is also important to recognize that groundwater from the HWD site will merge with the downgradient Fairchild plume containing higher VOC concentrations.

As a conservative measure, site use restrictions would be established if final post-remedial VOC soil concentrations are not generally consistent with the TAGM 4046 compound-specific guidance values.

Short-Term Effectiveness

The AS/SVE system would result in a rapid decrease in VOC concentrations in soil following system startup. However, the rate of the decrease would likely become slower over time with continued operation of the SVE system. The decrease in VOC soil concentrations would coincide with the decrease in total VOC concentrations monitored in the influent air stream to the SVE treatment equipment, which would eventually reach an asymptotic level. A similar result would be seen with groundwater VOC concentrations. Following system startup, there would likely be a moderate-to-rapid decrease in groundwater VOC concentrations that would diminish over time. An asymptotic level would also be anticipated with the groundwater VOC concentrations. Groundwater treatment under this alternative would be completed in a moderate length of time.

Under this alternative, onsite workers could be exposed to chemical constituents in soil during the soil boring/trenching activities to install the AS/SVE wells and conveyance piping. Exposure routes would include dermal contact, inhalation, and/or ingestion. However, the exposure would be of a relatively short duration and would be addressed via various health and safety precautions as discussed below.

Potential exposure of onsite workers to chemical constituents and operational hazards would be mitigated by the use of PPE as specified in a site-specific HASP and through proper equipment and material handling procedures to be specified in the remedy design documents and site work plans. Air monitoring would be performed during soil boring/trenching activities to determine the need for additional engineering controls (e.g., using water sprays to suppress dust, modifying the trenching rate, etc.) to confirm that dust or VOC vapors are within acceptable levels, as specified in the site-specific HASP.

The community would not have access to the site during the remedial activities because the site is currently fenced and entry would be controlled through the main gate off Picone Boulevard. Potential risks to the community during treatment would also be mitigated by implementing an air monitoring plan and by implementing vapor control/dust control techniques to mitigate the offsite migration of unacceptable levels of VOC vapors and/or fugitive dust from the site.

Based on the remedial activities described above, this remedial alternative may take at least 10 years to complete.

Long-Term Effectiveness and Permanence

Implementation of this alternative would permanently treat subsurface soil and groundwater containing VOCs. The soil and groundwater RAOs could potentially be attained in a moderate length of time following commencement of remedial construction (e.g., 10 to 15 years). However, additional air sparging (and vapor extraction) could be needed to achieve the groundwater RAOs depending on the total mass of VOCs present and mass removal rates. Operation, maintenance, and monitoring activities related to the AS/SVE system would continue until the remedial goals are attained. Operation of the AS/SVE system would generate additional noise at the nearby properties even if the system were to be equipped with sound abatement devices.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Implementation of this alternative would reduce the toxicity, mobility, and volume of the VOC constituents in soil and groundwater. VOCs would be volatilized (stripped) from groundwater, extracted from soil, and treated through vapor-phase GAC. VOCs adsorbed by the vapor-phase GAC would be destroyed during regeneration or incineration of the spent carbon. However, the VOCs would not be destroyed if the carbon were to be landfilled. The migration of VOCs through soil vapor would be controlled via the vacuum induced by the AS/SVE system. This remedial alternative consists of an irreversible process as target VOCs in soil and groundwater would be permanently removed/destroyed.

Implementability

AS/SVE is a proven technology that has been successfully implemented at numerous sites for VOC removal and could be implemented at the HWD site. AS/SVE is technically feasible and could be completed in a moderate amount of time. The critical elements for effectively and efficiently implementing AS/SVE are proper air flow/pressure and appropriately-spaced sparge/extraction wells. The radius of influence of the AS/SVE wells would be evaluated during pilot testing prior to design/full-scale implementation.

The equipment and materials necessary to implement this alternative are available, as are several capable remedial contractors. Installation of an AS/SVE system is technically feasible. A monitoring program would be developed to evaluate the effectiveness of the alternative. Implementation of this alternative would not result in large volumes of waste to be treated/disposed.

The timeframe associated with successful implementation of this remedial alternative is anticipated to be approximately 10 to 15 years (excluding pre-design activities and commencing with field construction), depending on performance standard. It is anticipated that treatment could be completed with a moderate disruption to current site activities.

Cost

The estimated cost associated with the AS/SVE alternative is $2,400,000 to achieve Performance Standard 1 and $2,870,000 to achieve Performance Standard 2. Detailed breakdowns of the estimated costs to achieve Performance Standards 1 and 2 under this Alternative are presented in Tables 11A and 11B, respectively. There are additional costs associated with the maintenance of the concrete/pavement materials, institutional controls, and monitoring.

5.3.5 Alternative 5 – Asphalt Cap/Institutional Controls, Groundwater Extraction/Onsite Treatment, and Subslab Depressurization

Technical Description

This alternative includes the construction of an engineered cap extending over the majority of the site, construction/operation of a groundwater extraction and onsite treatment system, and implementation of deed restrictions. It is assumed that the engineered cap would be installed over an approximately 12,000 square foot area of the site, and would extend beyond the locations where VOCs were identified in soil at concentrations exceeding the 10 ppm NYSDEC soil guidance value for total VOCs as presented in TAGM #4046. Potential horizontal limits of the engineered cap are shown on Figure 13.

The cap would be constructed directly over the existing concrete slab/asphalt pavement materials. For purposes of this FS Report, it is assumed that the cap would consist of a bituminous asphalt top (wearing) and base courses overlying a layer of dense-graded aggregate (interlocking stone), a geosynthetic drainage composite, a high-density polyethylene (HDPE) geomembrane with welded seams, and a non-woven geotextile. The geosynthetic drainage composite would be installed to convey water that seeps through the upper cap layers (bituminous asphalt top/base course material) away from the capped area. The HDPE liner would serve as a low-permeability barrier to minimize infiltration of water into the subsurface. The non-woven geotextile would provide a barrier between the existing concrete slab and the geomembrane to protect the geomembrane from puncture. A deed restriction would be established to notify future property owners of the presence of VOCs in soil at the site, the need to inspect and maintain the cap over the soil, and the need for health and safety provisions/cap repair in the event that excavation activities had to occur. Maintenance activities would be performed, as needed, and would consist of sealing and/or patching cracked areas of the cap, if present.

Under this alternative, groundwater extraction wells would be installed hydraulically downgradient from the site to capture the groundwater plume with total VOC concentrations exceeding 200 ppb or background (depending on whether Performance Standard 1 or 2, respectively, is selected) for treatment. The groundwater extraction rate and treatment system size would need to be increased to achieve background instead of the 200 ppb performance goal because the size of the capture zone would be increased. The actual locations and number of wells would be determined based on existing information and results of a pumping test conducted during a pre-design phase. The purpose of the pumping test would be to provide the necessary information to facilitate modeling of the capture zone created by pumping groundwater from the extraction wells and for estimating pumping rates. For cost estimation and remedial evaluation purposes in this FS Report, it is assumed that:

- For Performance Standard 1, a total of three extraction wells would be installed (locations are shown on Figure 13) and the combined pumping rate from the wells would be 75 gpm; and

- For Performance Standard 2, a total of four extraction wells would be installed and the combined pumping rate from the wells would be 100 gpm.

The pumping rates would be altered (as appropriate) during the design, construction, or operation of the groundwater withdrawal system to meet the RAOs in an efficient manner. It is assumed that each extraction well would be constructed using 6-inch diameter steel piping and would extend to a depth of approximately 40 feet below the ground surface.

Groundwater withdrawn from the extraction wells would be treated in an onsite water treatment system. The design of the system is dependent on the groundwater extraction rate and concentrations of VOCs in the extracted groundwater, which would be evaluated and determined during the pumping test (during remedial design). For the purposes of cost estimating in this FS, it is assumed that the groundwater treatment system would consist of the following components installed in a pre-engineered building enclosure:

- a polyethylene tank for flow equalization prior to treatment;
- two multi-media (sand) filters piped in parallel to filter particulates;
- a low-profile air stripper designed to treat the identified groundwater VOC concentrations at a flow rate of 75 gpm or 100 gpm, as appropriate;
- a catalytic oxidizer to treat the exhaust from the air stripper to meet NYSDEC air discharge requirements; and
- two carbon vessels piped in parallel to serve as polishing units to treat VOCs unable to be treated by the air stripper in order to meet site-specific discharge requirements.

The treated water would be discharged either to the nearby POTW (via the sanitary sewer system) or the recharge basin northeast of the site (via storm sewer piping) or it would be re-injected into groundwater. Discharge to the POTW would require a POTW-issued discharge permit, while discharge to the recharge basin or re-injection to groundwater would require a NYSDEC-issued SPDES permit (compliance with the substantive requirements of the permit). Selection of the discharge location for the treated groundwater is primarily dependent upon the discharge flow rate and the ability of the existing storm/sanitary sewers to accommodate additional flow. For purposes of the FS, it is assumed that the water would be discharged to the POTW.

Water samples would be collected/analyzed as appropriate (e.g., weekly) during operation of the treatment system to evaluate system performance and compliance with discharge limits. Groundwater samples would be collected from the existing site monitoring well network on an annual basis to evaluate the potential reduction of VOC concentrations in groundwater.

Based on the limited space available at the site, the groundwater component of the remedial alternative would not be constructed until after the new engineered cap is in place (unless the groundwater treatment system could be constructed on vacant land south of the site). Construction of the engineered cap would require approximately 1 month to complete. Although the duration of the groundwater extraction/onsite treatment component cannot be accurately predicted, it is expected to take an extended period of time. For cost estimating purposes, a duration of 30 years for this alternative is assumed. The present worth of remedial actions further than 30 years into the future does not significantly affect the total present worth (this is consistent with the NYSDEC and NCP guidance).

As part of this alternative, a subslab depressurization system would be installed to maintain a favorable pressure differential between the R&D building interior and the subsurface to mitigate potential subsurface vapor intrusion. The system would include two or more suction points, conveyance piping, and a high-suction fan to create a positive pressure differential across the R&D floor slab. The system would be operated, maintained, and monitored in accordance with an OM&M Plan.

Compliance with SCGs

Chemical-Specific SCGs

The Class GA groundwater quality standards presented in 6NYCRR Parts 700-705 and in the NYSDEC TOGS 1.1.1 document titled, *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations* (NYSDEC 2000) are applicable chemical-specific SCGs for this alternative. The groundwater extraction and onsite treatment system would hydraulically control VOCs in groundwater and reduce groundwater VOC concentrations over time. The low-permeability cap would minimize infiltration and mitigate the future migration of VOCs from soil to groundwater. Groundwater quality standards could potentially be achieved after a significant amount of groundwater has been extracted and treated over a period of many years, provided upgradient sources are addressed. As such, upgradient sources would have to be remediated in accordance with standards.

Chemical-specific guidelines that are to be considered under this alternative are the soil guidance values presented in NYSDEC TAGM #4046 titled, *Determination of Soil Cleanup Objectives and Cleanup Levels* (NYSDEC, 1994). The VOC concentrations in soil would not be reduced by this alternative.

Action-Specific SCGs

Action-specific SCGs that apply to this alternative are the OSHA construction standards and health and safety requirements associated with the construction of the new engineered cap and groundwater treatment system, installation of the groundwater pumping wells and conveyance piping, and performance of onsite monitoring activities. Workers and worker activities that occur during implementation of this alternative must comply with OSHA requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting as identified in 29 CFR Parts 1904, 1910, and 1926. Compliance with action-specific SCGs would be accomplished by following a NYSDEC-approved design and site-specific HASP.

Another action-specific SCG that would apply to this alternative is associated with re-injecting or discharging treated groundwater to the POTW or recharge basin. A discharge permit would need to be obtained from the local POTW and the treated water would need to meet influent requirements. If the treated groundwater were to be discharged to the recharge basin or re-injected, the discharge/re-injection would be conducted in compliance with SPDES requirements.

For the purpose of this FS, it is assumed that an air stripper would be used to treat the extracted groundwater. NYSDEC Air Guide 1, which incorporates by reference applicable federal and New York State regulations and requirements pertaining to air emissions, is an action-specific SCG for emissions from the air stripper. If needed, a catalytic oxidizer or vapor phase carbon would be used to treat the exhaust from the air stripper to meet NYSDEC air discharge requirements and comply with federal emission requirements.

Wastes generated during the implementation of this alternative (soil cuttings generated by installation of the pumping wells, soil removed during trenching to install the conveyance piping, PPE, etc.) would be characterized to determine appropriate offsite disposal requirements. If any of the materials are characterized as a hazardous waste, then the RCRA, UTS/LDR, and USDOT requirements for the packaging, labeling, transportation, and disposal of hazardous or regulated materials may be applicable. Compliance with these requirements would be achieved by utilizing licensed waste transporters and properly permitted disposal facilities.

Location-Specific SCGs

Remedial activities at the site would be conducted in accordance with local building/construction codes and ordinances, as appropriate, including those requirements at offsite disposal locations.

Overall Protection of Human Health and the Environment

The asphalt cap/institutional controls and groundwater extraction/onsite treatment alternative would meet all but one of the RAOs for the site, as summarized herein. Potential human exposure to soil containing VOCs, which is currently minimal because the existing concrete slab physically isolates the soil from direct contact, would also be mitigated by the new cap. The deed restriction would further address the potential human exposure pathway by notifying future site owners of the presence of VOCs in the soil and the need to maintain the cap. The low-permeability materials used to construct the cap would address the potential migration of VOCs in onsite soil to stormwater at the site and groundwater beneath the site (cracks in the existing concrete slab allow precipitation to infiltrate the subsurface). The groundwater extraction and onsite treatment activities would address potential groundwater quality impacts from the site and help control the migration of VOCs from groundwater to soil vapor. However, this alternative would do little to address the offsite migration of VOCs in soil vapor originating from onsite soil. Potential subsurface vapor intrusion into the R&D building would be further mitigated by the installation, operation, and maintenance of a subslab depressurization system.

Existing groundwater use restrictions in place in Suffolk County Sanitary Code, Article 4 – Water Supply, Section 406.4, would continue to minimize potential human exposure to VOCs in groundwater at concentrations exceeding groundwater quality standards. It is also important to recognize that groundwater from the HWD site will merge with the downgradient Fairchild plume containing higher VOC concentrations.

Short-Term Effectiveness

Hydraulic control of the VOCs in groundwater (at concentrations exceeding the remedial goal) would be attained in a relatively short timeframe. However, groundwater treatment under this alternative would take an extended period of time. It is possible that the subslab depressurization system could effectively mitigate potential subsurface migration of VOCs to indoor air at the R&D facility shortly upon operation.

Potential short-term risks to public health and the environment are associated with air emissions from the groundwater treatment system. An analysis of potential air quality impacts from the air stripper is required and, if necessary, offgas treatment would be installed for compliance with air emissions standards.

Under this alternative, onsite workers could be exposed to chemical constituents in soil during the soil boring activities to install the pumping wells, trenching to install the conveyance piping, and surface disturbance activities in preparation for the cap construction. Exposure routes could include dermal contact, inhalation, and/or ingestion. However, the exposure would be of a relatively short duration and would be addressed via various health and safety precautions as discussed below.

Potential exposure of onsite workers to chemical constituents and operational hazards would be mitigated by the use of PPE as specified in a site-specific HASP and through proper equipment and material handling procedures to be specified in the remedy design documents and site work plans. Air monitoring would be performed during soil boring/trenching activities and during site preparation for the cap installation to determine the need for additional engineering controls (e.g., using water sprays to suppress dust, modifying the trenching rate, etc.) to confirm that dust or VOC vapors are within acceptable levels, as specified in the site-specific HASP.

The community would not have access to the site during the installation of the asphalt cap because the site is currently fenced and entry would be controlled through the main gate off Picone Boulevard. Potential risks to the community during excavation/trenching activities would also be mitigated by implementing an air monitoring plan and by implementing vapor control/dust control techniques to mitigate the offsite migration of unacceptable levels of VOC vapors and/or fugitive dust from the site.

Long-Term Effectiveness and Permanence

A maintained cap would effectively isolate the subsurface soil containing VOCs over the long term. Unlike the existing concrete slab, the new cap would minimize the potential migration of VOCs in onsite soil to stormwater at the site and groundwater beneath the site. Under this alternative, VOCs would remain in the onsite soil and could potentially generate vapors that migrate offsite.

The groundwater extraction and onsite treatment system would be effective over the long term as the system would be maintained in operation. The system would likely operate for as long as site-related VOCs remain in groundwater at concentrations exceeding the remedial goals. Annual operation, maintenance, and monitoring activities related to the groundwater treatment system would continue until the groundwater remedial goals are attained.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Implementation of this alternative would not reduce the toxicity or volume of the VOC constituents in onsite soil. However, the mobility of VOCs in onsite soil would be reduced because the low-permeability materials of the cap would be a barrier to infiltration.

The mobility of VOCs in groundwater would be limited by the measure of hydraulic control achieved by the groundwater extraction system. VOC concentrations in groundwater would decrease over time by the continued operation of the groundwater extraction and onsite treatment system. VOCs in the extracted groundwater would be removed/destroyed by the groundwater treatment system equipment (e.g., air stripper and catalytic oxidizer). The groundwater treatment approach is an irreversible process as VOCs in groundwater would be permanently removed.

Implementability

Construction of an asphalt cap/institutional controls and groundwater extraction/treatment are technically feasible. The equipment and materials necessary to implement this alternative are available, as are several capable remedial contractors. A monitoring program would be developed to evaluate the effectiveness of the alternative. Implementation of this alternative would result in significant volumes of groundwater to be treated and discharged.

Groundwater extraction and onsite treatment could be effectively implemented at this site to remove VOCs from groundwater and provide hydraulic control of the groundwater VOC plume. Approval for discharge to the POTW would need to be obtained to confirm that the POTW would accept the treated water. An evaluation would also be needed to determine whether the sanitary sewer system could accommodate the additional flow from the onsite treatment system. In the event that discharge to the POTW is not feasible, treated groundwater could be discharged to the onsite storm sewer system (which conveys flow to the recharge basin) in accordance with SPDES requirements. Based on the location of the recharge basin, flow conveyed to the recharge basin may potentially facilitate hydraulic control of the groundwater plume of VOCs.

Treatability and pilot studies may be required to confirm that the water treatment system would meet necessary effluent requirements to satisfy POTW and/or SPDES requirements. In addition, pump tests and groundwater modeling would likely be required to confirm the groundwater extraction rates necessary to achieve hydraulic control.

The time associated with construction of the asphalt cap and the groundwater extraction/onsite treatment system would be approximately 4 to 5 months (excluding pilot and treatability studies), and the long-term O&M of the groundwater treatment system could last for an extended period of time.

Cost

The 30-year present worth estimated cost associated with the asphalt cap/institutional controls and groundwater extraction/onsite treatment alternative is $4,580,000 for Performance Standard 1 and $5,510,000 for Performance Standard 2. Detailed breakdowns of the estimated costs to achieve Performance Standards 1 and 2 under this Alternative are presented in Tables 12A and 12B, respectively.

5.3.6 Alternative 6 – Soil Excavation and Offsite Incineration/Disposal and Groundwater Extraction/Onsite Treatment

Technical Description

This alternative includes the excavation of impacted soil at the HWD site, offsite transportation of the soil for incineration/disposal, and construction/operation of a groundwater extraction and onsite treatment system. Approximately 1,300 CY of unsaturated soil would be excavated from an approximately 4,500 square foot area at the HWD site. The excavation would extend to depths of between approximately 6 feet and up to 13 feet bgs, and would be discontinued prior to reaching the groundwater table. The approximate horizontal and vertical limits of the proposed excavation area are shown on Figure 14. Excavation to the limits shown on Figure 14 would achieve both: (1) the 10 ppm performance goal for total VOCs in soil; and (2) the compound-specific TAGM 4046 soil guidance values of 1.4 ppm for PCE and 0.7 ppm for TCE. Both goals would be achieved by the excavation activities because the extent of soil containing total VOCs at concentrations exceeding the 10 ppm performance goal is equivalent to the extent of soil containing PCE and TCE above respective compound-specific TAGM 4046 soil guidance values.

Based on the anticipated excavation depths, it is assumed that sheetpiling would be installed around the perimeter of the excavation area to support the excavation sidewalls. The sheetpile system would be designed by a Professional Engineer in the State of New York in accordance with the OSHA regulations set forth in 29 CFR Part 1926. For the purpose of cost estimating in this FS, it is assumed that the sheetpile wall would be approximately 300 feet long and would extend to a depth of approximately 40 feet below grade. Excavation sidewall benching, sloping, and/or shoring would be performed within the excavation area, as needed, to stabilize sidewalls between sub-areas where different removal depths are required. Excavation sidewall benching/sloping was considered around the excavation perimeter, but was not evaluated due to the limited space available at the site, the depth of excavation required (and subsequently the amount of lateral space needed), and the existing soil conditions (e.g., sand and gravel). The proposed sheetpile wall would be installed following the removal of concrete pavement covering the proposed excavation area.

The existing concrete pavement covering the excavation area and proposed sheetpile wall locations would be broken up using an excavator equipped with a hydraulic ram-hoe attachment and removed. Based on the anticipated limits of the excavation area and an average concrete thickness of 8-inches, an estimated 100 CY of concrete debris would be generated for disposal.

After the concrete pavement is removed and sheetpiling is installed, excavation activities would be performed. Excavation of impacted soil would generally be conducted using conventional construction equipment, such as excavators, front-end loaders, dump trucks, etc. The excavated soil would be stockpiled in lined material staging areas for waste characterization purposes and/or direct-loaded for offsite disposal. The handling approach would be determined remedial design based on results obtained for pre-excavation in-situ waste characterization sampling conducted during the test boring program. If a stockpiling approach is selected, soil would likely be placed in separate stockpiles for every 200 to 300 CY. Waste characterization samples would be collected from each stockpile to minimize the amount of soil potentially characterized as a hazardous waste requiring incineration. For cost estimation and remedial evaluation purposes in this FS Report, it is assumed that approximately:

- 350 tons of soil would be characterized as a nonhazardous waste and transported to the Waste Management (WM) High Acres Subtitle D landfill located in Fairport, New York for disposal as a nonhazardous waste;

- 900 tons of soil would be characterized as a RCRA hazardous waste that meets UTS/LDRs (>0.7 ppm PCE concentration in TCLP extract and <60 ppm total PCE concentration) and transported to the CWM Chemical Services LLC Subtitle C Landfill in Model, City New York for offsite disposal; and

- 900 tons of soil would be characterized as a RCRA hazardous waste that fails UTS/LDRs (>0.7 ppm PCE concentration in TCLP extract and >60 ppm total PCE concentration) and transported to the Von Roll incineration facility in East Liverpool, Ohio for offsite incineration/disposal.

Airborne monitoring for VOCs and particulate (dust) would be conducted during the excavation activities in accordance with the NYSDOH's Community Air Monitoring Plan, dated June 2000. Based on the PCE concentrations identified in the RI soil samples (85 ppm average and 440 ppm maximum), engineering controls may be required to control VOC emissions during excavation activities to prevent the public from being exposed to VOC vapors at concentrations exceeding applicable criteria. For the purpose of this FS, it is assumed that a water-based vapor suppressant foam would be sprayed over the excavation area and soil stockpiles to control odors/reduce VOC emissions during excavation/handling activities. It is assumed that it would not be necessary to install a sprung structure under negative air pressure with vapor phase GAC for air emissions treatment. The potential need for a sprung structure would be evaluated during remedial design.

Depending on the final limits selected for the excavation area during design, it may be necessary to remove a portion of the existing onsite storm sewer system. Costs for the removal and replacement of two storm water catch basins and up to 75 feet of storm sewer piping are included in the cost estimate under this alternative.

Following completion of the excavation activities, the site would be restored by backfilling the excavation area with imported clean fill material, removing/decontaminating the sheetpiling, and re-paving the backfilled area. Based on the limited space available at the site, the groundwater component of the remedial alternative would not be constructed until after all excavated soil is transported for offsite treatment/disposal and the excavated area is restored (unless the treatment system could be constructed on vacant land south of the site).

The groundwater extraction and treatment system proposed under this alternative would consist of the same system described above for Alternative 5 – Asphalt Cap/Institutional Controls and Groundwater Extraction/ Onsite Treatment. The groundwater extraction and treatment system would operate to capture the groundwater plume with total VOC concentrations exceeding 200 ppb or background (depending on whether Performance Standard 1 or 2, respectively, is selected) for treatment.

Compliance with SCGs

Chemical-Specific SCGs

The Class GA groundwater quality standards presented in 6NYCRR Parts 700-705 and in the NYSDEC TOGS 1.1.1 document titled, *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations* (NYSDEC 2000) are applicable chemical-specific SCGs for this alternative. The groundwater extraction and onsite treatment system would hydraulically control VOCs in groundwater and reduce groundwater VOC concentrations over time. The soil excavation activities would mitigate the potential future migration of VOCs from soil to groundwater. Groundwater quality standards could potentially be achieved after a significant amount of groundwater has been extracted and treated over a period of many years, provided upgradient sources are addressed.

Chemical-specific guidelines that are to be considered under this alternative are the soil guidance values presented in NYSDEC TAGM #4046 titled, *Determination of Soil Cleanup Objectives and Cleanup Levels* (NYSDEC, 1994). The concentrations of VOCs in soil remaining following the excavation activities could potentially be consistent with the TAGM 4046 soil guidance values.

Action-Specific SCGs

Action-specific SCGs that apply to this alternative are the OHSA construction standards and health and safety requirements associated with the sheetpile wall installation, soil excavation, groundwater pumping well/ conveyance piping installation, treatment system construction, and performance of onsite monitoring activities. Workers and worker activities that occur during implementation of this alternative must comply with OSHA requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting as identified in 29 CFR Parts 1904, 1910, and 1926. Compliance with action-specific SCGs would be accomplished by following a NYSDEC-approved design and site-specific HASP.

Another action-specific SCG that would apply to this alternative is associated with re-injecting or discharging treated groundwater to the POTW or recharge basin. A discharge permit would need to be obtained from the local POTW and the treated water would need to meet influent requirements. If the treated groundwater were to be discharged to the recharge basin or re-injected, the discharge/re-injection would be conducted in compliance with SPDES requirements.

For the purpose of this FS, it is assumed that an air stripper would be used to treat the extracted groundwater. NYSDEC Air Guide 1, which incorporates by reference applicable federal and New York State regulations and requirements pertaining to air emissions, is an action-specific SCG for emissions from the air stripper. If needed, a catalytic oxidizer or vapor phase carbon would be used to treat the exhaust from the air stripper to meet NYSDEC air discharge requirements and comply with federal emission requirements.

Wastes generated during the implementation of this alternative (soil removed from the excavation area, soil cuttings generated by installation of the pumping wells, soil removed during trenching to install the conveyance piping, PPE, etc.) would be characterized to determine appropriate offsite disposal requirements. If any of the materials are characterized as a hazardous waste, then the RCRA, UTS/LDR, and USDOT requirements for the packaging, labeling, transportation, and disposal of hazardous or regulated materials may be applicable. Compliance with these requirements would be achieved by utilizing licensed waste transporters and properly permitted disposal facilities.

Action-specific SCGs associated with the incineration and subsequent disposal of treated soil at a RCRA facility would include the RCRA standards for "Owners/Operators of Permitted Hazardous Waste Facilities" contained in 40 CFR Part 264, the air emissions standards contained in 40 CFR Part 60, the prevention of significant deterioration (PSD) air emission provisions contained in 40 CFR Part 51, relevant requirements under the Clean Air Act contained in 40 CFR Parts 1-99, and relevant state requirements.

Location-Specific SCGs

Remedial activities at the site would be conducted in accordance with local building/construction codes and ordinances, as appropriate, including those requirements at offsite disposal locations.

Overall Protection of Human Health and the Environment

The soil excavation and offsite incineration/disposal and groundwater extraction/onsite treatment alternative would meet each of the RAOs for the site, as summarized herein. The soil excavation activities would mitigate potential human exposure to soil containing VOCs. These activities would also address the migration of VOCs in onsite soil to stormwater at the site and groundwater beneath the site. The excavation activities would also mitigate the offsite migration of VOCs in soil vapor originating from onsite soil. The groundwater extraction and onsite treatment activities would address potential groundwater quality impacts from the site and help control the migration of VOCs from groundwater to soil vapor. Existing groundwater use restrictions in place in Suffolk County Sanitary Code, Article 4 – Water Supply, Section 406.4, would continue to minimize potential human exposure to VOCs in groundwater at concentrations exceeding groundwater quality standards. It is also important to recognize that groundwater from the HWD site will merge with the downgradient Fairchild plume containing higher VOC concentrations.

Short-Term Effectiveness

In a relatively short timeframe, the excavation of soil containing VOCs would be completed and hydraulic control of the VOCs in groundwater (at concentrations exceeding the remedial goal) would be attained. However, groundwater treatment under this alternative would take an extended period of time.

Potential short-term risks to public health and the environment are associated with the excavation/handling of soil containing VOCs and potential air emissions from groundwater treatment. Water sprays and/or foam suppressants would be used during soil excavation/handling activities, as needed based on air monitoring activities, to mitigate potential risks (for inhalation) posed by fugitive dust or VOC vapors. An analysis of potential air quality impacts from the air stripper is required and, if necessary, offgas treatment would be installed for compliance with air emissions standards. Transportation of impacted soil increases the risk of in-traffic accidents. Local emissions from diesel exhaust can disturb local communities, and opposition at the disposal location is likely given recent opposition from residents in the Town of Porter to the continuation of disposal of hazardous waste in their community.

Under this alternative, onsite workers could be exposed to chemical constituents in soil during the excavation/handling activities and soil boring activities. Exposure routes could include dermal contact, inhalation, and/or ingestion. However, the exposure would be of a relatively short duration and would be addressed via various health and safety precautions as discussed below.

Potential exposure of onsite workers to chemical constituents and operational hazards would be mitigated by the use of PPE as specified in a site-specific HASP and through proper equipment and material handling procedures to be specified in the remedy design documents and site work plans. Air monitoring would be performed during soil excavation/handling and boring activities to determine the need for additional engineering controls (e.g., using water sprays to suppress dust, modifying the excavation rate, etc.) to confirm that dust or VOC vapors are within acceptable levels, as specified in the site-specific HASP.

The community would not have access to the site during the excavation activities because the site is currently fenced and entry would be controlled through the main gate off Picone Boulevard. Potential risks to the community during excavation would also be mitigated by implementing an air monitoring plan and by implementing vapor control/dust control techniques to mitigate the offsite migration of unacceptable levels of VOC vapors and/or fugitive dust from the site.

Long-Term Effectiveness and Permanence

Implementation of this alternative would permanently remove subsurface soil containing VOCs. The soil RAOs could potentially be achieved in a relatively short timeframe (within a few weeks following installation of the sheetpile wall).

The groundwater extraction and onsite treatment system would be effective over the long term as the system would be maintained in operation. The system would likely operate for as long as site-related VOCs remain in groundwater at concentrations exceeding the remedial goals. Annual operation, maintenance, and monitoring activities related to the groundwater treatment system would continue until the groundwater remedial goals are attained.

Reduction of Toxicity, Mobility, and Volume Through Treatment

The soil excavation activities would reduce the toxicity, mobility, and volume of VOC constituents in the unsaturated zone at the HWD site as the soil would be permanently removed and replaced with clean backfill material. The toxicity, mobility, and volume of the VOC constituents in the excavated soil would be reduced by the offsite incineration/disposal activities.

The mobility of VOCs in groundwater would be limited by the measure of hydraulic control achieved by the groundwater extraction system. VOC concentrations in groundwater would decrease over time by the continued operation of the groundwater extraction and onsite treatment system. VOCs in the extracted groundwater would be removed/destroyed by the groundwater treatment system equipment (e.g., air stripper and catalytic oxidizer). The groundwater treatment approach is an irreversible process as VOCs in groundwater would be permanently removed.

Implementability

Excavation and offsite transportation of soils are commonly employed construction activities and are technically feasible. Soil that is characterized as hazardous and fails UTS/LDRs would be incinerated, which would destroy the VOC constituents in the soil, prior to landfill disposal. Soil that is characterized as hazardous and meets UTS/LDRs would be disposed of in a Subtitle C landfill. Soil that is characterized as nonhazardous would be disposed of in a Subtitle D landfill.

Groundwater extraction and onsite treatment could be effectively implemented at this site to remove VOCs from groundwater and provide hydraulic control of the groundwater VOC plume. Approval for discharge to the POTW would need to be obtained to confirm that the POTW would accept the treated water. An evaluation would also be needed to determine whether the sanitary sewer system could accommodate the additional flow from the onsite treatment system. In the event that discharge to the POTW is not feasible, treated groundwater could be discharged to the onsite storm sewer system (which conveys flow to the recharge basin) in accordance with SPDES requirements. Based on the location of the recharge basin, flow conveyed to the recharge basin may potentially facilitate hydraulic control of the groundwater plume of VOCs.

Treatability and pilot studies may be required to confirm that the water treatment system would meet necessary effluent requirements to satisfy POTW and/or SPDES requirements. In addition, pump tests and groundwater modeling would likely be required to confirm the groundwater extraction rates necessary to achieve hydraulic control.

Installation of the sheetpile wall and completion of soil excavation activities would require approximately 1 to 2 months to complete. The groundwater extraction and onsite treatment system could be constructed in a 3 to 4 month timeframe after backfilling activities are completed. Long-term O&M of the groundwater treatment system could last for an extended period of time.

Cost

The 30-year present worth estimated cost associated with the soil excavation and offsite incineration/disposal and groundwater extraction/onsite treatment alternative is $6,390,000 for Performance Standard 1 and $7,300,000 for Performance Standard 2. Detailed breakdowns of the estimated costs to achieve Performance Standards 1 and 2 under this Alternative are presented in Tables 13A and 13B, respectively.

6. Comparative Analysis of Alternatives

6.1 General

While Section 5 presented an analysis of each alternative's ability to meet the evaluation criteria, this section presents a comparative analysis of the alternatives to each other with respect to the seven evaluation criteria identified in Section 5. This comparative analysis identifies the advantages and disadvantages of each alternative relative to each other and in consideration of the seven evaluation criteria. The results of the comparative analysis are used as a basis for recommending a remedial alternative to address the VOCs in soil and groundwater in Subsection 6.2. The comparative analysis of remedial alternatives is presented below.

6.1.1 Compliance with SCGs

Chemical-Specific SCGs

The Class GA groundwater quality standards presented in 6NYCRR Parts 700-705 and in the NYSDEC TOGS 1.1.1 document titled, *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations* (NYSDEC 2000) are applicable chemical-specific SCGs for each alternative. Alternative 1 (No Action) provides limited means to achieve the groundwater quality standards and no means to monitor the location and movement of site groundwater that exceeds the standards.

Alternatives 2 (In-Situ Soil Chemical Oxidation and In-Situ Groundwater Chemical Oxidation) and 3 (SVE and In-Situ Groundwater Chemical Oxidation) both involve the delivery of chemicals to react with and chemically oxidize VOCs in groundwater to innocuous byproducts. Under both alternatives, a significant depth of treatment could be realized as the oxidant (which is denser than water) descends through the saturated zone and migrates with groundwater flow. Under Alternative 2, oxidant applied for soil treatment that is not consumed in the unsaturated overburden would migrate to groundwater and help further degrade VOCs in groundwater. Alternative 4 (SVE and Groundwater Air Sparging) involves injecting air into the groundwater to volatilize VOCs in groundwater. The vapors would be collected via operation of SVE equipment, and would result in the reduction of groundwater VOC concentrations over time. The groundwater extraction and treatment activities under Alternatives 5 (Asphalt Cap/Institutional Controls and Groundwater Extraction/Onsite Treatment) and 6 (Soil Excavation and Offsite Incineration/Disposal and Groundwater Extraction/Onsite Treatment) would result in the continued removal of groundwater containing VOCs and the reduction of groundwater VOC concentrations over time.

Groundwater quality would be assessed in connection with Alternatives 2 through 6. Groundwater quality standards could potentially be achieved in a relatively short timeframe under Alternatives 2 and 3 depending on the amount of oxidant injected and consumed by the targeted VOC constituents and formation, and the number of treatment applications provided, as long as upgradient sources of VOCs to groundwater are remediated in accordance with standards. Under Alternative 2, groundwater treatment would be performed concurrently with soil treatment, and both the soil and groundwater treatment components could be completed in as little as one year (excluding pre-design activities and commencing with construction). As discussed above in Subsection 5.3.3, groundwater treatment under Alternative 3 would begin after soil treatment is completed, and Alternative 3 could be completed in approximately six to eight years (excluding pre-design activities and commencing with construction).

Under Alternative 4, groundwater quality standards could potentially be achieved after a significant amount of air sparging is performed over an estimated 10 to 15 year period. Operation of the SVE system under Alternative 4, which would collect VOC vapors generated by air sparging, would continue until groundwater remedial goals are achieved. Under Alternatives 5 and 6, groundwater quality standards could potentially be achieved after a significant amount of groundwater has been extracted and treated over an extended period of time.

Chemical-specific guidelines that are to be considered under each alternative are the soil guidance values presented in NYSDEC TAGM #4046 titled, *Determination of Soil Cleanup Objectives and Cleanup Levels* (NYSDEC, 1994). Alternative 1 would rely on natural degradation processes that would not likely reduce VOC concentrations in soil at the site to below the TAGM 4046 soil guidance values. The soil areas targeted for treatment under Alternatives 2, 3, and 4 are based on the TAGM 4046 guidance values for soil remediation of VOCs. Therefore, these alternatives meet this SCG. Soil treatment via SVE would take longer to complete under Alternative 4 than under Alternative 2 because VOCs stripped from groundwater under Alternative 4 would continue to be drawn upward into unsaturated treated soils until groundwater air sparging is discontinued (which would occur after a 10 year period vs. the 1 to 2 year period for groundwater chemical oxidation).

VOC concentrations in soil would not be reduced by Alternative 5. However, the cap would mitigate infiltration (and hence partitioning of VOCs from soil to water) and would minimize unauthorized human contact with soils. Both of these results would protect groundwater quality and human health. VOC concentrations in soil remaining following the excavation activities under Alternative 6 would be consistent with the TAGM 4046 soil guidance values.

Action-Specific SCGs

Action-specific SCGs are not applicable under Alternative 1. OSHA regulations (29 CFR Parts 1904, 1910, and 1926) would apply to construction/installation activities included under Alternatives 2 through 6.

SCGs related to air emissions (including relevant federal and New York State regulations/requirements incorporated by reference in NYSDEC Air Guide 1) would apply to the removal/treatment activities under Alternatives 3 through 6. As no point source (or other) emissions are expected under Alternative 2, there would not be a need to comply with air discharge SCGs under Alternative 2. SCGs related to packaging, labeling, transportation, and disposal of hazardous materials (including RCRA, UTS/LDR, and USDOT requirements) would apply to the removal activities under Alternatives 2 through 6. In addition, SCGs related to the discharge of treated groundwater to the POTW or recharge basin, or the reinjection of treated groundwater would apply under Alternatives 5 and 6.

All of the remedial activities would be designed and implemented to meet action-specific SCGs.

Location-Specific SCGs

Remedial activities under Alternatives 2 through 6 would be conducted in accordance with local building/ construction codes and ordinances, as appropriate. However, depending on the outcome of the final design, Alternative 2 may not result in the construction of any permanent aboveground structures, mitigating the need for compliance with the identified location-specific SCGs.

6.1.2 Overall Protection of Human Health and the Environment

Alternative 1 (No Action) would be ineffective and would not meet the soil and groundwater RAOs for the HWD site. The capping, in-place treatment, or removal activities under Alternatives 2 through 6 would minimize potential future exposure of workers at the site to soil containing VOCs. These activities would also address potential migration of chemical constituents in onsite soil to stormwater at the site and groundwater beneath the site. The groundwater treatment activities under Alternatives 2 through 6 would mitigate groundwater quality impacts from the site and minimize potential human exposure to VOCs in groundwater at concentrations exceeding groundwater quality standards/guidance values. Under each alternative, existing groundwater use restrictions in place in Suffolk County Sanitary Code, Article 4 – Water Supply, Section 406.4, would continue to minimize potential human exposure to VOCs in groundwater at concentrations exceeding groundwater quality standards.

The two remedial performance standards considered under Alternatives 2 through 6 are protective of human health and the environment. The HWD site is currently, and will continue to be covered with concrete/pavement materials. These protective surfaces would also mitigate the potential for leaching of low VOC concentrations remaining following treatment.

The groundwater treatment activities under Alternatives 2 through 6 would also help control the migration of VOCs from groundwater to soil vapor. The migration of VOCs through soil vapor would be controlled by the soil treatment or removal activities under Alternatives 2, 3, 4, and 6, but not by the capping activities under Alternative 5. Potential subsurface vapor intrusion into the R&D facility would be further addressed via operation of a subslab depressurization system at the facility under Alternatives 2 and 5 and operation of the SVE system under Alternatives 3 and 4.

Overall protection of human health and the environment could potentially be achieved fastest by Alternative 2 (In-Situ Soil Chemical Oxidation and In-Situ Groundwater Chemical Oxidation), provided the proper amount of oxidant reaches the target VOCs, because the oxidant reacts quickly with these VOCs to form innocuous products. Long-term operation and/or maintenance activities would not be required under Alternative 2. As compared to the other alternatives, Alternative 2 also offers the advantage that VOCs in soil and groundwater would be destroyed in-situ without the need to bring impacted soil or groundwater to the surface for treatment or disposal. As a result, VOC-impacted materials would not need to be transported offsite through commercial areas under Alternative 2.

6.1.3 Short-Term Effectiveness

There are no short-term negative impacts associated with Alternative 1. Potential short-term impacts under Alternatives 2 through 5 are primary associated with worker exposure to soil and groundwater containing VOCs during the installation of the in-situ chemical oxidation delivery systems, installation of the SVE extraction/ conveyance systems, and removal of the soil/base materials for the new cap construction. There would also be short-term risks to onsite workers associated with handling potassium permanganate under Alternatives 2 and 3 and spent carbon under Alternatives 3 through 6. Alternative 6 involves significant excavation activities, and as such presents a greater potential for short-term risks to onsite workers and the community during implementation. Under Alternatives 2 through 6, appropriate measures would be implemented to mitigate these risks including, but not limited to, implementing a HASP that includes an air monitoring program, using PPE, and instituting engineering controls to suppress dust or VOC emissions.

Alternative 2 could potentially achieve the soil and groundwater RAOs identified for the HWD site in the least amount of time of the alternatives evaluated. Considering that Alternative 2 may achieve the remedial goals much quicker than the other alternatives under consideration, there will be inherently less onsite labor hours, thereby reducing the probability of potential site accidents/worker injury.

6.1.4 Long-Term Effectiveness and Permanence

The no-action alternative would provide limited means to achieve and no method to monitor long-term effectiveness. Under Alternatives 2 and 3, VOCs in soil and groundwater would be permanently removed/ destroyed by in-situ technologies. The soil and groundwater RAOs could potentially be attained in a relatively short timeframe under both Alternatives 2 and 3 (e.g., as little as one year for Alternative 2 and an estimated six or eight years for Alternative 3). Depending on the amount of oxidant consumed by natural organic material/ minerals and the total mass of VOCs present in the target media, additional chemical oxidation treatments could be required under both Alternatives 2 and 3 to achieve the RAOs. Operation of the SVE system included under Alternatives 3 and 4 would generate additional noise at the nearby properties for a period of several years, even if the system were to be equipped with sound abatement devices. The SVE system would forseeably operate for at least twice as long under Alternative 4 than under Alternative 3. Additional operation, maintenance, and monitoring activities relative to the SVE system could be required under Alternatives 3 and 4 to achieve the RAOs.

Under Alternative 5, a maintained engineered cap would effectively isolate subsurface soil containing VOCs over the long term. However, the VOCs would be allowed to remain in onsite soil and could potentially migrate offsite via soil vapor. Under Alternative 6, soil containing VOCs would be permanently removed and transported for offsite incineration/disposal. The groundwater extraction and onsite treatment system identified under Alternatives 5 and 6 would be effective over the long term as the system would be maintained in operation resulting in the continued removal of VOCs from groundwater. The system would likely operate for as long as site-related VOCs persist in groundwater at concentrations exceeding the remedial goals. Annual operation, maintenance, and monitoring activities related to the groundwater treatment system would continue until the groundwater remedial goals are attained.

6.1.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 1 does not include implementation of active treatment processes to reduce the toxicity, mobility, or volume of VOCs in soil and groundwater. Alternatives 2, 3, 4, and 6, which include in-situ soil chemical oxidation, soil vapor extraction and onsite vapor treatment, and excavation and offsite incineration/disposal, would reduce the toxicity, mobility, and volume of VOCs in onsite soil. Alternatives 2, 3, 4, and 6 involve irreversible processes for soil as target VOCs would be permanently removed. Target VOCs would also be permanently destroyed under Alternative 2 (upon reaction with oxidant) and Alternative 6 (upon incineration). Besides destroying VOCs, the oxidant delivered to soils under Alternative 2 would also destroy the phenol that was identified at estimated concentrations slightly above the TAGM 4046 soil guidance value. VOCs removed from soil under Alternatives 3 and 4 would only be destroyed if the carbon were to be incinerated. The cap under Alternative 5 would not reduce the toxicity and volume of VOCs in soil, but would reduce the mobility of the VOCs. The toxicity, mobility, and volume of VOCs in groundwater would be reduced by Alternatives 2 through 6. Each of these alternatives includes an irreversible treatment process for groundwater.

Alternative 2 would require the least amount of time to reduce the toxicity, mobility, and volume of VOCs in both soil and groundwater provided the proper amount of oxidant is delivered to the target VOCs in the subsurface. In addition, Alternative 2 would generate the least amount of waste materials. Under Alternative 2, there would not be any residuals that would remain after treatment, such as spent vapor-phase GAC associated with an SVE (or AS/SVE) system or precipitates, filtrates/backwash, spent GAC, etc. from a groundwater treatment system. In addition, there would not be any large amounts of materials requiring offsite transportation and disposal, such as the soil excavated under Alternative 6.

6.1.6 Implementability

Each of the alternatives could be implemented at the site. Pre-design testing would be performed prior to implementing Alternatives 2 through 6, particularly to further evaluate final design parameters for in-situ chemical oxidation, SVE, and groundwater extraction/onsite treatment. Pilot testing would also be performed to further evaluate design parameters for SVE, AS, and groundwater extraction/onsite treatment. As previously discussed, pilot testing is not technically required prior to full-scale implementation of in-situ chemical oxidation for the reasons discussed in Section 5. Parameters such as oxidant demand and potential infiltration/ oxidant injection rates would be evaluated through bench-scale testing of samples of soils collected from the site prior to the design and implementation of in-situ soil chemical oxidation.

Alternative 2 would be the simplest alternative to implement, as construction of onsite treatment systems requiring ongoing operation/maintenance is not needed, and only a small amount of waste (associated with installation of the delivery system) would need to be managed. Alternatives 3 through 6 would each require ongoing operation, maintenance, and monitoring activities relative to operation of an SVE system, groundwater air sparge system, and/or groundwater extraction and onsite treatment system. Operation, maintenance, and monitoring activities would be required for the longest period of time in connection with the groundwater extraction and onsite treatment systems under Alternatives 5 and 6. Alternative 6 would also present several technical challenges based on the depth/size of the soil excavation, such as maintaining excavation sidewalls and controlling the volatilization of VOCs from the excavation/material stockpiles.

6.1.7 Cost

The five remedial alternatives under consideration for the HWD site cover a wide range of capital and O&M costs. No capital or O&M costs are associated with the implementation of Alternative 1. The total costs to implement Alternatives 1 through 6 are presented in the table below.

Remedial Alternative		Performance Standard No.	Estimated Capital Costs	Estimated O&M Costs	Total Costs (Rounded)
Alternative 1 –	No Action	--	$0	$0	$0
Alternative 2 –	In-Situ Soil Chemical Oxidation, In-Situ Groundwater Chemical Oxidation (Focused Application), Subslab Depressurization, and Site Controls and Monitoring	1	$1,456,650	$138,473	$1,600,000
		2	$1,722,500	$138,473	$1,870,000
Alternative 3 –	Soil Vapor Extraction, In-Situ Groundwater Chemical Oxidation (Focused Application), and Site Controls and Monitoring	1	$1,289,925	$504,958	$1,800,000
		2	$1,442,675	$567,146	$2,010,000

Remedial Alternative		Performance Standard No.	Estimated Capital Costs	Estimated O&M Costs	Total Costs (Rounded)
Alternative 4 –	Soil Vapor Extraction, Groundwater Air Sparging, and Site Controls and Monitoring	1	$840,125	$1,559,239	$2,400,000
		2	$840,125	$2,021,954	$2,870,000
Alternative 5 –	Asphalt Cap/Institutional Controls, Groundwater Extraction/Onsite Treatment, and Subslab Depressurization	1	$1,135,030	$3,440,819	$4,580,000
		2	$1,371,825	$4,136,797	$5,510,000
Alternative 6 –	Soil Excavation and Offsite Incineration/Disposal and Groundwater Extraction/Onsite Treatment	1	$3,359,785	$3,027,599	$6,390,000
		2	$3,570,580	$3,723,577	$7,300,000

6.2 Recommended Remedial Alternative

Based on the results of the comparative analysis presented above, Alternative 2 – In-Situ Soil Chemical Oxidation, In-Situ Groundwater Chemical Oxidation, and Site Controls and Monitoring appears to be the most effective remedial alternative for eliminating significant threats to human health and the environment associated with the disposal of hazardous waste at the site in a manner that is consistent with the NCP and meeting the RAOs for the site. This alternative will result in a significant and permanent reduction in the total mass of VOCs in soil and groundwater as the oxidant reaches and destroys the target VOCs. In addition, this alternative will be protective of human health and the environment, have minimal short-term negative impacts when compared to the other alternatives, be effective over the long term, and be implemented for a cost comparatively lower than the other alternatives. The key advantages of Alternative 2 over the other alternatives evaluated in this FS Report are summarized below.

- The soil RAOs would likely be achieved in less time under Alternative 2 than the other alternatives considered, because the oxidant reacts quickly and completely with VOCs to form innocuous products. A quicker remediation is desirable as there would be inherently less onsite labor hours, which would reduce the probability of potential site accidents/site worker injury.

- The groundwater RAOs would likely be achieved in less time under Alternative 2 than the other alternatives considered. Although the same groundwater treatment technology is included under both Alternatives 2 and 3 (in-situ groundwater chemical oxidation), groundwater treatment would be implemented concurrently with soil treatment under Alternative 2 and following completion of soil treatment under Alternative 3.

- Alternative 2 would not involve the extraction and subsequent aboveground onsite handling/treatment of large amounts of impacted soil, soil vapor, or groundwater that presents potential exposure scenarios requiring mitigation, such as under Alternatives 3 through 6.

- There would not be the type of treatment residuals that would remain following treatment under Alternative 2, such as the spent vapor-phase GAC associated with the SVE system under Alternatives 3 and 4, or precipitates, filtrates/backwash, spent GAC, etc. associated with a groundwater treatment system under Alternatives 5 and 6.

- Alternative 2 would not include a blower or other mechanical equipment, other than a small fan for the subslab depressurization system at the R&D facility, that would continuously operate and generate added noise to the nearby properties like the SVE blower included under Alternatives 3 and 4 or the groundwater treatment system components included under Alternatives 5 and 6 (air stripper blowers, pumps, alarms, etc.).

- There would be an economy-of-scale for Alternative 2 associated with the design and use of the same technology to treat both soil and groundwater. For instance, oxidant applied for soil treatment that is not consumed in the unsaturated overburden would migrate to groundwater and help further degrade VOCs in groundwater.

- Long-term operation, maintenance, and monitoring activities would not be required under this alternative like Alternatives 3 through 6.

- Finally, Alternative 2 is the most cost-effective alternative evaluated.

Pre-design activities would be conducted in support of Alternative 2. If the findings of the bench-scale testing indicate that in-situ chemical oxidation is not effective, a review of alternative remedial measures will be conducted and additional recommendations will be presented to the NYSDEC. Based on the information discussed above and the detailed and comparative analysis of remedial alternatives, in-situ soil and groundwater chemical oxidation is the recommended remedial alternative for the site.

Treatment to the remedial goals under Performance Standard 1 (i.e., 10 ppm total VOCs in soil and 200 ppb total VOCs in groundwater) is recommended because the additional costs and treatment efforts to achieve the remedial goals under Performance Standard 2 cannot be justified since they will not increase the health or environmental protectiveness of the remedy. This is based on the following:

- remedial goals for soil under Performance Standard 1 are protective of human health and the environment and effectively eliminate significant threats. The HWD Site is currently, and will continue to be, covered with concrete/pavement materials. As previously indicated, these protective surfaces would be maintained and limit direct human exposure to soil. By preventing infiltration, the cover will also mitigate the potential for leaching of low VOC concentrations remaining following treatment;

- because background concentrations of VOCs in groundwater flowing onto the HWD site (from offsite sources) exceed NYS groundwater quality standards by one to two orders of magnitude, the proposed soil performance standard is appropriately protective of groundwater quality;

- the proposed 10 ppm total VOCs soil performance standard is consistent with the existing and anticipated future use of the Site as commercial/industrial. In addition, because the NYSDEC is now required by the new NYS Superfund Refinancing and Reform Legislation to separate soil cleanup objectives for commercial and industrial sites, use of the compound-specific TAGM 4046 soil guidance values at a commercial/ industrial site such as HWD, would be inconsistent with the current state of the law and the intent of the legislature to implement remedial actions at industrial sites in such a manner as to foster the reuse of such sites;

- site land use restrictions (in the form of a deed restriction or environmental easement) would be implemented if final post-remedial VOC soil concentrations are not generally consistent with TAGM 4046 compound-specific soil guidance values. Additionally, a site management plan could be prepared to address residual VOCs that could be excavated from the site during future redevelopment. Such a plan would: (1) include soil characterization and, where applicable, disposal/reuse in accordance with applicable regulations; (2) evaluate the potential for vapor intrusion for buildings developed onsite and identify potential mitigation measures;

- existing groundwater use restrictions in place in Suffolk County Sanitary Code, Article 4 – Water Supply, Section 406.4 would continue to minimize potential human exposure to VOCs in groundwater at concentrations exceeding groundwater quality standards;

- the amount of time, expense, and oxidant required to achieve background VOC groundwater concentrations could potentially be considerably more than that required to achieve the 200 ppb performance standard. The nearly 15 to 20% minimum anticipated cost increase (as identified in the detailed cost estimate tables) to treat from 200 ppb to background is unjustified considering that groundwater flowing beneath the HWD site merges with a larger plume associated with the Fairchild Republic site where the groundwater remedial action is addressing total VOCs above 200 ppb; and

- as stated in the NCP under 40 CFR Part 300.430(f)(1)(D), remedial costs should be proportional to the overall effectiveness of the remedial efforts;

- Finally, the proposed recommended remedial alternative appropriately and effectively eliminates significant threats to human health and the environment as required by Article 27, Title 13 of the Environmental Conservation Law.

7. References

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Tables

Table 1

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Groundwater/Surface Water Elevations - April 22, 2003

Well ID	Reference Point (feet)	Depth to Water (feet)	Water Elevation (feet)
MW-1	80.63	28.36	52.27
MW-1D	81.54	29.26	52.28
MW-2	65.39	13.37	52.02
MW-2D	65.20	NA	NA
MW-3	67.55	15.06	52.49
MW-3D	64.89	NA	NA
MW-4	69.69	NA	NA
MW-5	79.22	NA	NA
MW-6	67.72	15.53	52.19
MW-7	65.31	13.31	52.00
MW-8	64.61	12.73	51.88
W-1	65.33	13.45	51.88
W-2	68.39	NA	NA
W-3	65.02	13.31	51.71
Staff Gauge	57.90	5.3 (estimated)	52.6 (estimated)

Notes:

1. Water level measurements obtained by Blasland, Bouck & Lee, Inc. (BBL) on April 22, 2003 between 7:30 a.m. and 9:30 a.m.
2. Water elevations provided in feet above mean sea level (AMSL) in relation to North American Vertical Datum (NAVD) 1988.
3. Surveyed reference point on the staff gauge is the 6.0-foot mark, which corresponds to an elevation of 57.90 feet.
4. The bottom of the staff gauge is at the 1.88-foot mark (elevation 53.78 feet), and the water level in the recharge basin was approximately 1.2 feet below this mark.
5. NA = Not available.

Table 2

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Groundwater Analytical Results for Detected Volatile Organic Compounds (ppb)

Detected Compound	**NYSDEC Groundwater Standards**	**MW-1**	**MW-1D**	**MW-2**	**MW-3**	**BD042203 (MW-3)**	**MW-6**	**MW-7**	**MW-8**
Benzene	1	< 0.3	< 0.3	< 2.6	**2.0**	**1.8**	< 0.3	< 6.5	< 2.6
Chlorobenzene	5	< 0.2	< 0.2	< 1.8	**19**	**17**	< 0.2	< 4.5	< 1.8
cis-1,2-Dichloroethene	5	< 0.2	< 0.2	**21**	2.3	1.9	< 0.2	**38**	**27**
1,1-Dichloroethane	5	< 0.2	1.8	< 2.4	< 0.5	< 0.5	< 0.2	< 6.0	< 2.4
1,1-Dichloroethene	5	< 0.4	1.3	< 4.3	< 0.9	< 0.9	< 0.4	< 11	< 4.3
Ethylbenzene	5	< 0.4	< 0.4	< 3.7	**310**	**270**	< 0.4	< 9.2	< 3.7
Tetrachloroethene	5	**50**	0.8	**1,200**	1.4	1.2	**120**	**2,600**	**970**
Trichloroethene	5	< 0.2	1.7	**34**	< 0.4	< 0.4	1.1	**48**	**25**
1,1,1-Trichloroethane	5	< 0.2	1.4	< 1.6	< 0.3	< 0.3	0.3	< 4.0	< 1.6
Toluene	5	< 0.2	< 0.2	< 1.5	**9.6**	**8.2**	< 0.2	< 3.8	< 1.5
Xylenes (Total)	5	< 0.2	< 0.2	< 1.8	**40**	**35**	< 0.2	< 4.5	< 1.8

Notes:

1. Samples collected by Blasland, Bouck & Lee, Inc. (BBL) on April 22-23, 2003.
2. Sample BD042203 is a blind duplicate of sample MW-3.
3. Samples analyzed by Severn Trent Laboratories, Inc. (STL) of Edison, New Jersey for Target Compound List (TCL) volatile organic compounds (VOCs) using United States Environmental Protection Agency (USEPA) Method 624.
4. Concentrations are reported in parts per billion (ppb), which are equivalent to micrograms per liter (µg/L).
5. Groundwater quality standards are from the New York State Department of Environmental Conservation (NYSDEC) Division of Water, Technical and Operational Guidance Series (TOGS 1.1.1) document entitled, "Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations," dated June 1998, revised April 2000.
6. < = Compound was not detected at a concentration exceeding the reported laboratory detection limit.
7. Shaded value indicates a VOC concentration exceeding the presented groundwater quality standard.

Table 3

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
<u>Groundwater Field/Laboratory Analytical Results for Key Indicator Parameters of In-Situ Biodegradation</u>

Field/Laboratory Parameters	MW-1	MW-1D	MW-2	MW-3	MW-6	MW-7	MW-8
Field Parameters							
pH	6.2	6.2	6.3	6.8	7.7	6.5	6.0
Temperature (^{o}C)	13.9	15.3	11.3	13.0	15.2	11.2	11.6
Specific Conductance (mS/cm)	0.20	0.27	0.28	0.39	0.17	0.24	0.25
Dissolved Oxygen (mg/L)	8.6	0.5	7.1	0.8	6.5	5.7	3.5
Turbidity (NTU)	0.0	10.1	0.0	17.5	0.0	8.3	2.2
Redox (mV)	135	116	156	-121	127	157	-40
Laboratory Analytical Parameters							
Geochemical Parameters							
Alkalinity as CaCO$_3$ (mg/L)	32	71	61	200	29	52	92
Ammonia as N (mg/L)	< 2.0	< 2.0	< 2.0	3.7	2.2	5.2	< 2.0
Chloride (mg/L)	20	36	35	9.4	14	22	15
Nitrate (mg/L)	17	< 0.50	15	< 0.50	10	14	8.6
Nitrite (mg/L)	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phosphate (mg/L)	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Soluble Organic Carbon (mg/L)	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Sulfate (mg/L)	20	18	19	5.2	24	30	27
Sulfide (mg/L)	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Iron-dissolved (mg/L)	< 0.050	< 0.050	< 0.050	21	< 0.050	< 0.050	0.73
Carbon dioxide (mg/L)	34	76	26	71	26	28	38
Ethane (ng/L)	82	29	84	410	< 5.0	5.8	8,000
Ethene (ng/L)	23	32	25	340	11	8.4	180
Methane (ug/L)	0.71	14	0.73	780	0.08	0.13	160
Microbiological Parameters							
Biomass via PLFA (Cell/mL)	1.12E+04	2.23E+06	6.46E+03	1.34E+06	4.11E+03	8.81E+03	4.23E+05
Anaerobes via PLFA (% of population)	0.0	13.6	0.0	10.6	0.0	0.0	5.2
Metal reducers via PLFA (% of population)	0.0	1.3	0.0	2.1	0.0	0.0	1.4
Dehalococcoides Ethenogenes	ND	ND	ND	Detected	ND	ND	Detected

<u>Notes</u>:

1. Samples collected by Blasland, Bouck & Lee, Inc. (BBL) on April 22-23, 2003.
2. Field measurements obtained by BBL using a Horiba U-22 flow-through cell/water quality meter.
3. Laboratory analyses for key indicator parameters of in-situ biodegradation were performed by three laboratories, as summarized below:
   - Geochemical parameter analysis was performed by Microseeps, Inc. (University of Pittsburgh Applied Research Center) of Pittsburgh, Pennsylvania;
   - Phospholipid fatty acids (PLFA) analysis was performed by Microbial Insights, Inc. of Rockford, Tennessee; and
   - *Dehalococcoides ethenogenes* analysis was performed by Sirem Site Recovery & Management, Inc. (Sirem) of Guelph, Ontario.
4. Analyses were performed using the following methods:
   - United States Environmental Protection Agency (USEPA) Method 9056 for chloride, nitrate, nitrite, phosphate, and sulfate;
   - USEPA Method 310.1 for alkalinity;
   - USEPA Method 350.2 for ammonia;
   - USEPA Method 376.1 for sulfide;
   - USEPA Method 6010B for dissolved iron;
   - USEPA Method 9060 for dissolved organic carbon;
   - Laboratory-specific gas chromatography (GC) methods for carbon dioxide/methane (AM20GAX) and ethane/ethene (AM18);
   - A laboratory-specific gas chromatography/mass spectrometry (GC/MS) method for PLFA; and
   - A laboratory-specific polymerase chain-reaction (PCR) method for *dehalococcoides ethenogenes*.
5. Concentrations reported in the units identified above.

6. S.U. = Standard units.
7. ^{o}C = Degrees Celcius.
8. mS/cm = milliSiemens per centimeter.
9. NTU = Nephelometric turbidity units.
10. mV = milliVolt.
11. mg/L = milligrams per liter, which is equivalent to parts per million (ppm).
12. ng/L = nanograms per liter.
13. < = Compound was not detected at a concentration exceeding the reported laboratory detection limit.
14. ND = not detected above the analytical method detection limit.

Table 4

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Potential Chemical, Action, and Location-Specific SCGs

Potential Federal/ State Requirements and Guidance	Citation/Reference	Potential Status	Summary of Requirements/Guidance	Considerations in Remedial Process/Action for Attainment
Chemical-Specific SCGs				
Identification and Listing of Hazardous Wastes	40 CFR Part 261 6 NYCRR Part 371	Applicable	Establishes procedures for identifying solid wastes that are subject to regulation as hazardous wastes under 40 CFR Parts 260-266 and 6 NYCRR Parts 371-376.	Applicable to use for determining if soil that is removed from the site is a hazardous waste by characteristics or specific listing. These regulations do not set cleanup standards, but are considered when developing remedial alternatives.
Universal Treatment Standards/Land Disposal Restrictions (UTS/LDRs)	40 CFR Part 268	Applicable	Identifies hazardous wastes for which land disposal is restricted and provides a set of numerical constituents concentration criteria at which hazardous waste is restricted from land disposal.	Applicable to use if waste determined to be hazardous. These regulations will be used for remedial alternatives utilizing offsite land disposal.
Groundwater Quality Standards	6 NYCRR Part 703.5	Applicable	Establishes quality standards for groundwater.	These criteria are applicable in evaluating groundwater quality.
NYSDEC Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations	Division of Water Technical and Operational Guidance Series (TOGS 1.1.1, June 1998, revised April 2000)	Applicable	Provides a compilation of ambient water quality standards and guidance values for toxic and non-conventional pollutants for use in the NYSDEC programs.	These standards are applicable in evaluating groundwater quality.
NYSDEC Guidance on Determination of Soil Cleanup Objectives and Cleanup Levels	Technical and Administrative Guidance Memorandum (TAGM) #4046, January 24, 1994	To Be Considered	Provides a basis and a procedure to determine soil cleanup levels, as appropriate, for sites when cleanup to pre-disposal conditions is not possible or feasible. Contains generic soil cleanup objectives.	These guidance values are to be considered in evaluating soil quality.

Table 4
(cont'd)
Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
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Potential Federal/ State Requirements and Guidance	Citation/Reference	Potential Status	Summary of Requirements/Guidance	Considerations in Remedial Process/Action for Attainment
Chemical-Specific SCGs (cont'd)				
USEPA Region 3 Risk-Based Concentrations (RBCs) for Commercial/Industrial Soil	USEPA Region 3 www.epa.gov/reg3hwmd/risk/riskmenu.htm	To Be Considered	Provides RBCs for commercial/industrial soil ingestion based on adult occupational exposure, including an assumption that only 50% of total soil ingestion is work-related. Separate carcinogenic and non-carcinogenic risk-based concentrations are calculated for each pathway. The concentration in the USEPA Region 3 RBC table is the lower of the two values.	The RBCs are to be considered in evaluating soil quality.
USEPA Region 9 Preliminary Remediation Goals (PRGs) for Industrial Soil	USEPA Region 9 www.epa.gov/region09/waste/sfund/prg/index.com	To Be Considered	Provides PRGs for industrial soil for screening purposes. Each PRG corresponds to an excess lifetime cancer risk of 1×10^{-6} or a non-cancer hazard quotient of 1.	The PRGs are to be considered in evaluating soil quality.
Action-Specific SCGs				
OSHA – General Industry Standards	29 CFR Part 1910	Applicable	These regulations specify the 8-hour time-weighted average concentration for worker exposure to various organic compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR 1910.120.	Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
OSHA – Safety and Health Standards	29 CFR Part 1926	Applicable	These regulations specify the type of safety equipment and procedures to be followed during site remediation.	Appropriate safety equipment will be onsite and appropriate procedures will be followed during any remedial activities.
OSHA – Recordkeeping, Reporting, and Related Regulations	29 CFR Part 1904	Applicable	These regulations outline recordkeeping and reporting requirements for an employer under OSHA.	These regulations apply to the company(s) contracted to install, operate, and maintain remedial actions at hazardous waste sites.

Table 4
(cont'd)
Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
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RCRA – General Standards	40 CFR 264	Relevant and Appropriate	General performance standards requiring minimization of need for further maintenance and control; minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products. Also requires decontamination or disposal of contaminated equipment, structures, and soils.	Proper design considerations will be implemented to minimize the need for future maintenance. Decontamination actions and facilities will be included.
RCRA – Regulated Levels for Toxic Characteristics Leaching Procedure (TCLP) Constituents	40 CFR Part 261	Applicable	These regulations specify the TCLP constituent levels for identification of hazardous waste that exhibit the characteristic of toxicity.	Excavated soil may be sampled and analyzed for TCLP constituents prior to disposal to determine if the materials are hazardous based on the characteristic of toxicity.
RCRA – Preparedness and Prevention	40 CFR Part 264 Subpart C	Relevant and Appropriate	These regulations outline requirements for safety equipment and spill control.	Safety and communication equipment will be installed at the site as necessary. Local authorities will be familiarized with the site.
Land Disposal Facility Notice in Deed	40 CFR Parts 264/265	Applicable	Establishes provisions for a deed notation for closed hazardous waste disposal units to prevent land disturbance by future owners.	The regulations are potentially applicable because closed areas may be similar to closed RCRA units.
RCRA – Contingency Plan and Emergency Procedures	40 CFR Part 264 Subpart D	Relevant and Appropriate	Provides requirements for outlining emergency procedures to be used following explosions, fires, etc.	Plans will be developed and implemented during remedial design, as appropriate. If necessary to develop, copies of the plan will be kept onsite.
Standards Applicable to Transporters of Applicable Hazardous Waste – RCRA Section 3003	40 CFR Parts 262 and 263 40 CFR Parts 170-179	Applicable	Establishes the responsibility of offsite transporters of hazardous waste in the handling, transportation, and management of the waste. Requires manifesting, recordkeeping, and immediate action in the event of a discharge.	These requirements would be applicable to any company(s) contracted to transport hazardous material from the site.

Table 4
(cont'd)
Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
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USEPA – Administered Permit Program: The Hazardous Waste Permit Program	40 CFR Part 270 RCRA Section 3005	Applicable	Covers the basic permitting, application, monitoring, and reporting requirements for offsite hazardous waste management facilities.	Any offsite facility accepting hazardous waste from the site would be properly permitted. Implementation of the site remedy would include consideration of these requirements.
Land Disposal Restrictions	40 CFR Part 268	Applicable	Restricts land disposal of hazardous wastes that exceed specific criteria. Establishes Universal Treatment Standards (UTS) to which hazardous waste must be treated prior to land disposal.	Excavated soils that exhibit the characteristics of a hazardous waste or that are decharacterized after generation must be treated to 90% constituent concentration reduction capped at 10 times the UTS.
New York Air Quality Classification System	6 NYCRR Part 256	Relevant and Appropriate	Outlines the air quality classifications for different land uses and population densities.	Air quality classification system will be referenced during the treatment process design.
National Emission Standards for Hazardous Air Pollutants (NESHAP)	40 CFR Part 61	Applicable	Provides emission standards for hazardous air pollutants.	Proper designs on air emissions controls will be implemented to meet these regulations.
New Source Performance Standards (NSPS)	40 CFR Part 60.52	Relevant and Appropriate	Provides particulate emission limits for incinerators.	Particulate emission limits should be specified for compliance.
Clean Air Act (CAA) - Ambient Air Quality Standards (NAAQS)	40 CFR Part 1 - 99	To be considered	Applies to major stationary sources such as treatment units that have the potential to emit significant amounts of pollutants.	The treatment system will be designed to meet these emission limits. If required, prevention of significant deterioration (PSD) procedures will be included in the remedial design/remedial action process.

Table 4
(cont'd)
Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
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New York Permits and Certificates	6 NYCRR Part 201	Applicable	Provides instructions and regulations for obtaining a permit to operate an air emission source. Also provides instructions on what to do in case of malfunction.	Permits are not required for remedial actions implemented at hazardous waste sites; however, documentation for relevant and appropriate permit conditions would be provided to the NYSDEC prior to and during implementation of this alternative.
New York Emissions Testing, Sampling, and Analytical Determinations	6 NYCRR Part 202	Applicable	Outlines requirements for emissions testing for air emission sources. States that independent emissions tests can be ordered by the Commissioner of the NYSDEC.	Emissions from treatment procedure must be analyzed.
New York Regulations for General Process Emissions	6 NYCRR Part 212	Applicable	Outlines the procedure of environmental rating. The Commissioner determines a rating of emissions based on sampling.	The Commissioner will issue an environmental rating for emissions based on this regulation.
Protection of Significant Deterioration of Air Quality (PSD)	40 CFR Part 51.2	Applicable	New major stationary sources may be subject to PSD review [i.e., require best available control technology (BACT), lowest achievable detection limit (LAEL), and/or emission off-sets.	If necessary, PSD procedures will be included in the remedial design/remedial action process. The procedures could be expanded to BACT and LAEL evaluations.
New York Air Quality Standards	6 NYCRR Part 257	Applicable	Provides air quality standards for different chemicals (including those found at the site), particles, and processes.	Emissions from treatment processes will meet the air quality standards.
Clean Water Act (CWA) - Discharge to Waters of the U.S. National Pollution Discharge Elimination System (NPDES)	40 CFR Part 122, 125, 403, 230, and 402 33 USC 446 Section 404	To be considered	Establishes site-specific pollutant limitations and performance standards that are designed to protect surface water quality. Types of discharges regulated under CWA include discharge to surface water, indirect discharge to POTW, and discharges of dredged or fill material into U.S. waters.	May be relevant and appropriate for remedial alternatives that include discharging water to a POTW.

Table 4
(cont'd)
Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
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Potential Federal/ State Requirements and Guidance	Citation/Reference	Potential Status	Summary of Requirements/Guidance	Considerations in Remedial Process/Action for Attainment
National Pollutant Discharge Elimination System (NPDES)	40 CFR Part 122	Applicable	These regulations detail the specific permit requirements for the discharge of pollutants to the waters of the U.S.	Any water discharged from the site would be treated and discharged in accordance with NPDES permit requirements.
New York State Pollution Discharge Elimination System (SPDES)	6 NYCRR Parts 750-758	Applicable	These regulations detail the specific permit requirements for the discharge of pollutants to the waters of New York State.	Any water discharged from the site would be treated and discharged in accordance with NYSDEC SPDES permit requirements.
New York Hazardous Waste Management System – General	6 NYCRR Part 370	Relevant and Appropriate	Provides definitions of terms and general instructions for the Part 370 series of hazardous waste management.	Hazardous waste is to be managed according to this regulation.
New York State - Identification and Listing of Hazardous Wastes	6 NYCRR Part 371	Applicable	Establishes procedures for identifying solid wastes that are subject to regulation as hazardous waste.	Materials excavated/removed from the site will be handled in accordance with RCRA and New York State hazardous waste regulations, if appropriate.
New York State - Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities	6 NYCRR Part 372	Applicable	Provides requirements relating to the use of the manifest system and its recordkeeping requirements. Also establishes requirements for proper storage of hazardous waste. Applies to hazardous waste generators, transporters, and facilities in New York State.	This regulation will be applicable to the onsite storage of generated hazardous waste (if any) and to any company(s) contracted to do treatment work or to transport hazardous materials from the site.
Standards Applicable to Transporters of Applicable Hazardous Waste – RCRA Section 3003	40 CFR Parts 262 and 263 40 CFR Parts 170-179	Applicable	Establishes the responsibility of offsite transporters of hazardous waste in the handling, transportation, and management of the waste. Requires manifesting, recordkeeping, and immediate action in the event of a discharge.	These requirements will be applicable to any company(s) contracted to transport hazardous materials from the site.

Table 4
(cont'd)
Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
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New York State - Waste Transporter Permits	6 NYCRR Part 364	Applicable	Governs the collection, transport, and delivery of regulated waste within New York State.	Properly permitted haulers will be used if any waste materials are transported offsite.
USDOT Rules for Transportation of Hazardous Materials	49 CFR Parts 107, 171.1 – 172.558	Applicable	Outlines procedures for the packaging, labeling, manifesting, and transportation of hazardous materials.	Any company contracted to transport hazardous waste from the site will be required to follow these regulations.
New York Regulations for Hazardous Waste Management Facilities	6 NYCRR Parts 373-1.1 – 373-1.8	Applicable	Provides requirements and procedures for obtaining a permit to operate a hazardous waste treatment, storage, and disposal facility (TSDF). Also lists contents and conditions of permit.	Any offsite facility accepting waste from the site must be properly permitted.
NYSDEC Technical and Administrative Guidance Memorandums (TAGM)	NYSDEC TAGMs	To be considered	TAGMs are NYSDEC guidance that are to be considered during the remedial process.	Appropriate TAGMs will be considered during the remedial process.
Location-Specific SCGs				
Local Building Permits	Not Available	Applicable	Local authorities may require a building permit for any permanent or semi-permanent structure, such as an onsite water treatment system building or a retaining wall.	If remedial activities require construction of permanent or semi-permanent structures, necessary permits will be obtained.
Sewage Treatment Plant (STP) Influent Requirements	Not Available	Applicable	Treatment plant will have requirements for waters discharged to the plant, including discharge permits.	For alternatives involving the onsite treatment of water and discharge to a STP, a discharge permit will be obtained and treatment will be performed to meet the STP influent requirements.

Table 4
(cont'd)
Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
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Potential Federal/ State Requirements and Guidance	Citation/Reference	Potential Status	Summary of Requirements/Guidance	Considerations in Remedial Process/Action for Attainment
National Historic Preservation Act	36 CFR Part 800	Applicable	Requirements for preservation of historic properties.	Activities taking place on a site on or under consideration for placement of the National Register of Historic Places must be planned to preserve the historic property and minimize harm.
Preservation of Area Containing Artifacts	36 CFR Part 65	Applicable	Requirements for preservation of historical/archeological artifacts.	Activities must be done to identify, preserve, and recover artifacts if the site has been identified as containing significant historical artifacts.
New York Preservation of Historic Structures or Artifacts	Section 14.09	Applicable	Requirements for preservation of historical/archeological artifacts.	Activities must be done to identify, preserve, and recover artifacts if the site has been identified as containing significant historical artifacts.

Table 5

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Preliminary Remedial Technology Screening Evaluation for Soil

General Response Action	Remedial Technology	Technology Process	Description	Screening Comments
No Action	No Action	No Action	Alternative would not include any remedial action.	Technically feasible.
Institutional Controls	Access Restrictions	Deed Restrictions	Deeds for the property would include restrictions on future site use and excavation of subsurface soils.	Potentially applicable.
In-Situ Containment/Control	Capping	Clay/Soil Cap	Placing and compacting clay material or soil material over areas containing constituents of concern.	Not retained. Not feasible for future site use in high traffic areas.
		Asphalt/Concrete Cap	Application of a layer of asphalt or concrete over areas containing constituents of concern.	Technically feasible.
		Multi-Media Cap	Application of clay material and a synthetic membrane over areas containing constituents of concern.	Not retained. Not feasible for future site use in high traffic areas.
	Physical Containment	Slurry Walls	Involves excavating a trench to the depth of a confining base layer while adding a slurry (e.g., soil/cement-bentonite mixture) to limit downgradient migration of constituents of interest.	Not retained. Excavation to confining base layer (located over 100 feet below grade) is not technically practical.

Table 5

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11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Preliminary Remedial Technology Screening Evaluation for Soil

General Response Action	Remedial Technology	Technology Process	Description	Screening Comments
In-Situ Containment/Control (cont'd)	Physical Containment (cont'd)	Steel Sheet Piles	Steel sheet piles are driven to the depth of a confining layer to limit downgradient migration of constituents of interest.	Not retained. Installation of sheet piling to confining base layer (located over 100 feet below grade) is not possible.
In-Situ Treatment	Immobilization	Stabilization/Solidification	Treatment process which immobilizes constituents of concern within a solid mass (monolith). A solid monolith is formed by injecting and mixing an immobilization agent into the media. A variety of agents (e.g., portland cement, lime, polymerics, proprietary agents, etc.) have been utilized and could be effective for immobilizing various constituents and media.	Not retained. Potential difficulties related to ability to provide adequate quality assurance/quality control (QA/QC) measures during implementation. Long-term stability and leaching characteristics of solidified material is unknown.
		Vitrification	Immobilizes or destroys constituents by melting the media utilizing electrical currents. The melted media then solidifies to form a glass-like monolith.	Not retained. Presence of underground utilities limits implementability.
	Extraction	Soil Flushing	Groundwater is extracted via extraction wells, passed through a treatment system (if required), extraction media is introduced into the water, and the water is then reinjected into the source areas to flush constituents from soil.	Not retained. This process is difficult to control.

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Farmingdale, New York

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Preliminary Remedial Technology Screening Evaluation for Soil

General Response Action	Remedial Technology	Technology Process	Description	Screening Comments
In-Situ Treatment (cont'd)	Extraction (cont'd)	Steam Stripping	Steam is used to remove VOCs from the media. The removed constituents are collected, recondensed, and treated.	Not retained. Presence of underground utilities and current site use inhibits this process.
		Soil Vapor Extraction	A vacuum is created to extract volatile constituents from vadose zone soils for treatment.	Technically feasible. Addresses management of soil vapors and off-site migration.
		Six-Phase Soil Heating	Electricity is applied to six subsurface electrodes to promote electrical resistive heating of soil and groundwater. This process is conducted in conjunction with soil vapor extraction (SVE) which is used to extract organic constituents volatilized by the heating process.	Not retained. Underground utilities would impede implementation of this process. Process requires large amount of surface area to implement.
		Dynamic Underground Stripping (DUS)/Hydrous Pyrolysis Oxidation (HPO)	Addition of heat (via steam injection and electrical resistive heating) to the subsurface to decrease the viscosity and increase the volitalization and mobility of residual contaminants to facilitate recovery. Process promotes in-situ biodegradation and in-situ hydrous pyrolysis oxidation (HPO).	Not retained. Presence of underground utilities limits implementability.

Table 5

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11A Picone Boulevard
Farmingdale, New York

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General Response Action	Remedial Technology	Technology Process	Description	Screening Comments
In-Situ Treatment (cont'd)	Biodegradation	Enhanced In-Situ Aerobic Biodegradation	Degradation of constituents by utilizing micro-organisms in an aerobic environment with the addition of amendments and controls to enhance the process performance and decrease duration.	Not retained. Oxygen delivery to vadose zone soils is not readily accomplished due to site conditions.
		In-Situ Anaerobic Biodegradation	Degradation of constituents by utilizing micro-organisms in an anaerobic environment.	Not retained. May not effectively address VOCs. Nitrate injection (a regulated compound) would be required which may impair groundwater quality.
	Chemical Treatment	In-Situ Chemical Oxidation	Addition of oxidizing agents (e.g., ozone, hydrogen peroxide, potassium permanganate, etc.) to degrade organic constituents to less-toxic byproducts (e.g., carbon dioxide, water, etc.).	Technically feasible. Delivery of oxidizing agents to vadose zone soil could be accomplished by use of an infiltration gallery consisting of a series of horizontal, slotted or perforated pipes buried approximately 2 feet below the ground surface.

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11A Picone Boulevard
Farmingdale, New York

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General Response Action	Remedial Technology	Technology Process	Description	Screening Comments
Removal	Excavation	Excavation	Physical removal of media containing constituents of concern to prevent future migration and exposure. Typical excavation equipment includes backhoes, loaders, and/or dozers.	Technically feasible.
Ex-Situ On-Site Treatment	Extraction	Solvent Extraction	Organic constituents (typically oils) are chemically extracted from the media using various solvents. Constituents are typically separated from the solvent and concentrated in oil phase (which may require additional management). Typically the solvent is recycled and reused.	Not retained. Process is used to remove oil present in high percentages from sludges. Extensive pretreatment may be required.
		On-Site Low-Temperature Thermal Desorption (LTTD)	Process by which soils containing organics with boiling point temperatures less than 800 degrees Fahrenheit are heated in a mobile thermal desorption unit and the organic compounds are desorbed from the soils into an induced air flow. The resulting gas is treated either by condensation and filtration or by thermal destruction.	Technically feasible.
		Steam Stripping	Steam is used to remove volatile constituents from the media. The removed constituents are collected, recondensed, and treated.	Not retained. Space at the site is limited.

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11A Picone Boulevard
Farmingdale, New York

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General Response Action	Remedial Technology	Technology Process	Description	Screening Comments
Ex-Situ On-Site Treatment (cont'd)	Recycle/Reuse	On-Site Asphalt Batching (Cold-Mix/Hot-Mix)	Impacted soil is excavated and mixed at the site with a heated asphalt emulsion and Portland cement to stabilize the VOCs in the soil. The end product material may be used as structural fill above the groundwater table.	Technically feasible.
	Thermal Destruction	On-Site Incineration	Use of a mobile incineration unit installed on-site for high-temperature thermal destruction of the organic compounds present in the media.	Not retained. Potential emissions a concern based on site's location adjacent to a residential area.
	Ex-Situ Biodegradation	Biopile	Air and amendments are circulated throughout an engineered pile of covered soil to enhance biodegradation.	Not retained. Space at the site is limited.
		Bioreactor	Amendments are mixed in a reactor to enhance the degradation of organic compounds through the use of micro-organisms in an aerobic or anaerobic environment.	Not retained. Space at the site is limited.

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Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
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General Response Action	Remedial Technology	Technology Process	Description	Screening Comments
Ex-Situ On-Site Treatment (cont'd)	Ex-Situ Biodegradation (cont'd)	Land Farming	Media is typically mixed with moisture, nutrients, and oxygen to enhance aerobic biodegradation of organic compounds.	Not retained. Space at the site is limited.
		Composting	Piles of media are created to enable oxygen, moisture, and nutrient amendments to be added in order to enhance degradation by aerobic micro-organisms.	Not retained. Space at the site is limited. Large amounts of reducing amendments may be required.
	Chemical Treatment	Oxidation	Addition of oxidation agents to degrade organic constituents to less-toxic byproducts.	Technically feasible.
	On-Site Disposal	RCRA Landfill	Construction of a landfill that would meet RCRA requirements.	Not retained. Space at the site is limited.
		Solid Waste Landfill	Construction of a landfill that would meet NYSDEC solid waste requirements.	Not retained. Space at the site is limited.

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Preliminary Remedial Technology Screening Evaluation for Soil

General Response Action	Remedial Technology	Technology Process	Description	Screening Comments
Off-Site Treatment/Disposal	Recycle/Reuse	Off-Site Asphalt Batching (Cold-Mix/Hot-Mix)	Impacted soil is excavated and mixed at an off-site facility with a heated asphalt emulsion and Portland cement to stabilize the VOCs in the soil. The end product material may be used as structural fill above the groundwater table.	Technically feasible.
		Brick/Concrete Manufacture	Soil is used as a raw material in manufacture of bricks or concrete. Heating in ovens during manufacture volatilizes organics and some inorganics. Other inorganics are bound into the product.	Not retained. Facilities capable of handling material are limited.
		Fuel Blending/Co-Burn in Utility Boiler	Soil is blended with feed coal to fire a utility boiler used to generate steam. Organics are destroyed.	Not retained. Facilities that accept residuals are limited.

Table 5

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Preliminary Remedial Technology Screening Evaluation for Soil

General Response Action	Remedial Technology	Technology Process	Description	Screening Comments
Off-Site Treatment/Disposal (cont'd)	Extraction	Low-Temperature Thermal Desorption (LTTD)	Process by which soils containing organics with boiling point temperatures less than 800 degrees Fahrenheit are heated and the organic compounds are desorbed from the soils into an induced airflow. The resulting gas is treated either by condensation and filtration or by thermal destruction.	Not retained. Identified LTTD treatment facilities are not permitted to treat soil containing PCE at the concentrations detected at the site.
	Thermal Destruction	Incineration	Process which uses high temperatures to thermally destruct organic compounds present in media.	Technically feasible.
	Chemical Treatment	Chemical Oxidation	Addition of oxidation agents to degrade organic constituents to less-toxic byproducts.	Technically feasible.
	Off-Site Disposal	RCRA Subtitle C Landfill	Disposal of media in an existing RCRA permitted landfill.	Technically feasible.
		Subtitle D Solid Waste Landfill	Disposal of media in an existing permitted non-hazardous landfill.	May be technically feasible for non-hazardous soil.

Note:

1. Shaded technologies have not been retained for further evaluation.

Table 6

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Preliminary Remedial Technology Screening Evaluation for Groundwater

General Response Action	Remedial Technology	Technology Process	Description	Screening Comments
No Action	No Action	No Action	Alternative would not include any remedial action.	Technically feasible.
Institutional Controls	Use Restrictions	Deed Restrictions/ Groundwater Use Restrictions	Deeds for the property and down gradient off-site properties may include restrictions on use of groundwater.	Potentially applicable.
In-Situ Containment/Control	Capping/Infiltration Control	Clay/Soil Cap	Placing and compacting clay material or soil material over areas containing constituents of concern to minimize infiltration of storm water.	Not retained. Not feasible for future site use in high traffic areas.
		Asphalt/Concrete Cap	Application of a layer of asphalt or concrete over areas containing constituents of concern to minimize infiltration of storm water.	Technically feasible.
		Multi-Media Cap	Application of clay material and a synthetic membrane over areas containing constituents of concern to minimize infiltration of storm water.	Not retained. Not practical for use in high traffic areas.
	Hydraulic Containment	Slurry Walls	Involves excavating a trench to the depth of a confining base layer while adding a slurry (e.g., soil/cement-betonies mixture) to limit down gradient migration.	Not retained. Excavation to confining base layer (located over 100 feet below grade) is not practical.
		Steel Sheet Piles	Steel sheet piles are driven to the depth of a confining layer to limit down gradient migration of groundwater.	Not retained. Installation of sheet piling to confining base layer (located over 100 feet below grade) is not practical.

Table 6

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Preliminary Remedial Technology Screening Evaluation for Groundwater

General Response Action	Remedial Technology	Technology Process	Description	Screening Comments
In-Situ Containment/Control (cont'd)	Hydraulic Containment (cont'd)	Grout Curtains	Holes are drilled around groundwater plumes. A grout is injected under pressure through the holes and allowed to cure to create a vertical barrier.	Not retained. Effectiveness to achieve and maintain desired permeability is limited.
In-Situ Treatment	Biodegradation	Enhanced In-Situ Aerobic Biodegradation	Degradation of constituents by utilizing aerobic micro-organisms with the addition of amendments and controls to enhance the process performance and decrease duration.	Technically feasible.
		Enhanced In-Situ Anaerobic Biodegradation	Degradation of constituents by utilizing anaerobic micro-organisms with the addition of amendments and controls to enhance the process performance and decrease duration.	Technically feasible.
	Chemical Treatment	In-Situ Chemical Oxidation (Focused Application)	Addition of oxidizing agents (e.g., ozone, hydrogen peroxide, etc.) below the water table to degrade organic constituents to less-toxic byproducts.	Technically feasible.
	Monitored Natural Attenuation	Monitored Natural Attenuation	Natural biological and physical processes that result in the reduction of concentration, toxicity, and mobility of chemical constituents. This process relies on long-term monitoring to demonstrate the reduction of impacts caused by chemical constituents.	Technically feasible.
	Physical Separation	Air Sparging	A process in which VOCs are removed through volatilization by injection of air into the subsurface below the groundwater table under controlled pressure.	Technically feasible.

Table 6

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Preliminary Remedial Technology Screening Evaluation for Groundwater

General Response Action	Remedial Technology	Technology Process	Description	Screening Comments
Extraction	Groundwater Extraction	Vertical Extraction Wells	Vertical wells are installed and utilized to recover groundwater for treatment/disposal.	Technically feasible.
		Horizontal Extraction Wells	Horizontal wells are utilized to replace conventional cluster wells in soils.	Technically feasible.
		Collection Trenches	A zone of higher permeability material is installed within the desired capture area with a perforated collection laterally placed along the base to direct groundwater to a collection area for treatment and/or disposal.	Technically feasible.
		Subsurface Drains	A high permeability channel is installed to provide groundwater collection and redirection of movement for treatment and/or disposal.	Not retained. Difficult to install due to depth to groundwater.
Ex-Situ On-Site Treatment	Chemical Treatment	Ion Exchange	Exchange of constituent cationic or anionic ions in the groundwater with ions held by an ion exchange material. Typically used to remove metallic elements and inorganic ions.	Not retained. Not proven to effectively treat organics.
		UV/Oxidation	Oxidation by subjecting groundwater to ultraviolet light and ozone.	Technically feasible.
		Chemical Oxidation	Addition of oxidizing agents to degrade organic constituents to less-toxic byproducts.	Not retained. Not practical to treat the volume of water to be extracted.

Table 6

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Preliminary Remedial Technology Screening Evaluation for Groundwater

General Response Action	Remedial Technology	Technology Process	Description	Screening Comments
Ex-Situ On-Site Treatment (cont'd)	Physical Separation	Carbon Adsorption	Process by which organic constituents are adsorbed to the carbon as groundwater is passed through carbon units.	Technically feasible.
		Air Stripping	A process in which VOCs are removed through volatilization by increasing the contact between the groundwater and air.	Technically feasible.
		Precipitation/Coagulation/Flocculation	Process which transforms dissolved constituents into insoluble solids by adding coagulating agents to facilitate subsequent removal from the liquid phase by sedimentation/ filtration. The process usually uses pH adjustment, addition of a chemical precipitant, and flocculation.	Not retained. May not effectively treat organics.
Extraction with Off-Site Treatment/Disposal	Hydraulic Control	Discharge to a local Publicly Owned Treatment Works (POTW)	Treated or untreated water is discharged to a sanitary sewer and treated at a local POTW facility.	Technically feasible.
		Discharge to Surface Water via Storm Sewer	Treated or untreated water is discharged to a surface water, provided that quality and quantity meet the allowable discharge requirements for surface waters (NYSDEC SPDES compliance).	Technically feasible.
		Reinsertion	Groundwater is extracted via extraction wells, passed through a treatment system, and is then reinvested into the ground through injection wells.	Technically feasible.

Note:

1. Shaded technologies have not been retained for further evaluation.

Table 7

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Secondary Remedial Technology Screening Evaluation for Soil

General Response Action	Remedial Technology	Technology Process	Effectiveness	Implementability
No Action	No Action	No Action	Does not achieve the RAOs for soil.	Not applicable.
Institutional Controls	Access Restrictions	Deed Restrictions	This option alone would not meet the RAOs. However, institutional controls could be used in conjunction with other remedial technologies to achieve RAOs.	Readily implementable.
In-Situ Containment/ Control	Capping	Asphalt/Concrete Cap	Effective for reducing infiltration of precipitation/surface water. Effective for reducing potential exposure to impacted surface soils. Long-term effectiveness requires ongoing maintenance and monitoring. Suitable for high-traffic areas.	The property is currently paved with an approximately 6-inch thick slab of concrete. Equipment and materials to construct a new or enhanced low-permeability asphalt/concrete cap are readily available.
In-Situ Treatment	Extraction	Soil Vapor Extraction	Effective for reducing VOC concentrations in soil.	Technically implementable.
	Chemical Treatment	In-Situ Chemical Oxidation	Effective for reducing VOC concentrations in soil provided the proper amount of oxidant reaches affected areas.	Technically implementable. Number of oxidant applications to achieve remedial goals is unknown.
Removal	Excavation	Excavation	Proven process for effectively removing unsaturated soil above the water table.	Technically implementable. Equipment capable of excavating the soil is readily available. Site conditions (i.e., presence of subsurface utilities) inhibits excavation in select areas of the site.

Table 7

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Secondary Remedial Technology Screening Evaluation for Soil

General Response Action	Remedial Technology	Technology Process	Effectiveness	Implementability
Ex-Situ On-Site Treatment	Extraction	On-Site Low-Temperature Thermal Desorption (LTTD)	Proven process for effectively treating organic compounds.	Spatial limitations at the site are potentially a limiting factor.
	Recycle/Reuse	On-Site Asphalt Batching (Cold-Mix/Hot-Mix)	Effective for treating organics and inorganics through volatilization and encapsulation. Thermal pretreatment may be required to prevent leaching. No long-term data available. Bench-scale testing would be required to determine effectiveness.	Potentially implementable. However, may not be effective in the long-term for organic constituents.
	Chemical Treatment	Chemical Oxidation	Proven process for effectively treating organic compounds.	Spatial limitations at the site are potentially a limiting factor.
Off-Site Treatment/Disposal	Recycle/Reuse	Off-Site Asphalt Batching (Cold-Mix/Hot-Mix)	Effective for treating organics and inorganics through volatilization and encapsulation. Thermal pretreatment may be required to prevent leaching. No long-term data available. Bench-scale testing would be required to determine effectiveness.	Permitted facilities are limited.

Table 7

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Secondary Remedial Technology Screening Evaluation for Soil

General Response Action	Remedial Technology	Technology Process	Effectiveness	Implementability
Off-Site Treatment/Disposal (Cont'd)	Thermal Destruction	Incineration	Proven process for effectively addressing organic constituents.	Limited number of treatment facilities, but vendors indicate availability.
	Chemical Treatment	Chemical Oxidation	Proven process for effectively treating organic compounds.	Treatment facilities are limited.
	Disposal	RCRA Subtitle C Landfill	Proven process that can effectively disposal of RCRA hazardous solid waste.	Easily implemented.
		Subtitle D Solid Waste Landfill	Proven process that can effectively disposal of non-hazardous solid waste.	Easily implemented.

Note:

1. Shaded technologies have not been retained for development of remedial alternatives.

Table 8

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Secondary Remedial Technology Screening Evaluation for Groundwater

General Response Action	Remedial Technology	Technology Process	Effectiveness	Implementability
No Action	None	None	Does not achieve the RAOs for groundwater.	Technically feasible.
Institutional Controls	Use Restrictions	Deed Restrictions/ Groundwater Use Restrictions	This option alone would not meet the RAOs. However, institutional controls could be used in conjunction with other remedial technologies to achieve RAOs.	Readily implementable. Would require coordination with off-site property owners for off-site impacts.
In-Situ Containment/ Control	Capping/Infiltration Control	Asphalt/Concrete Cap	Effective for reducing infiltration of precipitation/surface water to assist in maintaining hydraulic control. Long-term effectiveness requires ongoing maintenance and monitoring. Suitable for high-traffic areas.	The property is currently capped with an approximately 6-inch thick slab of concrete. Equipment and materials necessary to construct a new low permeability asphalt/concrete cap are readily available.
In-Situ Treatment	Biodegradation	Enhanced In-Situ Aerobic Biodegradation	Innovative technology. Process effective for addressing site-related constituents. Radius of influence surrounding injection points is uncertain. A delivery system could be designed based on available bio-geochemical data.	Not retained. Requires presence of appropriate microorganisms and nutrients, as well as appropriate environmental conditions. Microorganisms needed to break VOCs down into innocuous byproducts have not been identified at the site. Delivery of large amounts of supplemental nutrients would be required.

Table 8

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Secondary Remedial Technology Screening Evaluation for Groundwater

General Response Action	Remedial Technology	Technology Process	Effectiveness	Implementability
In-Situ Treatment (Cont'd)	Biodegradation (Cont'd)	Enhanced In-Situ Anaerobic Biodegradation	Innovative technology. Process effective for addressing site-related constituents. Radius of influence surrounding injection points is uncertain. A delivery system could be designed based on available bio-geochemical data.	Not retained. Requires presence of appropriate microorganisms and nutrients, as well as appropriate environmental conditions. Microorganisms needed to break VOCs down into innocuous byproducts have not been identified at the site. Delivery of large amounts of supplemental nutrients would be required.
	Chemical Treatment	In-Situ Chemical Oxidation (Focused Application)	Innovative technology. Process effective for addressing site-related constituents. Radius of influence surrounding injection points is uncertain. This technology is most efficiently used to reduce chemical concentrations within "hot-spot" areas. Pilot-scale testing would be required to determine effectiveness and implementability.	Effectiveness is based on the ability to deliver oxidizing agents to impacted media.
	Monitored Natural Attenuation	Monitored Natural Attenuation	Potentially achieves RAOs for offsite groundwater in conjunction with other in-situ technology such as biodegradation or chemical oxidation.	Easily implemented. Appropriate microorganisms and environmental conditions have been identified offsite.
	Physical Separation	Air Sparging	Process effective for reducing VOC concentrations in groundwater. Radius of influence of sparge wells is uncertain. Would require operation of SVE system to collect vapors originating from groundwater that enter overlying unsaturated soils.	Technically implementable.

Table 8

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Secondary Remedial Technology Screening Evaluation for Groundwater

General Response Action	Remedial Technology	Technology Process	Effectiveness	Implementability
Removal	Groundwater Removal	Vertical Extraction Wells	Proven process for effectively extracting groundwater. Implementation of this process along with treatment could effectively achieve the RAOs for groundwater.	Easily implemented.
		Horizontal Extraction Wells	Proven process for effectively extracting groundwater. Implementation of this process along with treatment could effectively achieve the RAOs for groundwater.	Not retained. Requires specialized horizontal drilling equipment. Not necessarily appropriate for the site.
		Collection Trenches	Proven process for effectively extracting groundwater. Implementation of this process along with treatment could effectively achieve the RAOs for groundwater.	Not retained. The required depth of the collection trench would likely be below the reach of excavation equipment.
Ex-Situ On-Site Treatment	Chemical Treatment	UV/Oxidation	Proven process for effectively treating organic compounds. Use of this process may effectively achieve the RAOs. May be implemented as part of process treatment train.	Not easily implemented due to limited space. Process equipment capable of performing UV/oxidation is available. A bench-scale treatability study may be required to evaluate the removal efficiency of this process and to make project-specific adjustments to the process. May require special provisions for the storage of process chemicals.

Table 8

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Secondary Remedial Technology Screening Evaluation for Groundwater

General Response Action	Remedial Technology	Technology Process	Effectiveness	Implementability
Ex-Situ On-Site Treatment (cont'd)	Physical Separation	Carbon Adsorption	Effective at removing organic constituents. Use of this process may effectively achieve the RAOs. May be implemented as part of process treatment train.	Easily implemented. Carbon adsorption process equipment is readily available. This process can be preceded by other treatment technologies to reduce the amount of carbon used.
		Air Stripping	Effective at removing volatile organic constituents. Use of this process may effectively achieve the RAOs for groundwater. May be implemented as part of process treatment train.	Easily implemented. Air stripping process equipment is readily available.
Off-Site Treatment/Disposal	Hydraulic Control	Discharge to a local Publicly Owned Treatment Works (POTW)	Potentially available process for effectively handling groundwater. Impacted groundwater would require treatment to achieve water quality criteria established by the POTW. Treated groundwater would be subject to additional treatment at the POTW.	Can potentially be implemented, subject to approval by the POTW. Equipment and materials necessary to pretreat and discharge the water to the sanitary sewer system at the site are commercially available. Discharges to the sanitary sewer must meet POTW requirements.
		Discharge to Surface Water via Storm Sewer	Potentially available process for effectively handling groundwater. Impacted groundwater would require treatment to achieve water quality discharge limits.	Can potentially be implemented, subject to approval by the sewer authority. Equipment and materials to treat and discharge the water to the storm sewer system at the site are commercially available. Discharges to surface water must meet the requirements of a SPDES permit.

Table 8

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Secondary Remedial Technology Screening Evaluation for Groundwater

General Response Action	Remedial Technology	Technology Process	Effectiveness	Implementability
Off-Site Treatment/Disposal (cont'd)	Groundwater Discharge (cont'd)	Reinsertion	Proven process for effectively discharging treated groundwater. Prior to reinjection, impacted groundwater would require treatment to achieve water quality criteria established by the NYSDEC. Groundwater reinjection may affect the ability to maintain hydraulic control under groundwater extraction and containment scenarios.	Easily implemented. Equipment and materials to treat and reinject groundwater at the site are available.

Note:

1. Shaded technologies have not been retained for development of remedial alternatives.

Table 9A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 2:
In-Situ Soil Chemical Oxidation, In-Situ Groundwater Chemical Oxidation (Focused Application), Subslab Depressurization, and Site Controls and Monitoring - Performance Standard 1

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
CAPITAL COSTS					
Common Elements					
1	Treatability Study	1	LS	$35,000	$35,000
2	Engineering Design	1	LS	$75,000	$75,000
3	Mobilization/Demobilization	1	LS	$20,000	$20,000
4	Oversight	1	LS	$50,000	$50,000
5	Permitting	1	LS	$15,000	$15,000
6	Reporting	1	LS	$50,000	$50,000
7	Waste Disposal	1	LS	$40,000	$40,000
8	Site Restoration	1	LS	$10,000	$10,000
				Subtotal Common Elements	***$295,000***
In-Situ Soil Chemical Oxidation					
9	Infiltration Gallery Installation	500	LF	$50	$25,000
10	Quarterly Oxidant Injection	3	Each	$75,000	$225,000
11	Verification Soil Sampling and Analysis	3	Events	$12,000	$36,000
				Subtotal In-Situ Soil Chemical Oxidation	***$286,000***
In-Situ Groundwater Chemical Oxidation (Focused Application)					
12	Concrete Removal	1	LS	$7,500	$7,500
13	Injection Well Installation	42	Each	$1,000	$42,000
14	Quarterly Oxidant Injection	4	Each	$110,000	$440,000
15	Quarterly Groundwater Monitoring	4	Events	$7,500	$30,000
				Subtotal In-Situ Groundwater Chemical Oxidation	***$519,500***
Subslab Depressurization System					
16	Subslab Depressurization System	1	LS	$20,000	$20,000
				Subtotal Capital Cost	***$1,120,500***
				Engineering and Administration (10%)	***$112,050***
				Contingency (20%)	***$224,100***
				Estimated Capital Cost	**$1,456,650**
ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS					
Chemical Oxidation					
17	Post-Remedial Quarterly Groundwater Monitoring and Reporting	1	LS	$60,000	$60,000
				Subtotal Annual O&M Cost	***$60,000***
				O&M Contingency (20%)	***$12,000***
				Estimated Annual O&M Cost	**$72,000**
				Present Worth Factor (Years 2&3, 7%)	**1.6897**
				Total Present Worth of Annual O&M	**$121,658**
Subslab Depressurization System					
18	O&M Labor and Electricity Usage	1	LS	$7,750	$7,750

Table 9A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 2:
In-Situ Soil Chemical Oxidation, In-Situ Groundwater Chemical Oxidation (Focused Application), Subslab Depressurization, and Site Controls and Monitoring - Performance Standard 1

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
Subtotal Annual O&M Cost					***$7,750***
O&M Contingency (20%)					***$1,550***
Estimated Annual O&M Cost					**$9,300**
Present Worth Factor (2 yrs., 7%)					**1.8080**
Total Present Worth of Annual O&M					**$16,814**
Total Estimated Cost					**$1,595,123**
Rounded To					**$1,600,000**

General Comments:

1. ***Number of oxidant applications to achieve remedial goals is unknown.***
2. All costs include labor, equipment, and materials, unless otherwise noted.
3. Costs do not include legal fees, negotiations, or oversight by the New York State Department of Environmental Conservation (NYSDEC).
4. Unit costs are in 2003 dollars and are estimated from standard estimating guides, vendors, and professional judgment and experience from other projects.
5. Costs are based on current site information and project understanding.
6. Cost estimates for the FS are for the purpose of comparing relative costs for alternatives against each other and do not represent actual design or construction cost estimates. Following the remedy selection process, record of decision, and pre-design activities, a design/construction cost estimate can be prepared.

Assumptions:

1. Treatability study cost estimate includes costs to remove a small section of concrete pavement, excavate a test pit and perform testing to evaluate potential infiltration/oxidant injection rates, and collect soil samples from the pit for soil oxidant demand testing and laboratory analysis for volatile organic compounds (VOCs). Results of investigation would be used to provide a preliminary design specification for the chemical oxidation treatment alternative, including oxidant injection rate and total volume of oxidant needed.
2. Engineering design cost estimate includes costs to prepare a basis of design document and contract drawings/specifications.
3. Mobilization/demobilization cost estimate includes costs for the mobilization and demobilization of all labor, equipment, and materials necessary to implement this remedial alternative.
4. Oversight cost estimate includes costs for engineering oversight for 2 weeks of infiltration gallery construction and 2 weeks per quarterly injection event, for a total of 8 weeks.
5. Permitting cost estimate includes costs to demonstrate compliance with the substantive permitting requirements for a SPDES/ underground injection control permit for injecting oxidant into the groundwater. Assumes that permit-related efforts will not require more than 100 hours time and costs for travel/meetings/permit fees would not exceed $5,000.
6. Reporting cost estimate includes costs to prepare a report summarizing treatment activities and results obtained for laboratory analysis of verification soil samples and quarterly groundwater samples.
7. Waste disposal cost estimate includes costs for the offsite transportation and disposal of soil removed for trenching to install the infiltration gallery, soil cuttings generated by injection well installation activities, and personal protective equipment. Cost estimate is based on 75 cubic yards (CY) of material and assumes offsite disposal as a hazardous waste at the CWM Chemical Services, LLC facility in Model City, New York. Assumes a soil density of 1.6 tons/CY. Also includes costs for the offsite transportation and disposal of miscellaneous nonhazardous waste generated during the quarterly injection events, including personal protective equipment, disposable sampling equipment, miscellaneous containers, etc.
8. Site restoration cost estimate includes costs for general site cleanup following construction of the infiltration gallery. Does not include costs to remove the infiltration gallery piping following the final treatment or abandon the injection wells.
9. Infiltration gallery installation cost estimate includes costs for installing 6 parallel runs of 2-inch diameter perforated Schedule 80 polyvinyl chloride (PVC) piping to distribute oxidant solution to soil in the vicinity of the piping. Assumes that each run of piping would be between 40 and 95 feet long, and individual piping runs would be spaced 10 feet apart. Includes costs to excavate approximately 500 feet of 2-foot wide by 2-foot deep trench for the piping installation. Cost estimate includes costs to place bedding material beneath/around the piping, imported clean backfill material above the piping, and an asphalt pavement patch at the ground surface. Cost estimate assumes that 25 CY of concrete will be removed and transported to a recycler for crushing and future use as fill material. Assumes concrete does not contain detectable levels of VOC constituents. Assumes shoring/ bracing will not be required.

Table 9A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 2:
In-Situ Soil Chemical Oxidation, In-Situ Groundwater Chemical Oxidation (Focused Application), Subslab Depressurization, and Site Controls and Monitoring - Performance Standard 1

10. Quarterly oxidant injection cost estimate includes costs to inject a potassium permanganate solution (35 grams per liter KMNO4) into each of the 6 injection gallery lines at a rate of approximately 1.5 gallons per minute per line. Assumes that 9 days would be required for each quarterly injection event. The oxidant solution would be prepared in 5,000 gallon batches (in a 5,000 gallon) frac tank. Approximately 40,000 gallons of oxidant solution would be required for each quarterly injection event at a cost of approximately $16,500 per event. The estimated cost for labor and equipment for each quarterly injection event is $40,000. Assumes a total of 5 tons of potassium permanganate would be required for each quarterly injection event. Cost estimate also includes an additional $15,000 per injection event for uncertainties associated with oxidant demand.
11. Verification soil sampling and analysis cost estimate includes costs for soil boring and sampling activities after each injection event to evaluate the reduction in VOC soil concentrations. Assumes the installation of 12 soil borings to a depth of approximately 15 feet and the collection of two soil samples per boring for laboratory analysis for VOCs following each injection event.
12. Concrete removal cost estimate includes costs to saw cut and remove concrete at proposed injection well cluster locations. Assumes concrete debris would be transported for offsite use as fill material. Assumes concrete does not contain detectable levels of VOCs.
13. Injection well installation cost estimate includes costs to install injection well clusters (2 wells per cluster) in a 100-foot-wide by 150-foot-long area. Assumes well clusters would be arranged in 6 rows with up to 4 well clusters per row. Spacing between well clusters is assumed to be approximately 25 feet. Individual wells would be a maximum of 40 feet deep. Includes costs for concrete curb boxes at each well cluster location.
14. Quarterly oxidant injection cost estimate includes costs to inject a potassium permanganate solution (35 grams per liter KMnO4) into each injection well at a rate of approximately 5 gallons per minute per well for a total of 5.5 hours per well per event. Assumes that 8 days would be required for each quarterly injection event. The oxidant solution would be prepared in 5,000 gallon batches (in a 5,000 gallon frac tank). Approximately 85,500 gallons of oxidant solution would be required for each quarterly injection event at a cost of approximately $45,000 per event. The estimated cost for labor and equipment for each quarterly injection event is $35,000. Assumes a total of 12.5 tons of potassium permanganate would be required for each quarterly injection event. Cost estimate includes an additional $30,000 per injection event for uncertainties associated with oxidant demand.
15. Quarterly groundwater monitoring cost estimate includes costs for collecting groundwater samples for field screening and laboratory analysis for VOCs on a quarterly basis for a period of one year at a cost of $7,500 per monitoring event. Assumes sampling would be conducted immediately prior to each treatment.
16. Subslab depressurization system cost estimate includes costs for engineering coordination ($5,000), oversight ($1,200), high suction fan ($2,000), 150 lineal feet conveyance/header piping ($1,800), miscellaneous pipe fittings/gate valves ($900), subcontractor testing/oversight ($840), two 200 pound vapor phase drum-type carbon vessels ($1,300), mechanical/electrical installation ($1,300), and abatement system startup ($5,000).

17. Post-remedial groundwater monitoring and reporting cost estimate includes costs for collecting groundwater samples at the site groundwater monitoring well network on a quarterly basis beginning approximately 3 months following the final oxidant injection event. Groundwater field parameter measurements would be obtained and samples would be submitted for laboratory analysis for VOCs. Includes preparation of two annual groundwater monitoring reports to summarize the first and second year's quarterly monitoring activities.
18. Subslab depressurization system annual O&M labor based on bi-monthly site visits (every other month) to field screen vapors removed by the system and perform indoor sampling (6 visits/year @ $1,250/visit = $7,500) and electricity costs ($250).

Additional Assumptions:

1. Cost estimate assumes an average total organic carbon concentration of 1,000 to 2,000 ppm, a total mass of VOCs in the soil of less than 500 pounds, and no non-aqueous phase liquid (NAPL) in the soil/groundwater.
2. Assumes the oxidant demand for the sand and gravel soil at the HWD site does not exceed 3 grams per kilogram (g/Kg).
3. Cost estimate also assumes groundwater plume of VOCs is 100 feet wide (perpendicular to the groundwater flow direction) by 150 feet long (parallel to groundwater flow direction) and is 30 feet thick. Assumes that the average organic carbon fraction is 0.001.
4. Cost estimate assumes that treatment can be completed in a one year timeframe based on the estimated mass of VOCs assumed to be present in the vadose-zone soil/dissolved phase and the stoichiometric relationship for the amount of oxidant required to destroy the estimated total mass of VOCs. Assumes an oxidant efficiency of under 20% and an oxidant loading factor of safety of 1.25. Assumes there would be no re-bound in groundwater VOC concentrations after the final (fourth) treatment.
5. Assumes that redox-sensitive metals such as arsenic, chromium, and selenium will not be identified in groundwater at concentrations exceeding groundwater quality standards following the oxidant injection events.
6. Cost estimate assumes a soil infiltration rate of 10 inches per hour.
7. Cost estimate assumes that off-gas treatment would not be required in connection with treatment.

Table 9B

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 2:
In-Situ Soil Chemical Oxidation, In-Situ Groundwater Chemical Oxidation (Focused Application), Subslab Depressurization, and Site Controls and Monitoring - Performance Standard 2

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
CAPITAL COSTS					
Common Elements					
1	Treatability Study	1	LS	$35,000	$35,000
2	Engineering Design	1	LS	$75,000	$75,000
3	Mobilization/Demobilization	1	LS	$20,000	$20,000
4	Oversight	1	LS	$50,000	$50,000
5	Permitting	1	LS	$15,000	$15,000
6	Reporting	1	LS	$50,000	$50,000
7	Waste Disposal	1	LS	$40,000	$40,000
8	Site Restoration	1	LS	$10,000	$10,000
				Subtotal Common Elements	***$295,000***
In-Situ Soil Chemical Oxidation					
9	Infiltration Gallery Installation	500	LF	$50	$25,000
10	Quarterly Oxidant Injection	4	Each	$75,000	$300,000
11	Verification Soil Sampling and Analysis	4	Events	$12,000	$48,000
				Subtotal In-Situ Soil Chemical Oxidation	***$373,000***
In-Situ Groundwater Chemical Oxidation (Focused Application)					
12	Concrete Removal	1	LS	$7,500	$7,500
13	Injection Well Installation	42	Each	$1,000	$42,000
14	Quarterly Oxidant Injection	5	Each	$110,000	$550,000
15	Quarterly Groundwater Monitoring	5	Events	$7,500	$37,500
				Subtotal In-Situ Groundwater Chemical Oxidation	***$637,000***
Subslab Depressurization System					
16	Subslab Depressurization System	1	LS	$20,000	$20,000
				Subtotal Capital Cost	***$1,325,000***
				Engineering and Administration (10%)	***$132,500***
				Contingency (20%)	***$265,000***
				Estimated Capital Cost	**$1,722,500**
ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS					
Chemical Oxidation					
17	Post-Remedial Quarterly Groundwater Monitoring and Reporting	1	LS	$60,000	$60,000
				Subtotal Annual O&M Cost	***$60,000***
				O&M Contingency (20%)	***$12,000***
				Estimated Annual O&M Cost	**$72,000**
				Present Worth Factor (Years 2&3, 7%)	**1.6897**
				Total Present Worth of Annual O&M	**$121,658**
Subslab Depressurization System					
18	O&M Labor and Electricity Usage	1	LS	$7,750	$7,750

Table 9B

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 2:
In-Situ Soil Chemical Oxidation, In-Situ Groundwater Chemical Oxidation (Focused Application), Subslab Depressurization, and Site Controls and Monitoring - Performance Standard 2

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
				Subtotal Annual O&M Cost	*$7,750*
				O&M Contingency (20%)	*$1,550*
				Estimated Annual O&M Cost	**$9,300**
				Present Worth Factor (2 yrs., 7%)	**1.8080**
				Total Present Worth of Annual O&M	**$16,814**
				Total Estimated Cost	**$1,860,973**
				Rounded To	**$1,870,000**

General Comments:

See general comments under Table 9A.

Assumptions:

Assumptions under Table 9A are applicable, except:
1. Four quarterly oxidation injection events are anticipated for soil treatment to achieve Endpoint 2.
2. Five quarterly oxidant injection events are anticipated for groundwater treatment to achieve Endpoint 2.

Table 10A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 3:
Soil Vapor Extraction, In-Situ Groundwater Chemical Oxidation (Focused Application), and Site Controls and Monitoring - Performance Standard 1

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
CAPITAL COSTS					
Common Elements					
1	Engineering Design	1	LS	$75,000	$75,000
2	Mobilization/Demobilization	1	LS	$25,000	$25,000
3	Oversight	1	LS	$55,000	$55,000
4	Permitting	1	LS	$30,000	$30,000
5	Waste Disposal	1	LS	$40,000	$40,000
6	Site Restoration	1	LS	$10,000	$10,000
				Subtotal Common Elements	***$235,000***
Soil Vapor Extraction					
7	Soil Vapor Extraction System Pilot Study	1	LS	$30,000	$30,000
8	Soil Vapor Extraction System Wells	7	Each	$2,500	$17,500
9	Conveyance Piping	325	LF	$50	$16,250
10	Soil Vapor Extraction System Equipment and Installation	1	LS	$85,000	$85,000
11	Soil Vapor Extraction System Startup	1	LS	$12,000	$12,000
				Subtotal Soil Vapor Extraction	***$160,750***
In-Situ Groundwater Chemical Oxidation (Focused Application)					
12	Treatability Study	1	LS	$35,000	$35,000
13	Concrete Removal	1	LS	$7,500	$7,500
14	Injection Well Installation	42	Each	$1,000	$42,000
15	Engineering Observation	8	Days	$1,500	$12,000
16	Quarterly Oxidant Injection	4	Each	$110,000	$440,000
17	Quarterly Groundwater Monitoring	4	Events	$7,500	$30,000
18	Reporting	1	LS	$30,000	$30,000
				Subtotal Groundwater Chemical Oxidation	***$596,500***
				Subtotal Capital Cost	***$992,250***
				Engineering and Administration (10%)	***$99,225***
				Contingency (20%)	***$198,450***
				Estimated Capital Cost	**$1,289,925**
ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS					
Soil Vapor Extraction					
19	Soil Vapor Extraction System O&M	1	LS	$65,000	$65,000
20	Annual Reporting	1	LS	$20,000	$20,000
				Subtotal Annual O&M Cost	***$85,000***
				O&M Contingency (20%)	***$17,000***
				Estimated Annual O&M Cost	**$102,000**
				Present Worth Factor (5 yrs., 7%)	**4.1002**
				Total Present Worth of Annual O&M	**$418,220**

Table 10A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 3:
Soil Vapor Extraction, In-Situ Groundwater Chemical Oxidation (Focused Application), and Site Controls and Monitoring - Performance Standard 1

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
In-Situ Groundwater Chemical Oxidation (Focused Application)					
21	Post-Remedial Quarterly Groundwater Monitoring and Reporting	1	LS	$60,000	$60,000
				Subtotal Annual O&M Cost	***$60,000***
				O&M Contingency (20%)	***$12,000***
				Estimated Annual O&M Cost	**$72,000**
				Present Worth Factor (Years 7&8, 7%)	**1.2047**
				Total Present Worth of Annual O&M	**$86,738**
				Total Estimated Cost	**$1,794,884**
				Rounded To	**$1,800,000**

General Comments:

1. All costs include labor, equipment, and materials, unless otherwise noted.
2. Costs do not include legal fees, negotiations, or oversight by the New York State Department of Environmental Conservation (NYSDEC).
3. Unit costs are in 2003 dollars and are estimated from standard estimating guides, vendors, and professional judgment and experience from other projects.
4. Costs are based on current site information and project understanding.
5. Cost estimates for the FS are for the purpose of comparing relative costs for alternatives against each other and do not represent actual design or construction cost estimates. Following the remedy selection process, record of decision, and pre-design activities, a design/construction cost estimate can be prepared.

Assumptions:

1. Engineering design cost estimate includes costs to prepare a basis of design document and contract drawings/specifications.
2. Mobilization/demobilization cost estimate includes costs for the mobilization and demobilization of all labor, equipment, and materials necessary to implement this remedial alternative.
3. Oversight cost estimate includes costs for engineering oversight of remedial construction activities and quarterly injection activities for this alternative. Cost estimate is based on 3 weeks of field time for the soil vapor extraction (SVE) system construction. Cost estimate is also based on field time for four quarterly groundwater chemical oxidation injection events at 100 hours per event.
4. Permitting cost estimate includes costs to obtain an air discharge permit from the NYSDEC for the SVE system. Also includes costs to demonstrate compliance with the substantive permitting requirements for a SPDES/underground injection control permit for injecting oxidant into the groundwater. Assumes that permit-related efforts will not require more than 100 hours time and costs for travel/meetings/permit fees would not exceed $5,000.
5. Waste disposal cost estimate includes costs for the offsite transportation and disposal of soil removed for trenching to install the SVE conveyance piping, soil cuttings generated by well installation activities, and personal protective equipment. Cost estimate is based on 75 cubic yards (CY) of material and assumes offsite disposal as a hazardous waste at the CWM Chemical Services, LLC facility in Model City, New York. Assumes a soil density of 1.6 tons/CY. Also includes costs for the offsite transportation and disposal of miscellaneous nonhazardous waste generated during the quarterly injection events, including personal protective equipment, disposable sampling equipment, miscellaneous containers, etc.
6. Site restoration cost estimate includes costs for general site cleanup following construction of the SVE treatment system. Does not include costs to abandon the SVE wells, remove the conveyance piping, and remove all treatment system components. Also does not include costs to abandon the chemical oxidation injection wells.

Feasibility Study Report
Cost Estimate for Alternative 3:
Soil Vapor Extraction, In-Situ Groundwater Chemical Oxidation (Focused Application), and Site Controls and Monitoring - Performance Standard 1

7. Soil vapor extraction system pilot study and design cost estimate includes costs for a pilot study that would include the use of a rented blower to extract vapors from one or two SVE wells to further evaluate the soil permeability and volatile organic compound (VOC) mass removal rate. Costs for the SVE wells are included under Item No. 8.
8. Soil vapor extraction system wells cost estimate includes costs for 6 vertical SVE wells, placed in two rows and spaced approximately 30 feet apart. Assumes each well would be approximately 12 feet deep and be constructed using 4-inch diameter polyvinvyl chloride (PVC) piping. Assumes a radius of influence of greater than 20-feet per well. Also includes one SVE well to capture subsurface vapors potentially migrating through soil beneath the R&D building floor slab.
9. Conveyance piping cost estimate includes costs for excavating approximately 325 feet of 2-foot wide by 4-foot deep trench and installing 4-inch diameter PVC conveyance piping in the trench to convey extracted soil vapor to an SVE treatment system in the southwest corner of the site. Cost estimate includes costs for placing bedding material beneath/around the piping, imported clean backfill material above the piping, and an asphalt pavement patch at the ground surface. Cost estimate assumes approximately 33 CY of concrete will be removed and transported to a recycler for crushing and future use as fill material. Assumes concrete does not contain detectable levels of VOC constituents. Does not include costs for providing temporary shoring/bracing in the trench.
10. Soil vapor extraction system equipment and installation cost estimate includes costs for a 10 to 15 horsepower rotary lobe blower to deliver an estimated air flow rate of 750 cubic feet per minute (CFM) at approximately 20-inches water column, a vapor/liquid separator module (knock-out pot), control panel, and 8-foot wide by 20-foot long skid-mounted steel framed enclosure for approximately $40,000. Cost estimate also includes two 2,000 pound skid-mounted vapor-phase granular-activated carbon filters/vessels equipped with piping/flex hoses and sample ports for approximately $15,000. Includes approximately $5,000 for establishing electrical service, $15,000 for mechanical installation, and $10,000 for miscellaneous expenses.
11. Soil vapor extraction system startup cost estimate includes costs to startup the treatment system, including making any necessary adjustments to air flow rates from header lines and performing troubleshooting, as needed. Cost estimate is based on 3 site visits during the first week of operation, 2 site visits during the second week of operation, and 1 site visit during the third and fourth weeks of operation at $1,200 per visit.
12. Treatability study cost estimate includes costs to conduct a treatability study to evaluate oxidant demand and provide a preliminary design specification for oxidant application.
13. Concrete removal cost estimate includes costs to saw cut and remove concrete at proposed injection well cluster locations. Assumes concrete debris would be transported for offsite use as fill material. Assumes concrete does not contain detectable levels of VOCs.
14. Injection well installation cost estimate includes costs to install injection well clusters (2 wells per cluster) in a 100-foot-wide by 150-foot-long area. Assumes well clusters would be arranged in 6 rows with up to 4 well clusters per row. Spacing between well clusters is assumed to be approximately 25 feet. Individual wells would be a maximum of 40 feet deep. Includes costs for concrete curb boxes at each well cluster location.
15. Engineering observation cost estimate includes costs for an onsite engineer/geologist to characterize soil encountered during well installation activities and coordinate the installation of the injection wells.
16. Quarterly oxidant injection cost estimate includes costs to inject a potassium permanganate solution (35 grams per liter $KMnO_4$) into each injection well at a rate of approximately 5 gallons per minute per well for a total of 5.5 hours per well per event. Assumes that 8 days would be required for each quarterly injection event. The oxidant solution would be prepared in 5,000 gallon batches (in a 5,000 gallon frac tank). Approximately 85,500 gallons of oxidant solution would be required for each quarterly injection event at a cost of approximately $45,000 per event. The estimated cost for labor and equipment for each quarterly injection event is $35,000. Assumes a total of 12.5 tons of potassium permanganate would be required for each quarterly injection event. Cost estimate includes an additional $30,000 per injection event for uncertainties associated with oxidant demand.
17. Quarterly groundwater monitoring cost estimate includes costs for collecting groundwater samples for field screening and laboratory analysis for VOCs on a quarterly basis for a period of one year at a cost of $7,500 per monitoring event. Assumes sampling would be conducted immediately prior to each treatment.

Table 10A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 3:
Soil Vapor Extraction, In-Situ Groundwater Chemical Oxidation (Focused Application), and Site Controls and Monitoring - Performance Standard 1

18. Reporting cost estimate includes costs to prepare an annual report documenting the groundwater treatment and results for the quarterly groundwater monitoring.
19. Soil vapor extraction system O&M cost estimate includes costs for bi-monthly site visits to inspect treatment system components, evaluate treatment system performance (i.e., conduct screening using a photoionization detector), and make necessary adjustments. Cost estimate includes 24 site visits per year at a cost of $1,200 per visit ($30,000 per year). Cost estimate also includes annual changeout of 2,000 pounds of carbon at $1.50 per pound ($3,000 per year), electricity to operate the treatment sytem ($10,000 per year), and coordination/miscellaneous repairs ($20,000 per year). It is assumed that carbon changeout will not be required more than once per year based on the estimated total mass of VOCs in the soil (less than 500 pounds) and a conservative estimated carbon adsorption efficiency of 10%.
20. Annual reporting cost estimate includes costs to prepare annual reports to summarize treatment system operation and maintenance activities performed, and results obtained for performance monitoring and final verification sampling.
21. Post-remedial groundwater monitoring and reporting cost estimate includes costs for collecting groundwater samples at the site groundwater monitoring well network on a quarterly basis beginning approximately 3 months following the final oxidant injection event. Groundwater field parameter measurements would be obtained and samples would be submitted for laboratory analysis for VOCs. Includes preparation of two annual groundwater monitoring reports to summarize the first and second year's quarterly monitoring activities.

Additional Assumptions:

1. Cost estimate is based on SVE system operating for 5 years.
2. Cost estimate assumes that the in-siu groundwater chemical oxidation treatment can be completed in a one year timeframe based on the estimated mass of VOCs assumed to be present in the dissolved phase and sorbed phase and the stoichiometric relationship for the amount of oxidant required to destroy the estimated total mass of VOCs. Assumes an oxidant efficiency of under 20% and an oxidant loading factor of safety of 1.25. Assumes there would be no re-bound in VOC concentrations after the final (fourth) treatment.
3. Cost estimate assumes that there is no non-aqueous phase liquid (NAPL) in the soil/groundwater. Also assumes that redox sensitive metals such as arsenic, chromium, and selenium will not be identified in groundwater at concentrations exceeding groundwater quality standards following the oxidant injection events.
4. Cost estimate also assumes groundwater plume of VOCs is 100 feet wide (perpendicular to the groundwater flow direction) by 150 feet long (parallel to groundwater flow direction) and is 30 feet thick. Assumes that the average organic carbon fraction is 0.001.
5. Assumes the oxidant demand for the saturated soil does not exceed 1 gram per kilogram (g/Kg).

Table 10B

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 3:
Soil Vapor Extraction, In-Situ Groundwater Chemical Oxidation (Focused Application), and Site Controls and Monitoring - Performance Standard 2

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
CAPITAL COSTS					
Common Elements					
1	Engineering Design	1	LS	$75,000	$75,000
2	Mobilization/Demobilization	1	LS	$25,000	$25,000
3	Oversight	1	LS	$55,000	$55,000
4	Permitting	1	LS	$30,000	$30,000
5	Waste Disposal	1	LS	$40,000	$40,000
6	Site Restoration	1	LS	$10,000	$10,000
				Subtotal Common Elements	***$235,000***
Soil Vapor Extraction					
7	Soil Vapor Extraction System Pilot Study	1	LS	$30,000	$30,000
8	Soil Vapor Extraction System Wells	7	Each	$2,500	$17,500
9	Conveyance Piping	325	LF	$50	$16,250
10	Soil Vapor Extraction System Equipment and Installation	1	LS	$85,000	$85,000
11	Soil Vapor Extraction System Startup	1	LS	$12,000	$12,000
				Subtotal Soil Vapor Extraction	***$160,750***
In-Situ Groundwater Chemical Oxidation (Focused Application)					
12	Treatability Study	1	LS	$35,000	$35,000
13	Concrete Removal	1	LS	$7,500	$7,500
14	Injection Well Installation	42	Each	$1,000	$42,000
15	Engineering Observation	8	Days	$1,500	$12,000
16	Quarterly Oxidant Injection	5	Each	$110,000	$550,000
17	Quarterly Groundwater Monitoring	5	Events	$7,500	$37,500
18	Reporting	1	LS	$30,000	$30,000
				Subtotal Groundwater Chemical Oxidation	***$714,000***
				Subtotal Capital Cost	***$1,109,750***
				Engineering and Administration (10%)	***$110,975***
				Contingency (20%)	***$221,950***
				Estimated Capital Cost	**$1,442,675**
ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS					
Soil Vapor Extraction					
19	Soil Vapor Extraction System O&M	1	LS	$65,000	$65,000
20	Annual Reporting	1	LS	$20,000	$20,000
				Subtotal Annual O&M Cost	***$85,000***
				O&M Contingency (20%)	***$17,000***
				Estimated Annual O&M Cost	**$102,000**
				Present Worth Factor (6 yrs., 7%)	**4.7655**
				Total Present Worth of Annual O&M	**$486,081**

Table 10B

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 3:
Soil Vapor Extraction, In-Situ Groundwater Chemical Oxidation (Focused Application), and Site Controls and Monitoring - Performance Standard 2

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
In-Situ Groundwater Chemical Oxidation (Focused Application)					
21	Post-Remedial Quarterly Groundwater Monitoring and Reporting	1	LS	$60,000	$60,000
				Subtotal Annual O&M Cost	***$60,000***
				O&M Contingency (20%)	***$12,000***
				Estimated Annual O&M Cost	**$72,000**
				Present Worth Factor (Years 8&9, 7%)	**1.1259**
				Total Present Worth of Annual O&M	**$81,065**
				Total Estimated Cost	**$2,009,821**
				Rounded To	**$2,010,000**

General Comments:

See general comments under Table 10A.

Assumptions:

Assumptions under Table 10A are applicable, except:

1. SVE treatment system is anticipated to operate for six years to achieve Endpoint 2.
2. Five quarterly oxidant injection events are anticipated for groundwater treatment to achieve Endpoint 2.

Table 11A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 4:
Soil Vapor Extraction, Groundwater Air Sparging, and Site Controls and Monitoring - Performance Standard 1

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
CAPITAL COSTS					
Common Elements					
1	Pilot Studies	1	LS	$75,000	$75,000
2	Engineering Design	1	LS	$75,000	$75,000
3	Mobilization/Demobilization	1	LS	$25,000	$25,000
4	Oversight	1	LS	$55,000	$55,000
5	Permitting	1	LS	$30,000	$30,000
6	System Startup	1	LS	$25,000	$25,000
7	Construction Report	1	LS	$25,000	$25,000
8	Waste Disposal	1	LS	$70,000	$70,000
9	Site Restoration	1	LS	$10,000	$10,000
				Subtotal Common Elements	***$390,000***
Soil Vapor Extraction					
10	SVE System Wells	13	Each	$2,500	$32,500
11	SVE Conveyance Piping	525	LF	$50	$26,250
12	SVE Equipment and Installation	1	LS	$95,000	$95,000
				Subtotal Soil Vapor Extraction	***$153,750***
Groundwater Air Sparging					
13	AS System Wells	22	Each	$2,500	$55,000
14	AS Conveyance Piping	250	LF	$50	$12,500
15	AS System Equipment and Installation	1	LS	$35,000	$35,000
				Subtotal Groundwater Air Sparging	***$102,500***
				Subtotal Capital Cost	***$646,250***
				Engineering and Administration (10%)	***$64,625***
				Contingency (20%)	***$129,250***
				Estimated Capital Cost	**$840,125**
ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS					
16	AS/SVE System O&M	1	LS	$125,000	$125,000
17	Groundwater Monitoring	1	LS	$30,000	$30,000
18	Annual Reporting	1	LS	$30,000	$30,000
				Subtotal Annual O&M Cost	***$185,000***
				O&M Contingency (20%)	***$37,000***
				Estimated Annual O&M Cost	**$222,000**
				Present Worth Factor (Years 1-10, 7%)	**7.0236**
				Total Present Worth of Annual O&M	**$1,559,239**
				Total Estimated Cost	**$2,399,364**
				Rounded To	**$2,400,000**

Table 11A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 4:
Soil Vapor Extraction, Groundwater Air Sparging, and Site Controls and Monitoring - Performance Standard 1

General Comments:

1. All costs include labor, equipment, and materials, unless otherwise noted.
2. Costs do not include legal fees, negotiations, or oversight by the New York State Department of Environmental Conservation (NYSDEC).
3. Unit costs are in 2004 dollars and are estimated from standard estimating guides, vendors, and professional judgment and experience from other projects.
4. Costs are based on current site information and project understanding.
5. Cost estimates for the FS are for the purpose of comparing relative costs for alternatives against each other and do not represent actual design or construction cost estimates. Following the remedy selection process, record of decision, and pre-design activities, a design/construction cost estimate can be prepared.

Assumptions:

1. Pilot studies estimate include costs for pilot studies that would include the use of rented equipment to extract vapors from one or two soil vapor extraction (SVE) wells to further evaluate the soil permeability and volatile organic compound (VOC) mass removal rate. Also includes costs for rental equipment required to perform an air sparging (AS) pilot test in conjunction with the SVE pilot test.
2. Engineering design cost estimate includes costs to prepare a basis of design document and contract drawings/specifications.
3. Mobilization/demobilization cost estimate includes costs for the mobilization and demobilization of all labor, equipment, and materials necessary to implement this remedial alternative.
4. Oversight cost estimate includes costs for engineering oversight of remedial construction activities for this alternative. Cost estimate is based on 3 weeks of field time for the AS/SVE system construction.
5. Permitting cost estimate includes costs to obtain an air discharge permit from the NYSDEC for the SVE system. Assumes that permit-related efforts will not require more than 100 hours time and costs for travel/meetings/permit fees would not exceed $5,000.
6. AS/SVE system startup cost estimate includes costs to startup the treatment system, including making any necessary adjustments to air flow rates from header lines and performing troubleshooting, as needed. Cost estimate is based on 3 site visits during the first week of operation, 2 site visits during the second week of operation, and 1 site visit during the third and fourth weeks of operation at $1,200 per visit.
7. Construction report cost estimate includes costs to prepare as-built drawings and a report summarizing the remedial alternative construction.
8. Waste disposal cost estimate includes costs for the offsite transportation and disposal of soil removed for trenching to install the AS and SVE conveyance piping, soil cuttings generated by well installation activities, and personal protective equipment. Cost estimate is based on 150 cubic yards (CY) of material and assumes offsite disposal as a hazardous waste at the CWM Chemical Services, LLC facility in Model City, New York. Assumes a soil density of 1.6 tons/CY.
9. Site restoration cost estimate includes costs for general site cleanup following construction of the AS/SVE treatment system. Does not include costs to abandon the AS/SVE wells, remove the conveyance piping, and remove all treatment system components.
10. SVE system wells cost estimate includes costs for 12 vertical SVE wells, placed in 3 rows and spaced approximately 35 feet apart. Assumes each well would be approximately 12 feet deep and be constructed using 4-inch diameter polyvinyl chloride (PVC) piping. Assumes a radius of influence of greater than 25-feet per well.
    Also includes one SVE well to capture subsurface vapors potentially migrating through soil beneath the R&D building floor slab.

Table 11A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 4:
Soil Vapor Extraction, Groundwater Air Sparging, and Site Controls and Monitoring - Performance Standard 1

11. SVE conveyance piping cost estimate includes costs for excavating approximately 450 feet of 2-foot wide by 3-foot deep trench and installing 4-inch diameter PVC conveyance piping in the trench to convey extracted soil vapor to an SVE treatment system in the southeast corner of the site. Cost estimate includes costs for placing bedding material beneath/around the piping, and an asphalt pavement patch at the ground surface. Cost estimate assumes approximately 35 CY of concrete will be removed and transported to a recycler for crushing and future use as fill material. Assumes concrete does not contain detectable levels of VOC constituents. Does not include costs for providing temporary shoring/bracing in the trench.
12. SVE system equipment and installation cost estimate includes costs for a 40 horsepower rotary lobe blower to deliver an estimated air flow rate of 1,200 cubic feet per minute (CFM) at approximately 20-inches water column, a vapor/liquid separator module (knock-out pot), control panel, and 8-foot wide by 20-foot long skid-mounted steel framed enclosure for approximately $50,000. Cost estimate also includes two 2,000 pound skid-mounted vapor-phase granular-activated carbon filters/vessels equipped with piping/flex hoses and sample ports for approximately $15,000. Includes approximately $5,000 for establishing electrical service, $15,000 for mechanical installation, and $10,000 for miscellaneous expenses.
13. AS system wells cost estimate includes costs for 22 air sparge wells, placed in four rows and spaced approximately 25 feet apart. Assumes each well would be approximately 30 feet deep and be constructed using 2-inch diameter PVC piping.
14. AS conveyance piping cost estimate includes costs for 2-inch diameter PVC conveyance piping in 325 feet of the same trench used for SVE conveyance piping. Also includes costs for an additional 250 feet of trenching and AS conveyance piping installation.
15. AS system equipment and installation cost estimate includes costs for two 25 horsepower two-stage stationary blowers/ compressors to each deliver an estimated air flow rate of 110 CFM total, or 5 CFM per well, at approximately 15 pounds per square inch (psi) air pressure. Assumes compressors would be housed in the same enclosure as the SVE system equipment, upgraded to an 8-foot wide by 30-foot long size. Includes an additional $15,000 on top of the SVE system equipment cost for mechanical installation and miscellaneous expenses.
16. AS/SVE O&M cost estimate includes costs for bi-monthly site visits to inspect treatment system components, evaluate treatment system performance (i.e., conduct screening using a photoionization detector), and make necessary adjustments. Cost estimate includes 24 site visits per year at a cost of $1,200 per visit ($30,000 per year). Cost estimate also includes annual changeout of 12,000 pounds of carbon at $1.50 per pound ($18,000 per year), electricity to operate the treatment system ($45,000 per year), and coordination/miscellaneous repairs ($30,000 per year). It is assumed that carbon changeout will not be required more than once per year based on the estimated total mass of VOCs in the unsaturated and saturated soil and a conservative estimated carbon adsorption efficiency of 10%.
17. Annual groundwater monitoring cost estimate includes costs for collecting groundwater samples at the site groundwater monitoring well network on a quarterly basis each year. Assumes field parameters will be measured and samples will be submitted for laboratory analysis for VOCs.
18. Annual reporting cost estimate includes costs to prepare annual reports to summarize AS/SVE system operation and maintenance activities performed, results obtained for SVE performance monitoring and verification sampling, and results obtained for quarterly groundwater monitoring activities.

Additional Assumptions:

1. Cost estimate is based on AS/SVE system operating for 10 years.
2. Assumes there would be no re-bound in VOC concentrations after 10 years of operation and maintenance.
3. Cost estimate also assumes groundwater plume of VOCs is 100 feet wide (perpendicular to the groundwater flow direction) by 150 feet long (parallel to groundwater flow direction) and is 30 feet thick.

Table 11B

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 4:
Soil Vapor Extraction, Groundwater Air Sparging, and Site Controls and Monitoring - Performance Standard 2

Item #	**Description**	**Estimated Quantity**	**Unit**	**Unit Price**	**Estimated Amount**
CAPITAL COSTS					
Common Elements					
1	Pilot Studies	1	LS	$75,000	$75,000
2	Engineering Design	1	LS	$75,000	$75,000
3	Mobilization/Demobilization	1	LS	$25,000	$25,000
4	Oversight	1	LS	$55,000	$55,000
5	Permitting	1	LS	$30,000	$30,000
6	System Startup	1	LS	$25,000	$25,000
7	Construction Report	1	LS	$25,000	$25,000
8	Waste Disposal	1	LS	$70,000	$70,000
9	Site Restoration	1	LS	$10,000	$10,000
				Subtotal Common Elements	***$390,000***
Soil Vapor Extraction					
10	SVE System Wells	13	Each	$2,500	$32,500
11	SVE Conveyance Piping	525	LF	$50	$26,250
12	SVE Equipment and Installation	1	LS	$95,000	$95,000
				Subtotal Soil Vapor Extraction	***$153,750***
Groundwater Air Sparging					
13	AS System Wells	22	Each	$2,500	$55,000
14	AS Conveyance Piping	250	LF	$50	$12,500
15	AS System Equipment and Installation	1	LS	$35,000	$35,000
				Subtotal Groundwater Air Sparging	***$102,500***
				Subtotal Capital Cost	***$646,250***
				Engineering and Administration (10%)	***$64,625***
				Contingency (20%)	***$129,250***
				Estimated Capital Cost	**$840,125**
ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS					
16	AS/SVE System O&M	1	LS	$125,000	$125,000
17	Groundwater Monitoring	1	LS	$30,000	$30,000
18	Annual Reporting	1	LS	$30,000	$30,000
				Subtotal Annual O&M Cost	***$185,000***
				O&M Contingency (20%)	***$37,000***
				Estimated Annual O&M Cost	**$222,000**
				Present Worth Factor (Years 1-15, 7%)	**9.1079**
				Total Present Worth of Annual O&M	**$2,021,954**
				Total Estimated Cost	**$2,862,079**
				Rounded To	**$2,870,000**

Table 11B

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 4:
Soil Vapor Extraction, Groundwater Air Sparging, and Site Controls and Monitoring - Performance Standard 2

General Comments:

See general comments under Table 11A.

Assumptions:

Assumptions under Table 11A are applicable, except AS/SVE system is anticipated to operate for 15 years to achieve Endpoint 2.

Table 12A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 5:
Asphalt Cap/Institutional Controls, Groundwater Extraction/Onsite Treatment, and Subslab Depressurization - Performance Standard 1

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
CAPITAL COSTS					
Common Elements					
1	Engineering Design	1	LS	$50,000	$50,000
2	Mobilization/Demobilization	1	LS	$25,000	$25,000
3	Oversight	1	LS	$75,000	$75,000
4	Site Restoration	1	LS	$10,000	$10,000
				Subtotal Common Elements	***$160,000***
Asphalt Cap/Institutional Controls					
5	Geotextile	12,000	SF	$0.20	$2,400
6	Geomembrane	12,000	SF	$0.75	$9,000
7	Geosynthetic Drainage Composite	12,000	SF	$0.60	$7,200
8	Dense Graded Aggregate (6-inches)	225	CY	$30	$6,750
9	Bituminous Asphalt Base Course (4-inches)	12,000	SF	$1.25	$15,000
10	Bituminous Asphalt Top Course (2-inches)	12,000	SF	$0.75	$9,000
11	Storm Sewer Manhole Modifications	1	LS	$3,000	$3,000
12	Institutional Controls	1	LS	$5,000	$5,000
				Subtotal Asphalt Cap/Institutional Controls	***$57,350***
Groundwater Extraction/Onsite Treatment					
13	Permitting	1	LS	$30,000	$30,000
14	Extraction Wells	3	Each	$6,000	$18,000
15	Extraction Pumps and Controls	3	Each	$3,000	$9,000
16	Extraction Transfer Piping	125	LF	$70	$8,750
17	Pre-Engineered Building Enclosure	1,600	SF	$75	$120,000
18	5,000 Gallon Equalization Tank	1	Each	$5,000	$5,000
19	Multi-Media Filter	1	Each	$15,000	$15,000
20	Air Stripper and Effluent Discharge Pump	1	Each	$60,000	$60,000
21	Catalytic Oxidizer	1	Each	$175,000	$175,000
22	Carbon Adsorption System	1	Each	$20,000	$20,000
23	Miscellaneous Mechanical	1	LS	$40,000	$40,000
24	Miscellaneous Electrical & Controls	1	LS	$60,000	$60,000
25	System Startup	1	LS	$50,000	$50,000
26	Miscellaneous Waste Disposal	1	LS	$25,000	$25,000
				Subtotal Groundwater Extraction/Onsite Treatment	***$635,750***
Subslab Depressurization System					
27	Subslab Depressurization System	1	LS	$20,000	$20,000
				Subtotal Capital Cost	***$873,100***
				Engineering and Administration (10%)	***$87,310***
				Contingency (20%)	***$174,620***
				Estimated Capital Cost	**$1,135,030**

Table 12A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 5:
Asphalt Cap/Institutional Controls, Groundwater Extraction/Onsite Treatment, and Subslab Depressurization - Performance Standard 1

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS					
Annual O&M					
28	Annual Cap Maintenance	1	LS	$5,000	$5,000
29	Treatment System O&M	1	LS	$130,000	$130,000
30	Utilities	1	LS	$25,000	$25,000
31	Groundwater Monitoring and Reporting	1	LS	$30,000	$30,000
32	Waste Disposal	1	LS	$20,000	$20,000
				Subtotal Annual O&M Cost	***$210,000***
				O&M Contingency (20%)	***$42,000***
				Estimated Annual O&M Cost	**$252,000**
				Present Worth Factor (30 years, 7%)	**12.4090**
				Total Present Worth of Annual O&M	**$3,127,068**
5-Year Equipment Changeout					
33	Pumps and Blowers	1	LS	$20,000	$20,000
34	Catalytic Oxidizer Catalyst	1	LS	$50,000	$50,000
				Subtotal 5-Year Equipment Changeout Cost	***$70,000***
				Changeout Contingency (20%)	***$14,000***
				Estimated 5-Year Equipment Changeout Cost	**$84,000**
				Present Worth Factor (Years 5, 15, 20, 25, 30, 7%)	**2.1577**
				Total Present Worth of 5-Year Changeout	**$181,247**
Post-Remedial Groundwater Monitoring					
35	Quarterly Groundwater Monitoring and Reporting	1	LS	$60,000	$60,000
				Subtotal Annual O&M Cost	***$60,000***
				O&M Contingency (20%)	***$12,000***
				Estimated Annual O&M Cost	**$72,000**
				Present Worth Factor (Years 31&32, 7%)	**0.2375**
				Total Present Worth of Annual O&M	**$17,100**
Subslab Depressurization System					
36	O&M Labor and Electricity Usage	1	LS	$7,750	$7,750
				Subtotal Annual O&M Cost	***$7,750***
				O&M Contingency (20%)	***$1,550***
				Estimated Annual O&M Cost	**$9,300**
				Present Worth Factor (30 yrs., 7%)	**12.4090**
				Total Present Worth of Annual O&M	**$115,404**
				Total Estimated Cost	**$4,575,849**
				Rounded To	**$4,580,000**

Table 12A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 5:
Asphalt Cap/Institutional Controls, Groundwater Extraction/Onsite Treatment, and Subslab Depressurization - Performance Standard 1

General Comments:

1. All costs include labor, equipment, and materials, unless otherwise noted.
2. Costs do not include legal fees, negotiations, or oversight by the New York State Department of Environmental Conservation (NYSDEC).
3. Unit costs are in 2003 dollars and are estimated from standard estimating guides, vendors, and professional judgment and experience from other projects.
4. Costs are based on current site information and project understanding.
5. Cost estimates for the FS are for the purpose of comparing relative costs for alternatives against each other and do not represent actual design or construction cost estimates. Following the remedy selection process, record of decision, and pre-design activities, a design/construction cost estimate can be prepared.

Assumptions:

1. Design cost estimate includes costs for all labor and materials necessary to design and prepare contract documents for the remedial elements of this alternative. Assumes that existing surface water drainage structures will need to be replaced. Assumes that a storm water runoff evaluation will not be required.
2. Mobilization/demobilization cost estimate includes costs for the mobilization and demobilization of all labor, equipment, and materials necessary to implement this remedial alternative.
3. Oversight cost estimate includes costs for engineering oversight of remedial construction activities for this alternative. Cost estimate is based on 10 weeks time in the field and includes rental of air monitoring equipment.
4. Site restoration cost estimate includes costs for general site cleanup following installation of the cap and installation of the treatment system.
5. Geotextile cost estimate includes costs to install an 8-ounce non-woven geotextile over the existing concrete pavement surface within the limits to be capped.
6. Geomembrane cost estimate includes costs to install a 40-mil thick high-density polyethylene geomembrane with welded seams over the geotextile.
7. Geosynthetic drainage composite cost estimate includes costs to install a composite drainage layer to convey water that seeps through the upper cap layers (bituminous asphalt top course/base material) away from the capped area.
8. Dense graded aggregate cost estimate includes costs to install an approximately 6-inch thick layer of interlocking stone to serve as a subbase for the bituminous asphalt top and base courses.
9. Bituminous asphalt base course cost estimate includes costs for a 4-inch thick layer of bituminous asphalt to serve as a base layer.
10. Bituminous asphalt top course cost estimate includes costs for a 2-inch thick layer of bituminous asphalt to serve as the wearing course.
11. Storm sewer manhole modifications cost estimate includes costs to install additional riser materials to match the new final grade established by construction of the engineered cap.
12. Institutional controls cost estimate includes costs for a deed restriction to notify future property owners of the presence of chemical constituents in soil at the site, the need to maintain the cap over the soil, and the need for health and safety provisions/ cap repair in the event that excavation activities had to occur.
13. Permitting cost estimate includes costs to obtain a permit for discharge of treated groundwater to the municipal sanitary sewer system. Assumes that permitting will require no more than 100 hours time and and for travel/meetings/permit fees would not exceed $5,000.
14. Extraction wells cost estimate includes costs to install three 6-inch diameter stainless steel extraction wells to a depth of approximately 40 feet below the ground surface. Cost estimate includes a concrete curb boxes, totalizing flow meters, pressure gauges, and valves. Also includes well development and survey activities to document the well locations/elevations.

15. Extraction pumps and controls cost estimate includes costs for submersible extraction pumps capable of pumping 25 gallons per minute (gpm) each and related water level sensors/flow controllers.
16. Extraction transfer piping cost estimate includes costs to excavate approximately 125 feet of 2-foot wide by 4-foot deep trench and installing 4- to 6-inch diameter high density polyetheylene (HDPE) dual-containment piping in the trench. Cost estimate includes costs for placing bedding material beneath/around the piping, imported clean backfill material above the piping, and an asphalt pavement patch at the ground surface.
17. Pre-engineered building enclosure cost estimate includes costs to provide and erect an approximately 40-foot long by 40-foot wide pre-engineered building system, including the foundation, concrete slab, and heating/ventilation.
18. 5,000 gallon equalization tank cost estimate includes costs to provide and install a 5,000 gallon capacity polyethylene tank for flow equalization prior to treatment.
19. Multi-media filters cost estimate includes costs for providing two sand filters in parallel to filter particles greater than 10 to 20 microns in size.
20. Air stripper and effluent discharge pump cost estimate includes costs to provide and install a low-profile (i.e., shallow-tray type) air stripper to treat groundwater containing volatile organic compounds (VOCs) at a maximum flow rate of 75 gpm. Also includes an effluent discharge pump to convey water to the municipal sanitary sewer system. Assumes that the existing sanitary sewer system can accommodate an additional flow of 75 gpm.
21. Catalytic oxidizer cost estimate includes costs to provide and install a catalytic oxidizer to treat the exhaust from the air stripper to meet requirements of the NYSDEC.
22. Carbon adsorption system cost estimate includes costs to provide and install two 2,000 pound skid-mounted carbon vessels piped in parallel to serve as polishing units to treat VOCs unable to be treated by the air stripper in order to meet site-specific discharge requirements.
23. Miscellaneous mechanical cost estimate includes costs to provide and install pumps, piping and valves, fittings, gauges, pipe supports, etc.
24. Miscellaneous electrical & controls cost estimate includes costs to provide and install conduits and wiring, electrical panels, instrumentation, lights, receptacles, programmable logic controller, and other electrical components.
25. System startup cost estimate includes costs to conduct hydraulic testing, groundwater pumping tests, sampling and analysis activities, and troubleshooting during the startup of the treatment system.
26. Miscellaneous waste disposal cost estimate includes costs to dispose of concrete/soil removed for trenching to install extraction transfer piping, soil cuttings generated by well installation activities, treatment residuals, disposable equipment, and personal protective equipment at a facility permitted to accept the materials.
27. Subslab depressurization system cost estimate includes costs for engineering coordination ($5,000), oversight ($1,200), high suction fan ($2,000), 150 lineal feet conveyance/header piping ($1,800), miscellaneous pipe fittings/gate valves ($900), subcontractor testing/oversight ($840), two 200 pound vapor phase drum-type carbon vessels ($1,300), mechanical/electrical installation ($1,300), and abatement system startup ($5,000).
28. Annual cap maintenance cost estimate includes costs for sealing cracks in the bituminous asphalt pavement and performing other minor repairs that may be needed.
29. Treatment system O&M cost estimate includes costs for weekly site visits to inspect treatment system components, evaluate treatment system performance (i.e., collect influent and treated effluent samples for laboratory analysis for VOCs), and make necessary adjustments. Cost estimate assumes 52 site visits per year at a cost of $1,200 per visit ($62,500), analysis of four water samples for VOCs per event plus quality assurance quality controls samples (7 samples @ $125/sample = $875 per sampling event and $45,500 per year), photoionization detector (PID) monitoring of the air discharge ($5,000 per year). Also includes $10,000 per year for labor and expenses to make repairs to the treatment system and $5,000 per year for carbon changeout.
30. Utilities cost estimate includes costs for electricity to operate the submersible well pump, effluent discharge pump, air stripper blowers, and electrical controls. Also includes natural gas for the catalytic oxidizer.
31. Groundwater monitoring and reporting cost estimate includes costs to collect groundwater samples at the site groundwater monitoring well network on an annual basis for field parameters and laboratory analysis for VOCs. Includes preparation of annual groundwater monitoring reports.
32. Waste disposal cost estimate includes costs to dispose of miscellaneous wastes generated by O&M activities, including disposable sampling equipment and personal protective equipment, and costs to discharge treated groundwater to a local POTW.
33. Pumps and blowers 5-year equipment changeout cost estimate includes costs to replace the submersible well pump, effluent discharge pump, and air stripper blowers every 5 years.
34. Catalytic oxidizer catalyst cost estimate includes costs to replace the catalyzer in the oxider used to treat emissions from the air stripper.
35. Post-remedial groundwater monitoring and reporting cost estimate includes costs for collecting groundwater samples at the site groundwater monitoring well network on a quarterly basis beginning approximately 3 months following the end of groundwater extraction and treatment activities. Groundwater field parameter measurements would be obtained and samples would be submitted for laboratory analysis for VOCs. Includes preparation of two annual groundwater monitoring reports to summarize the first and and second year's quarterly monitoring activities.
36. Subslab depressurization system annual O&M labor based on bi-monthly site visits (every other month) to field screen vapors removed by the system and perform indoor sampling (6 visits/year @ $1,250/visit = $7,500) and electricity costs ($250).

Table 12B

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 5:
Asphalt Cap/Institutional Controls, Groundwater Extraction/Onsite Treatment, and Subslab Depressurization - Performance Standard 2

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
CAPITAL COSTS					
Common Elements					
1	Engineering Design	1	LS	$50,000	$50,000
2	Mobilization/Demobilization	1	LS	$25,000	$25,000
3	Oversight	1	LS	$75,000	$75,000
4	Site Restoration	1	LS	$10,000	$10,000
				Subtotal Common Elements	***$160,000***
Asphalt Cap/Institutional Controls					
5	Geotextile	12,000	SF	$0.20	$2,400
6	Geomembrane	12,000	SF	$0.75	$9,000
7	Geosynthetic Drainage Composite	12,000	SF	$0.60	$7,200
8	Dense Graded Aggregate (6-inches)	225	CY	$30	$6,750
9	Bituminous Asphalt Base Course (4-inches)	12,000	SF	$1.25	$15,000
10	Bituminous Asphalt Top Course (2-inches)	12,000	SF	$0.75	$9,000
11	Storm Sewer Manhole Modifications	1	LS	$3,000	$3,000
12	Institutional Controls	1	LS	$5,000	$5,000
				Subtotal Asphalt Cap/Institutional Controls	***$57,350***
Groundwater Extraction/Onsite Treatment					
13	Permitting	1	LS	$30,000	$30,000
14	Extraction Wells	4	Each	$6,000	$24,000
15	Extraction Pumps and Controls	4	Each	$3,000	$12,000
16	Extraction Transfer Piping	170	LF	$70	$11,900
17	Pre-Engineered Building Enclosure	2,000	SF	$75	$150,000
18	5,000 Gallon Equalization Tank	2	Each	$5,000	$10,000
19	Multi-Media Filter	2	Each	$15,000	$30,000
20	Air Stripper and Effluent Discharge Pump	2	Each	$60,000	$120,000
21	Catalytic Oxidizer	1	Each	$175,000	$175,000
22	Carbon Adsorption System	2	Each	$20,000	$40,000
23	Miscellaneous Mechanical	1	LS	$60,000	$60,000
24	Miscellaneous Electrical & Controls	1	LS	$80,000	$80,000
25	System Startup	1	LS	$50,000	$50,000
26	Miscellaneous Waste Disposal	1	LS	$25,000	$25,000
				Subtotal Groundwater Extraction/Onsite Treatment	***$817,900***
Subslab Depressurization System					
27	Subslab Depressurization System	1	LS	$20,000	$20,000
				Subtotal Capital Cost	***$1,055,250***
				Engineering and Administration (10%)	***$105,525***
				Contingency (20%)	***$211,050***
				Estimated Capital Cost	**$1,371,825**

Table 12B

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 5:
Asphalt Cap/Institutional Controls, Groundwater Extraction/Onsite Treatment, and Subslab Depressurization - Performance Standard 2

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS					
Annual O&M					
28	Annual Cap Maintenance	1	LS	$5,000	$5,000
29	Treatment System O&M	1	LS	$160,000	$160,000
30	Utilities	1	LS	$40,000	$40,000
31	Groundwater Monitoring and Reporting	1	LS	$30,000	$30,000
32	Waste Disposal	1	LS	$20,000	$20,000
Subtotal Annual O&M Cost					***$255,000***
O&M Contingency (20%)					***$51,000***
Estimated Annual O&M Cost					**$306,000**
Present Worth Factor (30 years, 7%)					**12.4090**
Total Present Worth of Annual O&M					**$3,797,154**
5-Year Equipment Changeout					
33	Pumps and Blowers	1	LS	$30,000	$30,000
34	Catalytic Oxidizer Catalyst	1	LS	$50,000	$50,000
Subtotal 5-Year Equipment Changeout Cost					***$80,000***
Changeout Contingency (20%)					***$16,000***
Estimated 5-Year Equipment Changeout Cost					**$96,000**
Present Worth Factor (Years 5, 15, 20, 25, 30, 7%)					**2.1577**
Total Present Worth of 5-Year Changeout					**$207,139**
Post-Remedial Groundwater Monitoring					
35	Quarterly Groundwater Monitoring and Reporting	1	LS	$60,000	$60,000
Subtotal Annual O&M Cost					***$60,000***
O&M Contingency (20%)					***$12,000***
Estimated Annual O&M Cost					**$72,000**
Present Worth Factor (Years 31&32, 7%)					**0.2375**
Total Present Worth of Annual O&M					**$17,100**
Subslab Depressurization System					
36	O&M Labor and Electricity Usage	1	LS	$7,750	$7,750
Subtotal Annual O&M Cost					***$7,750***
O&M Contingency (20%)					***$1,550***
Estimated Annual O&M Cost					**$9,300**
Present Worth Factor (30 yrs., 7%)					**12.4090**
Total Present Worth of Annual O&M					**$115,404**
Total Estimated Cost					**$5,508,622**
Rounded To					**$5,510,000**

Table 12B

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 5:
Asphalt Cap/Institutional Controls, Groundwater Extraction/Onsite Treatment, and Subslab Depressurization - Performance Standard 2

General Comments:

See general comments under Table 12A.

Assumptions:

Assumptions under Table 12A are applicable, except the following changes are anticipated to achieve Endpoint 2:

1. One additional extraction well/pump would be required.
2. An additional 45 lineal feet of extraction transfer piping would be required.
3. The size of the pre-engineered building would need to increase by an estimated 400 square feet to accommodate additional or larger treatment components.
4. An additional influent equalization tank, multi-media filter, air stripper, or carbon unit (or larger sizes of each) would be required to treat the additional flow to be conveyed to the treatment system.
5. There would be an upcharge for additional mechanical and electrical installation associated with the additional (or larger size) equipment.
6. Treatment system O&M and utility costs would increase due to the additional treatment capacity.
7. 5-year equipment change-out costs would increase.

Table 13A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 6: Soil Excavation and Offsite Incineration/Disposal and Groundwater Extraction/Onsite Treatment - Performance Standard 1

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
CAPITAL COSTS					
Common Elements					
1	Engineering Design	1	LS	$90,000	$90,000
2	Mobilization/Demobilization	1	LS	$25,000	$25,000
3	Oversight	1	LS	$100,000	$100,000
4	Site Restoration	1	LS	$10,000	$10,000
				Subtotal Common Elements	***$225,000***
Soil Excavation and Offsite Incineration/Disposal					
5	Material Staging Area Construction	1	LS	$10,000	$10,000
6	Concrete Pavement Removal	100	CY	$45	$4,500
7	Sheetpile Wall Installation	12,000	SF	$30	$360,000
8	Soil Excavation/Handling	1,300	CY	$20	$26,000
9	Vapor Suppressant Foam	1	LS	$10,000	$10,000
10	Waste Characterization Sample Analyses	6	Each	$1,000	$6,000
11	Transportation and Offsite Disposal of Nonhazardous Waste	550	tons	$150	$82,500
12	Transportation and Offsite Disposal of Hazardous Waste	900	tons	$275	$247,500
13	Transportation and Offsite Incineration of Hazardous Waste	900	tons	$1,000	$900,000
14	Storm Sewer Replacement	1	LS	$15,000	$15,000
15	Sand/Gravel Backfill Material Placement	1,250	CY	$25	$31,250
16	Dense Graded Aggregate (6-inches)	80	CY	$30	$2,400
17	Bituminous Asphalt Base Course (4-inches)	4,500	SF	$1.25	$5,625
18	Bituminous Asphalt Top Course (2-inches)	4,500	SF	$0.65	$2,925
19	Reporting	1	LS	$20,000	$20,000
				Subtotal Soil Excavation and Offsite Incineration/Disposal	***$1,723,700***
Groundwater Extraction/Onsite Treatment					
20	Permitting	1	LS	$30,000	$30,000
21	Extraction Wells	3	Each	$6,000	$18,000
22	Extraction Pumps and Controls	3	Each	$3,000	$9,000
23	Extraction Transfer Piping	125	LF	$70	$8,750
24	Pre-Engineered Building Enclosure	1,600	SF	$75	$120,000
25	5,000 Gallon Equalization Tank	1	Each	$5,000	$5,000
26	Multi-Media Filter	1	Each	$15,000	$15,000
27	Air Stripper and Effluent Discharge Pump	1	Each	$60,000	$60,000
28	Catalytic Oxidizer	1	Each	$175,000	$175,000

Table 13A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 6:
Soil Excavation and Offsite Incineration/Disposal and Groundwater Extraction/Onsite Treatment - Performance Standard 1

29	Carbon Adsorption System	1	Each	$20,000	$20,000

Table 13A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 6:
Soil Excavation and Offsite Incineration/Disposal and Groundwater Extraction/Onsite Treatment - Performance Standard 1

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
30	Miscellaneous Mechanical	1	LS	$40,000	$40,000
31	Miscellaneous Electrical & Controls	1	LS	$60,000	$60,000
32	System Startup	1	LS	$50,000	$50,000
33	Miscellaneous Waste Disposal	1	LS	$25,000	$25,000
	Subtotal Groundwater Extraction/Onsite Treatment				*$635,750*
	Subtotal Capital Cost				*$2,584,450*
	Engineering and Administration (10%)				*$258,445*
	Contingency (20%)				*$516,890*
	Estimated Capital Cost				**$3,359,785**
ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS					
Annual O&M					
34	Treatment System O&M	1	LS	$130,000	$130,000
35	Utilities	1	LS	$25,000	$25,000
36	Groundwater Monitoring and Reporting	1	LS	$30,000	$30,000
37	Waste Disposal	1	LS	$5,000	$5,000
	Subtotal Annual O&M Cost				*$190,000*
	O&M Contingency (20%)				*$38,000*
	Estimated Annual O&M Cost				**$228,000**
	Present Worth Factor (30 years, 7%)				**12.4090**
	Total Present Worth of Annual O&M				**$2,829,252**
5-Year Equipment Changeout					
38	Pumps and Blowers	1	LS	$20,000	$20,000
39	Catalytic Oxidizer Catalyst	1	LS	$50,000	$50,000
	Subtotal 5-Year Equipment Changeout Cost				*$70,000*
	Changeout Contingency (20%)				*$14,000*
	Estimated 5-Year Equipment Changeout Cost				**$84,000**
	Present Worth Factor (Years 5, 15, 20, 25, 30, 7%)				**2.1577**
	Total Present Worth of 5-Year Changeout				**$181,247**
Post-Remedial Groundwater Monitoring					
40	Quarterly Groundwater Monitoring and Reporting	1	LS	$60,000	$60,000
	Subtotal Annual O&M Cost				*$60,000*
	O&M Contingency (20%)				*$12,000*
	Estimated Annual O&M Cost				**$72,000**
	Present Worth Factor (Years 31&32, 7%)				**0.2375**
	Total Present Worth of Annual O&M				**$17,100**
	Total Estimated Cost				**$6,387,384**
	Rounded To				**$6,390,000**

Table 13A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 6:
Soil Excavation and Offsite Incineration/Disposal and Groundwater Extraction/Onsite Treatment - Performance Standard 1

General Comments:

1. All costs include labor, equipment, and materials, unless otherwise noted.
2. Costs do not include legal fees, negotiations, or oversight by the New York State Department of Environmental Conservation (NYSDEC).
3. Unit costs are in 2003 dollars and are estimated from standard estimating guides, vendors, and professional judgment and experience from other projects.
4. Costs are based on current site information and project understanding.
5. Cost estimates for the FS are for the purpose of comparing relative costs for alternatives against each other and do not represent actual design or construction cost estimates. Following the remedy selection process, record of decision, and pre-design activities, a design/construction cost estimate can be prepared.

Assumptions:

1. Engineering design cost estimate includes costs for all labor and materials necessary to design and prepare contract documents for the remedial elements of this alternative. Also includes additional sampling to verify final excavation limits prior to sheetpile wall installation.
2. Mobilization/demobilization cost estimate includes costs for the mobilization and demobilization of all labor, equipment, and materials necessary to implement this remedial alternative.
3. Oversight cost estimate includes costs for engineering oversight of remedial construction activities for this alternative. Cost estimate is based on 15 weeks time in the field and includes rental of air monitoring equipment.
4. Site restoration cost estimate includes costs for general site cleanup following completion of excavation/backfilling activities and following installation of the groundwater treatment system.
5. Material staging area construction cost estimate includes costs to construct a 70-foot long by 60-foot wide lined pad for temporary staging/characterization of excavated soil. It is assumed that the staging area would consist of a 4-inch thick granular fill base layer (interlocking stone), a 40-mil high-density polyethylene (HDPE) liner over the base layer and bermed sidewalls formed using granular fill, and an 8-inch thick sacrificial sand layer over the liner.
6. Concrete pavement removal cost estimate includes costs for removing the existing concrete pavement over the approximately 4,500 square foot soil excavation area. Assumes that the average concrete thickness is 8 inches and that the concrete would be transported for offsite crushing/use as hard fill. Assumes concrete does not contain detectable levels of VOCs.
7. Sheetpile wall installation cost estimate includes costs for installing sheetpile wall around the proposed excavation limits. Assumes that the wall would be approximately 300 feet long and would extend to a depth of 40 feet below grade to permit excavation to a maximum depth of approximately 13 feet.
8. Soil excavation/handling cost estimate includes costs for excavating approximately 1,300 cubic yards of soil containing volatile organic compounds (VOCs) and transferring the excavated soil to the material staging area for characterization. Cost estimate assumes that soil would be excavated to depths ranging from 6 to 13 feet below grade from a 4,500 square foot area. Includes costs for measures to suppress vapors (adding lime, covering soil, etc.).
9. Vapor suppressant foam cost estimate includes costs for spraying a water-based suppressant foam over the excavation area and soil stockpiles to control odors/reduce VOC emissions during excavation/handling activities. Cost estimate is based on 20 drums of foam @ $275/drum ($5,500), sprayer rental ($2,000 for one month), and labor. Assumes it will not be necessary to provide a sprung structure under negative air pressure with vapor phase carbon for air emissions treatment. The potential need for a sprung structure would be evaluated during remedial design.
10. Waste characterization sample analyses cost estimate includes costs for collecting waste characterization soil samples at a frequency of one sample per approximately 250 CY of excavated soil. Assumes that each sample would be analyzed for Toxicity Characteristic Leaching Procedure (TCLP) VOCs, TCLP semi-volatile organic compounds (SVOCs), TCLP metals, ignitability, corrosivity, reactivity, polychlorinated biphenyls (PCBs), and total VOCs.

Table 13A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 6:
Soil Excavation and Offsite Incineration/Disposal and Groundwater Extraction/Onsite Treatment - Performance Standard 1

11. Transportation and offsite disposal of nonhazardous waste cost estimate assumes that approximately 350 tons of soil will be characterized as nonhazardous (i.e., based on the analytical results obtained for one waste characterization sample) and transported to the Waste Management (WM) High Acres Subtitle D landfill located in Fairport, New York for disposal as a nonhazardous waste. Also assumes that materials used to construct the soil staging pads (an estimated 200 tons) will be transported for offsite disposal as a nonhazardous waste. Soil density is assumed to be 1.6 tons per cubic yard.
12. Transportation and offsite disposal of hazardous waste cost estimate includes costs for transportation of 900 tons of soil anticipated to be characterized as a RCRA hazardous waste that meets land disposal restrictions (i.e., total PCE concentrations assumed to be below 60 ppm) to the CWM Chemical Services LLC Subtitle C landfill located in Model City, New York for offsite disposal.
13. Transportation and offsite incineration of hazardous waste cost estimate includes costs for transportation of 900 tons of soil anticipated to be characterized as a RCRA hazardous waste that fails land disposal restrictions (i.e., total PCE concentrations at or above 60 ppm) to the VonRoll incineration facility in East Liverpool, Ohio.
14. Storm sewer replacement cost estimate includes costs to replace 2 storm sewer catch basins and up to 75 feet of piping removed as part of the soil excavation activities. Assumes that the sewer system is above the water table and sheeting is not required.
15. Sand/gravel backfill material placement cost estimate includes costs for providing, placing, and compacting a general sand and gravel backfill material in the excavated area to a height of 1-foot below the surrounding grade.
16. Dense graded aggregate cost estimate includes costs to install an approximately 6-inch thick layer of interlocking stone to serve as a subbase for bituminous asphalt top and base courses.
17. Bituminous asphalt base course cost estimate includes costs for a 4-inch thick layer of bituminous asphalt to serve as a base layer.
18. Bituminous asphalt top course cost estimate includes costs for a 2-inch thick layer of bituminous asphalt to serve as the top (wear) layer.
19. Reporting cost estimate includes costs for a certification report to summarize the soil removal and waste handling activities.
20. Permitting cost estimate includes costs to obtain a permit for discharge of treated groundwater to the municipal sanitary sewer system. Assumes that permitting will require no more than 100 hours time and and for travel/meetings/permit fees would not exceed $5,000.
21. Extraction wells cost estimate includes costs to install three 6-inch diameter stainless steel extraction wells to a depth of approximately 40 feet below the ground surface. Cost estimate includes a concrete curb boxes, totalizing flow meters, pressure gauges, and valves. Also includes well development and survey activities to document the well locations/elevations.
22. Extraction pumps and controls cost estimate includes costs for submersible extraction pumps capable of pumping 25 gallons per minute (gpm) each and related water level sensors/flow controllers.
23. Extraction transfer piping cost estimate includes costs to excavate approximately 125 feet of 2-foot wide by 4-foot deep trench and installing 4- to 6-inch diameter high density polyetheylene (HDPE) dual-containment piping in the trench. Cost estimate includes costs for placing bedding material beneath/around the piping, imported clean backfill material above the piping, and an asphalt pavement patch at the ground surface.
24. Pre-engineered building enclosure cost estimate includes costs to provide and erect an approximately 40-foot long by 40-foot wide pre-engineered building system, including the foundation, concrete slab, and heating/ventilation.
25. 5,000 gallon equalization tank cost estimate includes costs to provide and install a 5,000 gallon capacity polyethylene tank for flow equalization prior to treatment.
26. Multi-media filters cost estimate includes costs for providing two sand filters in parallel to filter particles greater than 10 to 20 microns in size.
27. Air stripper and effluent discharge pump cost estimate includes costs to provide and install a low-profile (i.e., shallow-tray type) air stripper to treat groundwater containing volatile organic compounds (VOCs) at a maximum flow rate of 75 gpm. Also includes an effluent discharge pump to convey water to the municipal sanitary sewer system. Assumes that the existing sanitary sewer system can accommodate an additional flow of 75 gpm.
28. Catalytic oxidizer cost estimate includes costs to provide and install a catalytic oxidizer to treat the exhaust from the air stripper to meet requirements of the NYSDEC.

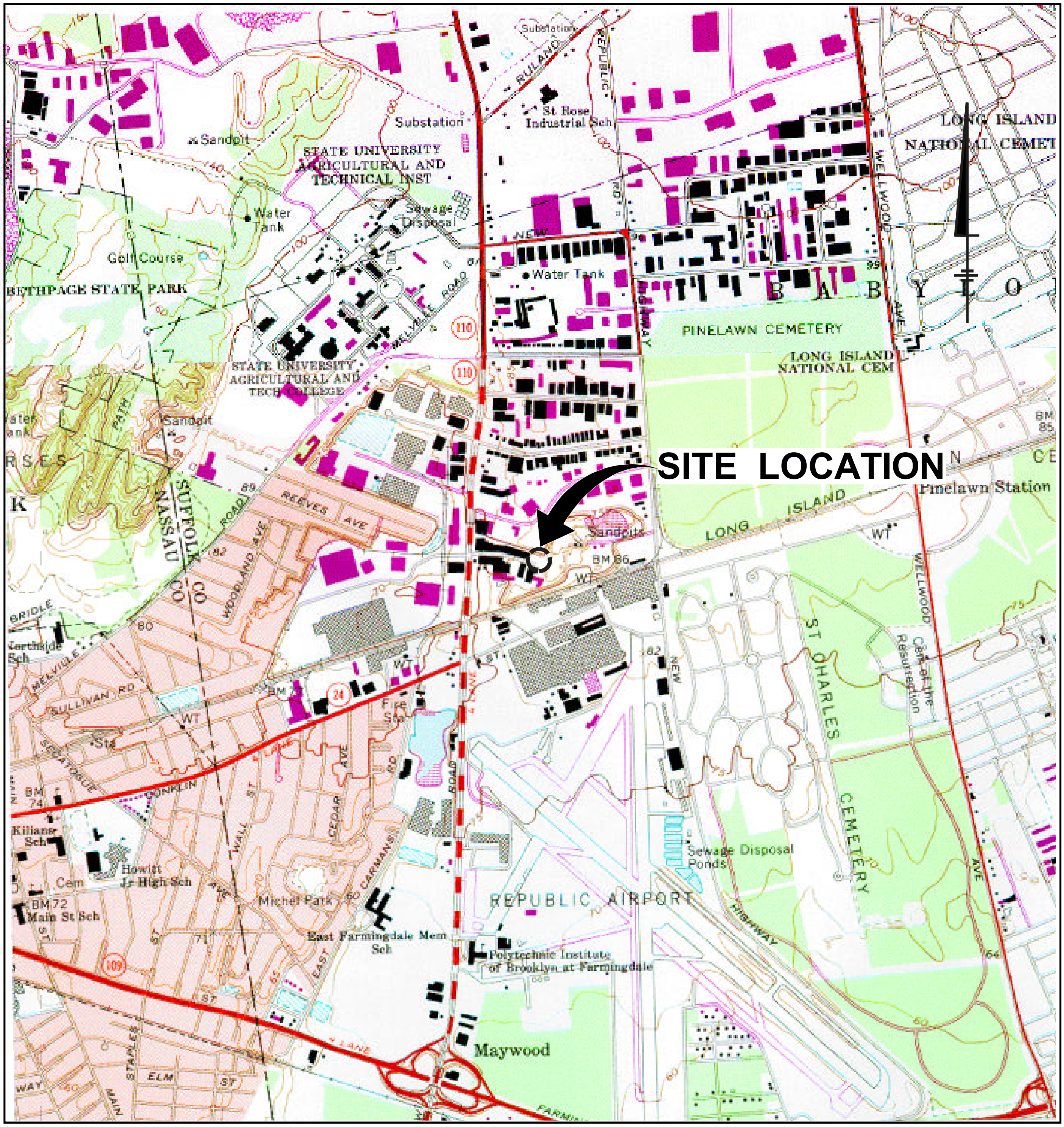
Table 13A

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Cost Estimate for Alternative 6:
Soil Excavation and Offsite Incineration/Disposal and Groundwater Extraction/Onsite Treatment - Performance Standard 1

29. Carbon adsorption system cost estimate includes costs to provide and install two 2,000 pound skid-mounted carbon vessels piped in parallel to serve as polishing units to treat VOCs unable to be treated by the air stripper in order to meet site-specific discharge requirements.
30. Miscellaneous mechanical cost estimate includes costs to provide and install pumps, piping and valves, fittings, gauges, pipe supports, etc.
31. Miscellaneous electrical & controls cost estimate includes costs to provide and install conduits and wiring, electrical panels, instrumentation, lights, receptacles, programmable logic controller, and other electrical components.
32. System startup cost estimate includes costs to conduct hydraulic testing, groundwater pumping tests, sampling and analysis activities, and troubleshooting during the startup of the treatment system.
33. Miscellaneous waste disposal cost estimate includes costs to dispose of concrete/soil removed for trenching to install extraction transfer piping, soil cuttings generated by well installation activities, treatment residuals, disposable equipment, and personal protective equipment at a facility permitted to accept the materials.
34. Treatment system O&M cost estimate includes costs for weekly site visits to inspect treatment system components, evaluate treatment system performance (i.e., collect influent and treated effluent samples for laboratory analysis for VOCs), and make necessary adjustments. Cost estimate assumes 52 site visits per year at a cost of $1,200 per visit ($62,500), analysis of four water samples for VOCs per event plus quality assurance quality controls samples (7 samples @ $125/sample = $875 per sampling event and $45,500 per year), photoionization detector (PID) monitoring of the air discharge ($5,000 per year). Also includes $10,000 per year for labor and expenses to make repairs to the treatment system and $5,000 per year for carbon changeout.
35. Utilities cost estimate includes costs for electricity to operate the submersible well pump, effluent discharge pump, air stripper blowers, and electrical controls. Also includes natural gas for the catalytic oxidizer.
36. Groundwater monitoring and reporting cost estimate includes costs to collect groundwater samples at the site groundwater monitoring well network on an annual basis for field parameters and laboratory analysis for VOCs. Includes preparation of annual groundwater monitoring reports.
37. Waste disposal cost estimate includes costs to dispose of miscellaneous wastes generated by O&M activities, including disposable sampling equipment and personal protective equipment.
38. Pumps and blowers 5-year equipment changeout cost estimate includes costs to replace the submersible well pump, effluent discharge pump, and air stripper blowers every 5 years.
39. Catalytic oxidizer catalyst cost estimate includes costs to replace the catalyzer in the oxider used to treat emissions from the air stripper.
40. Post-remedial groundwater monitoring and reporting cost estimate includes costs for collecting groundwater samples at the site groundwater monitoring well network on a quarterly basis beginning approximately 3 months following the end of groundwater extraction and treatment activities. Groundwater field parameter measurements would be obtained and samples would be submitted for laboratory analysis for VOCs. Includes preparation of two annual groundwater monitoring reports to summarize the first and and second year's quarterly monitoring activities.

Figures



REFERENCE: AMITYVILLE, NEW YORK USGS QUAD. 1969 PR 1979, HUNTINGTON, NEW YORK USGS QUAD 1967 PR 1979

2000' 0 2000'

APPROXIMATE SCALE: 1" = 2000'

HAZARDOUS WASTE DISPOSAL, INC.
11A PICONE BOULEVARD
FARMINGDALE, NEW YORK

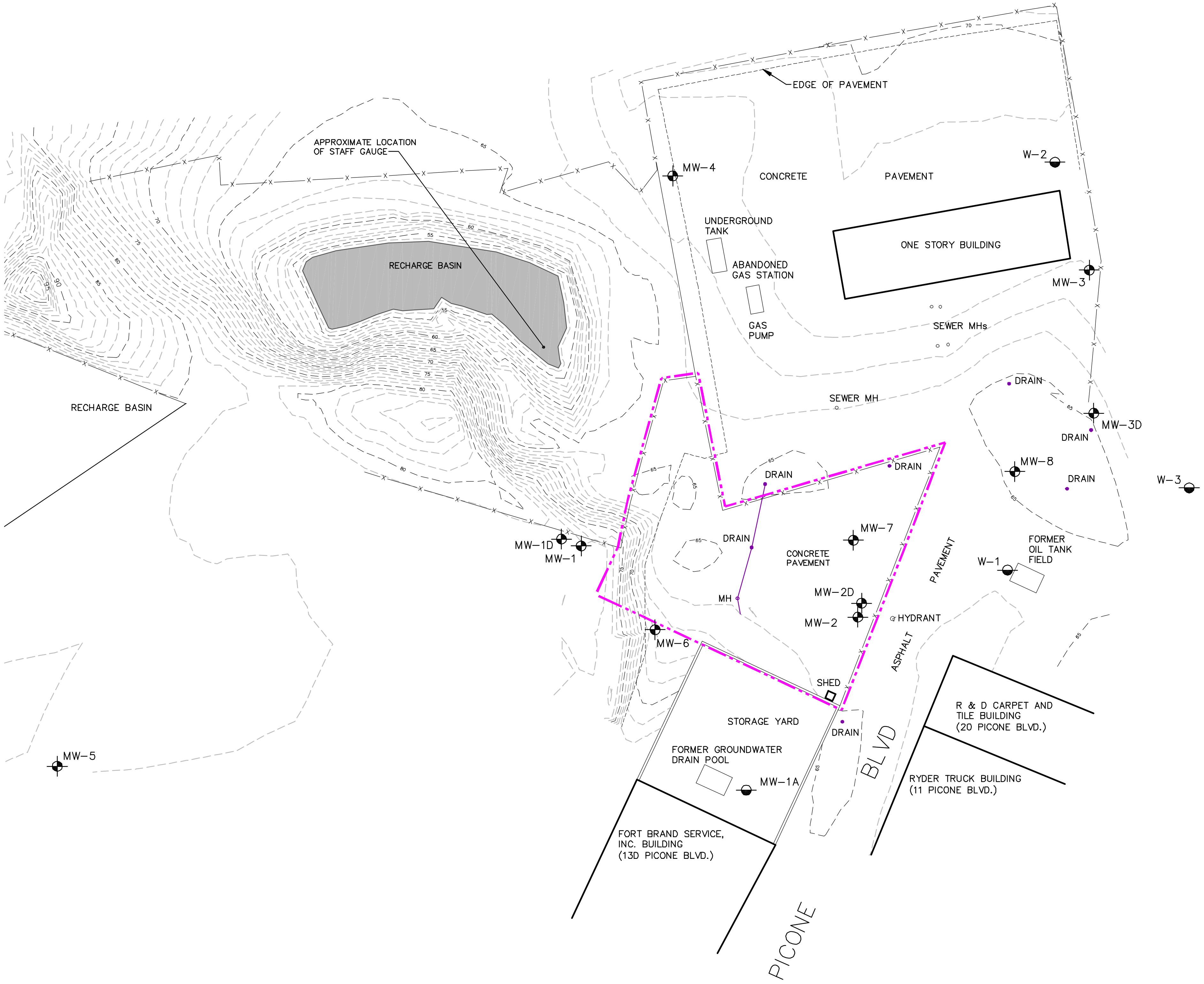
FEASIBILITY STUDY REPORT

SITE LOCATION MAP

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

FIGURE
1

07/24/03 SYR-D85-DJH
60405021/60405n01.CDR



LEGEND:

-·-·-·-	SITE BOUNDARY LOCATION (11A PICONE BOULEVARD)
—x—x—	FENCE LINE
⌖	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF THE HWD SITE)
⊖	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF OTHER SITES)

NOTES:

1. WELLS MW-1 THROUGH MW-4 INSTALLED BY GIBBS & HILL, INC. IN SEPTEMBER 1990.
2. WELLS MW-5 AND MW-6 WERE INSTALLED IN JUNE 1994 BY FANNING, PHILIPS & MOLNAR.
3. WELLS W-1, W-2 AND W-3 INSTALLED BY TYREE BROTHERS ENVIRONMENTAL SERVICES, INC., SOURCE IS MAP PROVIDED BY GIBBS & HILL, INC. DATED 6/17/94 (NOT TO SCALE).
4. WELLS MW-1D THROUGH MW-3D INSTALLED BY BLASLAND, BOUCK & LEE, INC. (BBL) IN DECEMBER 1999. WELLS MW-7 AND MW-8 INSTALLED BY BBL DURING FEBRUARY 2001 AND APRIL 2003, RESPECTIVELY.
5. THE LOCATION OF THE OLD TANK FIELD IS APPROXIMATE. THE SOURCE IS A MAP PRODUCED BY TYREE BROTHERS ENVIRONMENTAL SERVICES, INC. (NOT TO SCALE, NO DATE PROVIDED).
6. THE LOCATIONS OF THE FORMER GROUNDWATER DRAINPOOL AND MONITORING WELL MW-1A AT 13D PICONE BOULEVARD ARE APPROXIMATE. THE SOURCE IS FIGURE 2 – GROUNDWATER SAMPLING LOCATIONS PREPARED BY FANNING, PHILLIPS & MOLMAR (FPM) DATED 8/23/96.
7. THE LOCATION OF THE ABANDONED GAS STATION (GAS PUMP AND UNDERGROUND TANK) IS APPROXIMATE. THE SOURCE IS A MAP PROVIDED IN THE GIBBS & HILL, INC. DECEMBER 1991 PHASE II INVESTIGATION REPORT (NOT TO SCALE).

SOURCE:

ALL BASE MAP INFORMATION UNLESS OTHERWISE NOTED WAS TAKEN FROM A MAP ENTITLED "MONITORING WELL AND SOIL BORING LOCATION PLAN, HWD SITE-PICONE BOULEVARD, FARMINGDALE NEW YORK, PROJECT No. 604.05 #2". PREPARED BY ALBERT W. TAY. FILE No. 99390-3.DWG. SURVEYED 11/22/99 THROUGH 11/29/99. SURVEY REVISED 2/9/2000 AND 5/13/2003.

0 40' 80'
GRAPHIC SCALE

HAZARDOUS WASTE DISPOSAL, INC.
11A PICONE BOULEVARD
FARMINGDALE, NEW YORK
FEASIBILITY STUDY REPORT

SITE PLAN

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
2

X: 60405X01.DWG
L: ON=*, OFF=REF*
P: PAGESET/PLT-DL
4/29/04 ROC-85-SLM,SYR-85-GMS RCB
60405021/60405B01.DWG

Circuitron		
Depth (ft.)	40	100
Date	'93–94	'93–94
PCE	21	63
TCE	3	82
TCA	5,800	240

Claremont Poly Chemical (GW–8)			
Depth (ft.)	30	30	30
Date	'86	'91	'92
PCE	110	440	760
TCE	32	35	16
TCA	10	12	6

Target Rock	
	Wastewater
Date	'82–83
PCE	2,700
TCE	NR
TCA	50,000,000

Well GW–7			
Depth (ft.)	190	190	190
Date	'86	'88	'92
PCE	71	100	340
TCE	ND	6	14
TCA	ND	ND	4

Well BP–4B	
Depth (ft.)	200
Date	'92
PCE	510
TCE	44
TCA	56

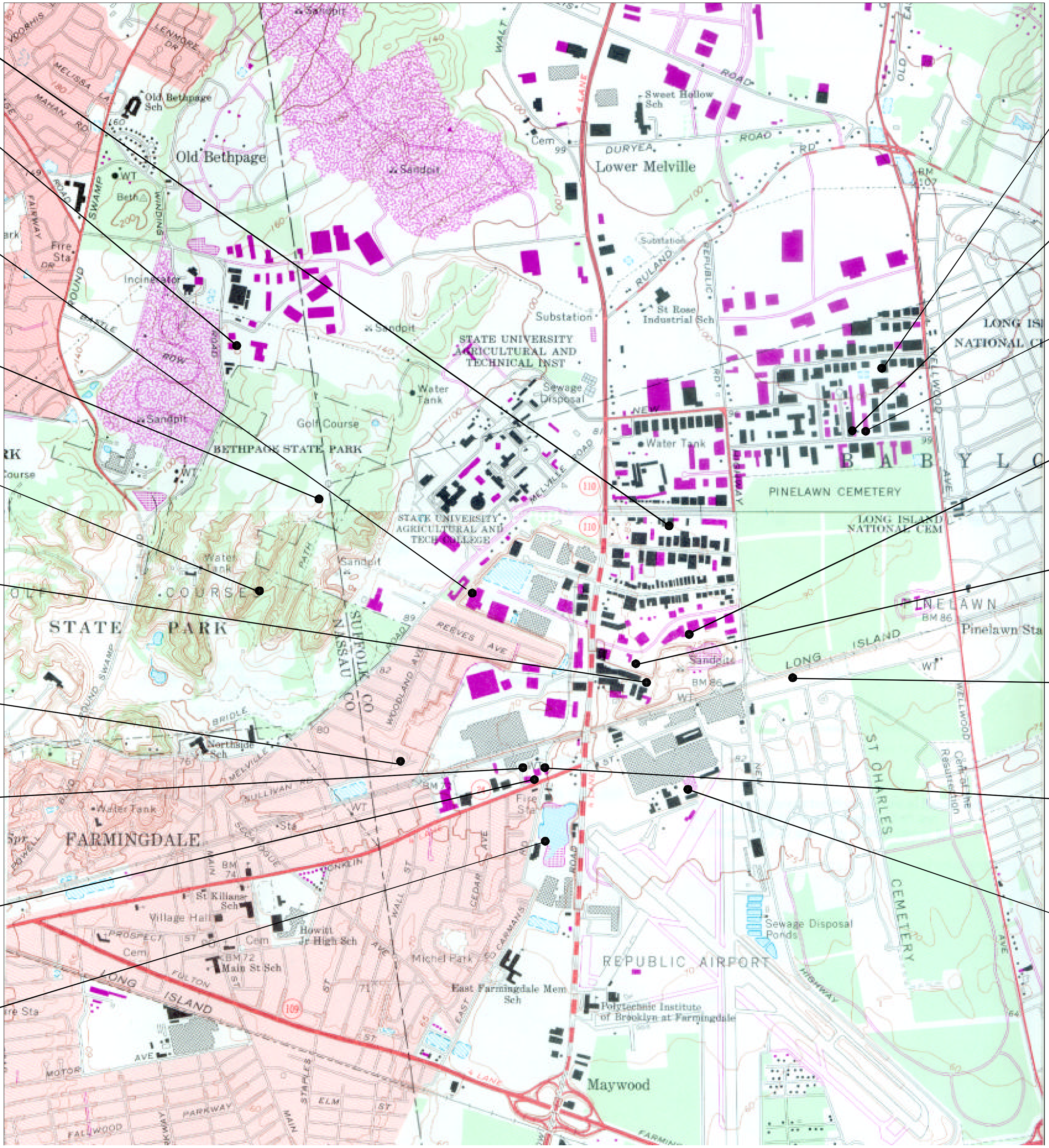
Hazardous Waste Disposal		
Depth (ft.)	15	15
Date	'90	'03
PCE	790	2,600
TCE	130	48
TCA	150	1.4

B.H. Aircraft	
Depth (ft.)	NR
Date	'91–92
PCE	ND
TCE	6
TCA	550

Fire Station	
Depth (ft.)	20
Date	'90
PCE	12,143
TCE	NR
TCA	NR

Brandt Airflex	
Depth (ft.)	26
Date	'95
PCE	170,000
TCE	13,000

Old Recharge Basin Wells				
Well	6S		6D	
Depth (ft.)	38	38	58	58
Date	'87	'92	'87	'93
PCE	3	ND	3	14
TCE	ND	27	1	32
TCA	9	550	10	662



Minmilt Reality	
Depth (ft.)	NR
Date	'92
PCE	4,100
TCE	NR
TCA	NR

Tronic Plating	
Depth (ft.)	100
Date	'89
PCE	480
TCE	18
TCA	42

Astro Electroplating	
Depth (ft.)	30
Date	'89
PCE	NR
TCE	100
TCA	62

Well S–22003	
Depth (ft.)	230
Date	'93
PCE	7
TCE	21
TCA	10

Well S–20041	
Depth (ft.)	268
Date	NR
PCE	1–15
TCE	4–85
TCA	2–372

Well S–75033	
Depth (ft.)	52
Date	'82–85
PCE	3
TCE	ND
TCA	40–52

Kenmark Textiles	
Depth (ft.)	30
Date	'89
PCE	140
TCE	ND
TCA	370

Well MW–29XD	
Depth (ft.)	185
Date	'92
PCE	22,720
TCE	ND
TCA	370

LEGEND:

● APPROXIMATE SAMPLING LOCATION

NOTES:

1. ALL CONCENTRATIONS ARE REPORTED IN MICROGRAMS PER LITER (ug/L), EQUIVALENT TO PARTS PER BILLION (ppb).
2. ND = NOT DETECTED.
3. NR = NOT REPORTED.
4. PCE = TETRACHLOROETHENE
5. TCE = TRICHLOROETHENE
6. TCA = 1,1,1 – TRICHLOROETHANE

SOURCE:

1. BASE MAP SOURCE USGS QUADRANGLES HUNTINGTON, NEW YORK AND AMITYVILLE, NEW YORK, PHOTOREVISED 1979 AT A SCALE OF 1" = 2,000'.

2. SAMPLING LOCATIONS AND ANALYTICAL RESULTS (EXCEPT RESULTS FOR HAZARDOUS WASTE DISPOSAL [HWD]) ARE FROM A MAP TITLED "GROUNDWATER QUALITY MAIN PLANT SITE VICINITY" BY EDER ASSOCIATES, 1995 AT A SCALE OF 1" = 2,000'. HWD RESULTS ARE AS SUMMARIZED IN THIS FS REPORT AND THE RI REPORT (BBL, 2002).

0 2000' 4000'
GRAPHIC SCALE

HAZARDOUS WASTE DISPOSAL, INC.
11A PICONE BOULEVARD
FARMINGDALE, NEW YORK
FEASIBILITY STUDY REPORT

REGIONAL GROUNDWATER QUALITY

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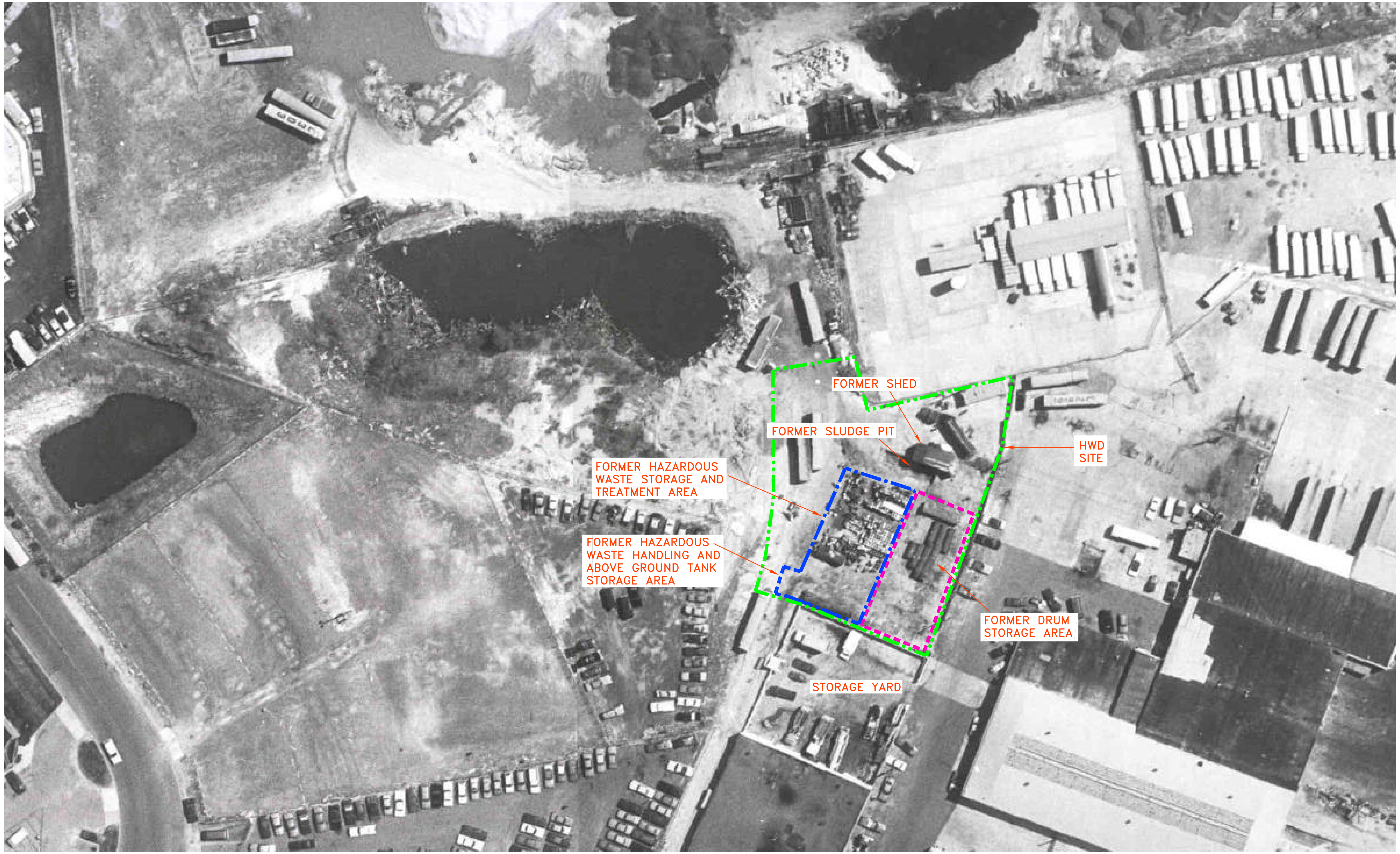
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
3

X: X
L: ON=*, OFF=REF*
P: PAGESET/PLT–DL
5/6/04 SYR–85–RCB
60405010/60405B01.DWG



LEGEND:

🟩	SITE PROPERTY BOUNDARY LOCATION (11A PICONE BOULEVARD)
🟪	APPROXIMATE FORMER DRUM STORAGE AREA BOUNDARY
🟦	APPROXIMATE AREA BOUNDARY FOR HAZARDOUS WASTE STORAGE AND TREATMENT AREA, AND HAZARDOUS WASTE HANDLING AND ABOVE GROUND TANK STORAGE AREA

SOURCE:

UNDISTORTED APRIL 7, 1980 AERIAL PHOTOGRAPH PROVIDED BY AEROGRAPHICS, INC.

NOTE:

AREA BOUNDARIES DEPICTED ARE BASED ON SKETCHES OF SITE INSPECTIONS CONDUCTED ON JUNE 30, 1982 AND SEPTEMBER 14, 1982, BY SCHD, AND FIGURES 1–2 AND 1–3 OF THE NYSDEC 1991 PHASE II REPORT BY GIBBS & HILL.

0 40' 80'
GRAPHIC SCALE

HAZARDOUS WASTE DISPOSAL, INC.
11A PICONE BOULEVARD
FARMINGDALE, NEW YORK
FEASIBILITY STUDY REPORT

HISTORICAL SITE OPERATION FEATURES (APRIL 7, 1980)

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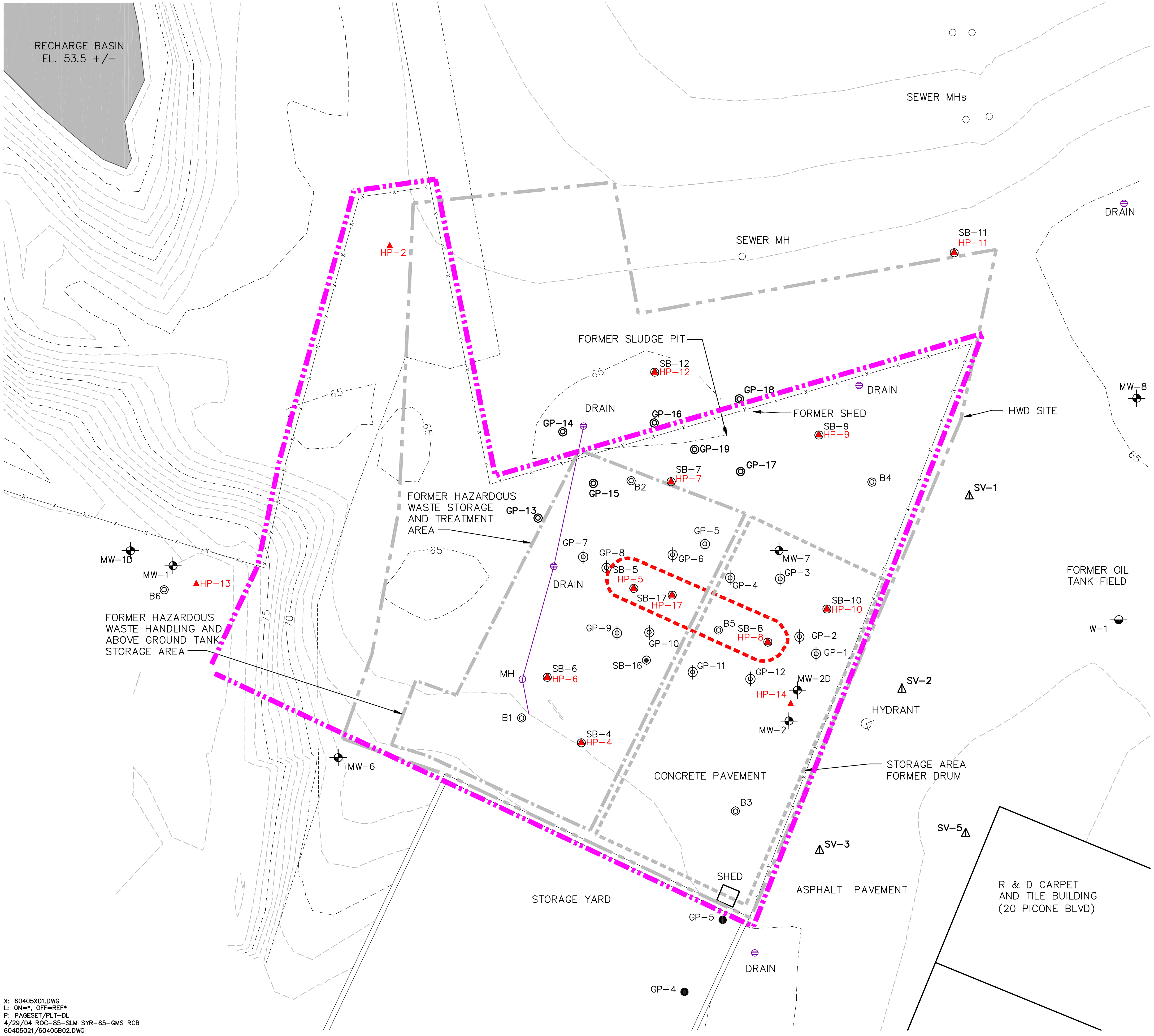
engineers, scientists, economists

FIGURE
4

X: 60405X01, 60405X02.JPG
L: ON=*, OFF=REF*
P: PAGESET/PLT–DL
4/29/04 CRA–54–IY SYR–85–KMD GMS RCB
60405021/60405N01.DWG



LEGEND:

▬ ▪ ▪ ▬	SITE BOUNDARY LOCATION (11A PICONE BOULEVARD)
—x—x—	FENCE LINE
◎	SOIL VOC DELINEATION BORING (AUGUST 2002)
△	SOIL VAPOR SAMPLE LOCATION (AUGUST 2002)
⊕	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF THE HWD SITE)
⊖	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF OTHER SITES)
◬	SOIL BORING/HYDROPUNCH™ LOCATION
▲	HYDROPUNCH™ LOCATION ONLY
◉	SOIL BORING LOCATION ONLY
⌽	GEOPROBE® SOIL BORING LOCATION
⬭	LOCATION OF REINFORCED CONCRETE PAD
●	GEOPROBE® GROUNDWATER SAMPLING LOCATION (APPROXIMATE)
◎	PHASE II SOIL BORING LOCATION (APPROXIMATE)

NOTES:

1. SOIL VOC DELINEATION BORINGS AND SOIL VAPOR SAMPLE LOCATIONS WERE SURVEYED BY BBL DURING AUGUST 2002.
2. THE LOCATION OF THE FORMER OIL TANK FIELD IS APPROXIMATE. THE SOURCE IS A MAP PRODUCED BY TYREE BROTHERS ENVIRONMENTAL SERVICES, INC. (NOT TO SCALE, NO DATE PROVIDED).
3. SOIL BORINGS B−1 THROUGH B−6 WERE INSTALLED BY GIBBS & HILL, INC. AT THE APPROXIMATE LOCATIONS SHOWN, SOURCE IS FIGURE 2 PROVIDED IN THEIR REPORT ENTITLED "ENGINEERING INVESTIGATIONS AT INACTIVE HAZARDOUS WASTE SITES IN THE STATE OF NEW YORK − PHASE II INVESTIGATION, DECEMBER 1991".
4. THE LOCATIONS OF GEOPROBE GROUNDWATER SAMPLING LOCATIONS (GP−4 AND GP−5) AT 13D PICONE BOULEVARD ARE APPROXIMATE. THE SOURCE IS FIGURE 2 − GROUNDWATER SAMPLING LOCATIONS PREPARED BY FANNING, PHILLIPS & MOLMAR (FPM) DATED 8/23/96.
5. HISTORICAL SITE OPERATION FEATURES ARE BASED ON AN UNDISTORTED APRIL 7, 1980 PHOTOGRAPH PROVIDED BY AEROGRAPHICS, INC., SKETCHES OF SITE INSPECTIONS CONDUCTED ON JUNE 30, 1982 AND SEPTEMBER 14, 1982 BY THE SUFFOLK COUNTY HEALTH DEPARTMENT, AND FIGURES 1−2 AND 1−3 OF THE NYSDEC 1991 PHASE II REPORT BY GIBBS & HILL.

SOURCE:

ALL BASE MAP INFORMATION UNLESS OTHERWISE NOTED WAS TAKEN FROM A MAP ENTITLED "MONITORING WELL AND SOIL BORING LOCATION PLAN, HWD SITE−PICONE BOULEVARD, FARMINGDALE, NEW YORK, PROJECT No. 604.05 #2", PREPARED BY ALBERT W. TAY, FILE No. 99390−3.DWG, SURVEYED 11/22/99 THROUGH 11/29/99. SURVEY REVISED 2/9/2000 AND 5/13/2003.

0 15' 30'
GRAPHIC SCALE

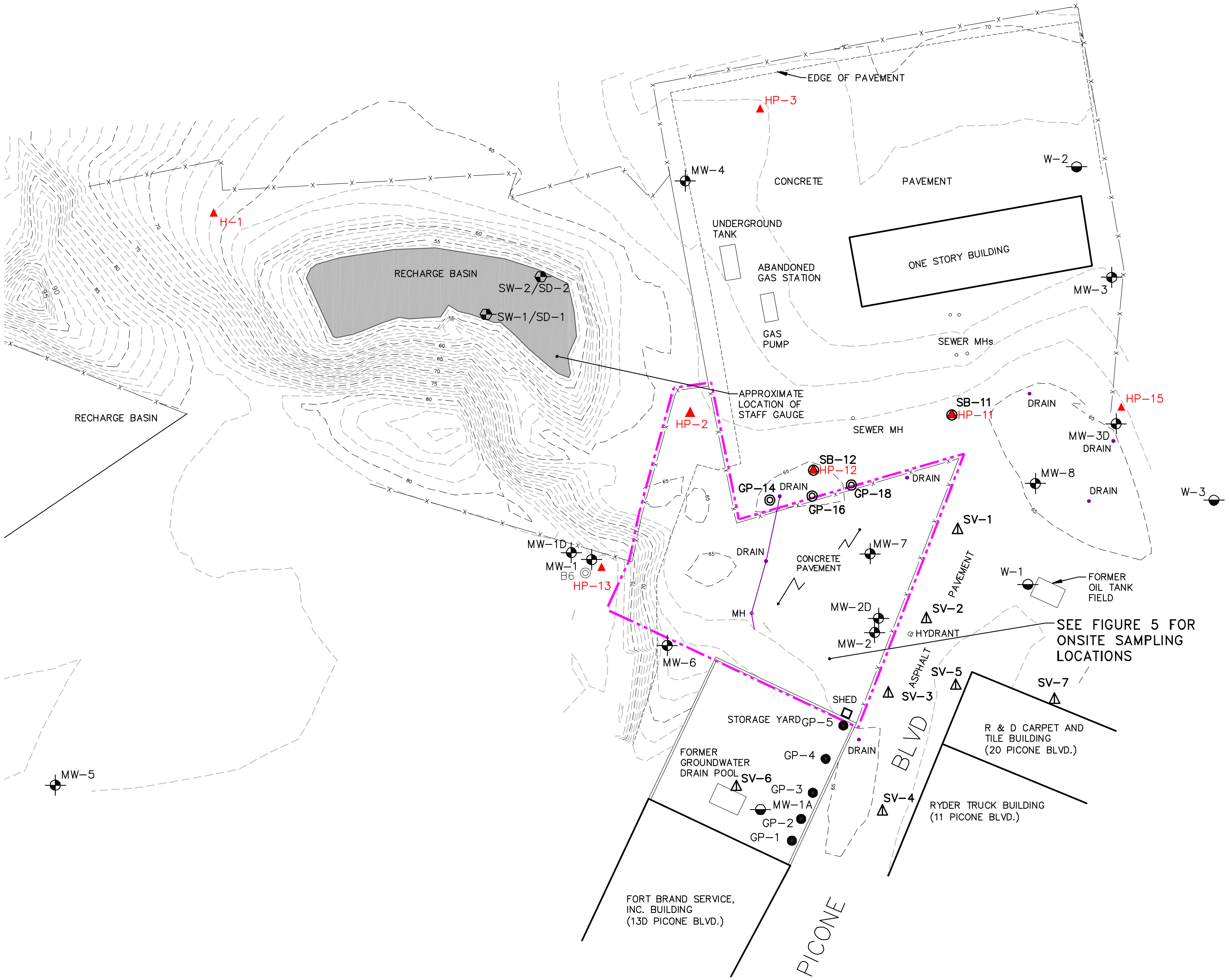
HAZARDOUS WASTE DISPOSAL, INC.
11A PICONE BOULEVARD
FARMINGDALE, NEW YORK
FEASIBILITY STUDY REPORT

ONSITE SAMPLING LOCATIONS

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
5

X: 60405X01.DWG
L: ON=*, OFF=REF*
P: PAGESET/PLT−DL
4/29/04 ROC−85−SLM SYR−85−GMS RCB
60405021/60405B02.DWG



LEGEND:

—·—·—	SITE BOUNDARY LOCATION (11A PICONE BOULEVARD)
—x—x—	FENCE LINE
◎	SOIL VOC DELINEATION BORING (AUGUST 2002)
△	SOIL VAPOR SAMPLE LOCATION (AUGUST 2002)
⊕	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF THE HWD SITE)
◒	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATIONS OF OTHER SITES)
⊚	SOIL BORING/HYDROPUNCH™ LOCATION
▲	HYDROPUNCH™ LOCATION ONLY
◉	SOIL BORING LOCATION ONLY
●	GEOPROBE® GROUNDWATER SAMPLING LOCATION
○	PHASE II SOIL BORINGS
◐	SURFACE WATER/SEDIMENT SAMPLING LOCATION (APPROXIMATE LOCATION)

NOTES:

1. SOIL VOC DELINEATION BORINGS AND SOIL VAPOR SAMPLE LOCATIONS WERE SURVEYED BY BBL DURING AUGUST 2002.
2. THE LOCATION OF THE FORMER OLD TANK FIELD IS APPROXIMATE. THE SOURCE IS A MAP PRODUCED BY TYREE BROTHERS ENVIRONMENTAL SERVICES, INC. (NOT TO SCALE, NO DATE PROVIDED).
3. APPROXIMATE LOCATIONS OF SOIL BORINGS B-1 THROUGH B-6 AND SURFACE WATER AND SEDIMENT SAMPLES (SW-1/SD-1 AND SW-2/SD-2) WERE INSTALLED BY GIBBS & HILL, INC., SOURCE IS FIGURE 2 PROVIDED IN THEIR REPORT ENTITLED "ENGINEERING INVESTIGATIONS AT INACTIVE HAZARDOUS WASTE SITES IN THE STATE OF NEW YORK – PHASE II INVESTIGATION, DECEMBER 1991".
4. THE LOCATION OF THE ABANDONED GAS STATION (GAS PUMP AND UNDERGROUND TANK) IS APPROXIMATE. THE SOURCE IS A MAP PROVIDED IN THE GIBBS & HILL, INC. DECEMBER 1991 PHASE II INVESTIGATION REPORT (NOT TO SCALE).
5. THE LOCATIONS OF THE FORMER GROUNDWATER DRAINPOOL, MONITORING WELL MW-1A AND GEOPROBE GROUNDWATER SAMPLING LOCATIONS (GP-3 THROUGH GP-5) AT 13D PICONE BOULEVARD ARE APPROXIMATE. THE SOURCE IS FIGURE 2 – GROUNDWATER SAMPLING LOCATIONS PREPARED BY FANNING, PHILLIPS & MOLMAR (FPM) DATED 8/23/96.

SOURCE:

ALL BASE MAP INFORMATION UNLESS OTHERWISE NOTED WAS TAKEN FROM A MAP ENTITLED "MONITORING WELL AND SOIL BORING LOCATION PLAN, HWD SITE–PICONE BOULEVARD, FARMINGDALE NEW YORK, PROJECT No. 604.05 #2", PREPARED BY ALBERT W. TAY, FILE No. 99390–3.DWG. SURVEYED 11/22/99 THROUGH 11/29/99. SURVEY REVISED 2/9/2000 AND 5/13/2003.

0 40' 80'
GRAPHIC SCALE

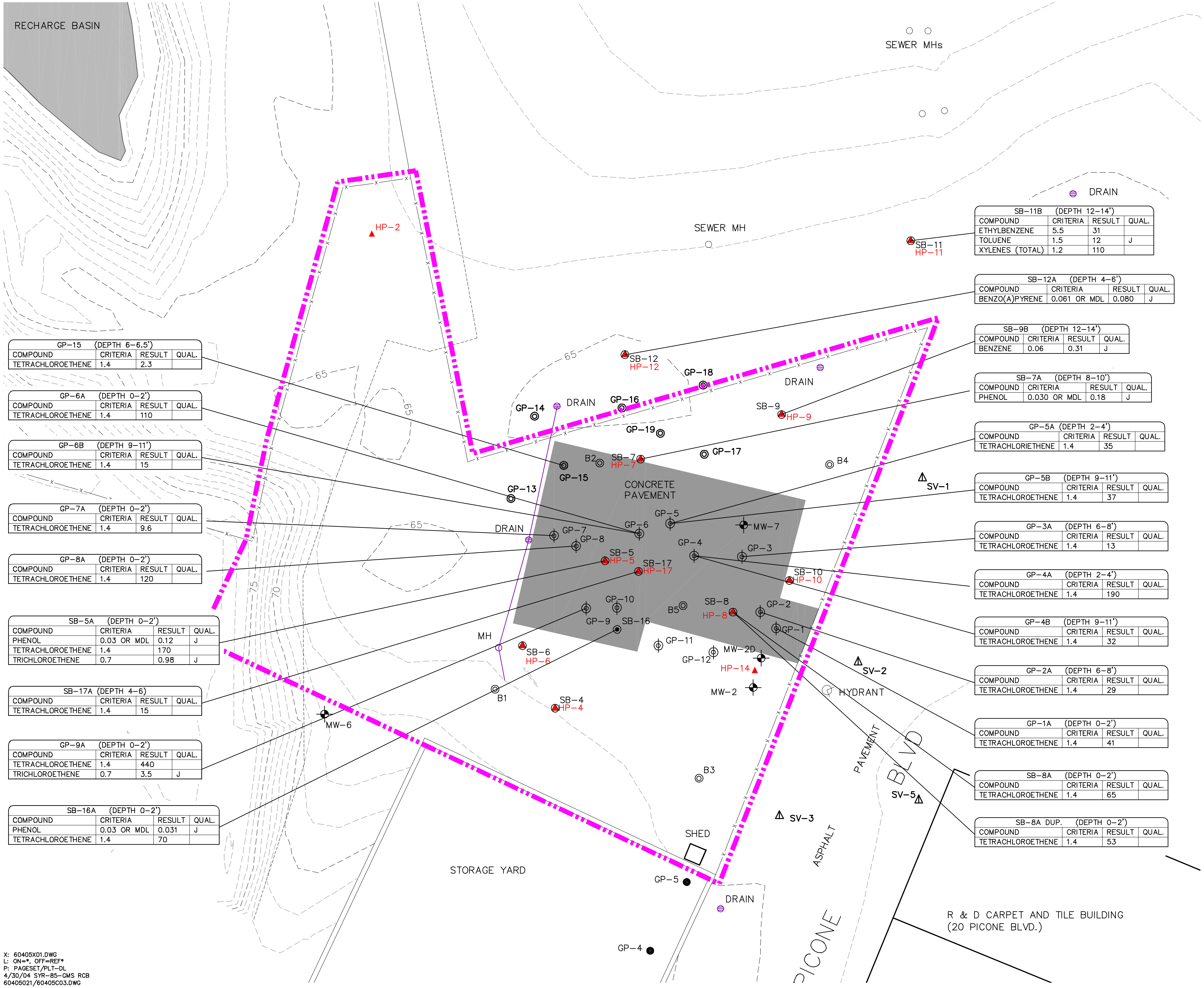
HAZARDOUS WASTE DISPOSAL, INC.
11A PICONE BOULEVARD
FARMINGDALE, NEW YORK
FEASIBILITY STUDY REPORT

SAMPLING LOCATIONS NEAR THE HWD SITE

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
6

X: 60405X01.DWG
L: ON=*, OFF=REF*
P: PAGESET/PLT-DL
5/6/04 ROC-85-SLM SYR-85-GMS RCB
60405021/60405B03.DWG



GP−15 (DEPTH 6−6.5')

COMPOUND	CRITERIA	RESULT	QUAL.
TETRACHLOROETHENE	1.4	2.3	

GP−6A (DEPTH 0−2')

COMPOUND	CRITERIA	RESULT	QUAL.
TETRACHLOROETHENE	1.4	110	

GP−6B (DEPTH 9−11')

COMPOUND	CRITERIA	RESULT	QUAL.
TETRACHLOROETHENE	1.4	15	

GP−7A (DEPTH 0−2')

COMPOUND	CRITERIA	RESULT	QUAL.
TETRACHLOROETHENE	1.4	9.6	

GP−8A (DEPTH 0−2')

COMPOUND	CRITERIA	RESULT	QUAL.
TETRACHLOROETHENE	1.4	120	

SB−5A (DEPTH 0−2')

COMPOUND	CRITERIA	RESULT	QUAL.
PHENOL	0.03 OR MDL	0.12	J
TETRACHLOROETHENE	1.4	170	
TRICHLOROETHENE	0.7	0.98	J

SB−17A (DEPTH 4−6)

COMPOUND	CRITERIA	RESULT	QUAL.
TETRACHLOROETHENE	1.4	15	

GP−9A (DEPTH 0−2')

COMPOUND	CRITERIA	RESULT	QUAL.
TETRACHLOROETHENE	1.4	440	
TRICHLOROETHENE	0.7	3.5	J

SB−16A (DEPTH 0−2')

COMPOUND	CRITERIA	RESULT	QUAL.
PHENOL	0.03 OR MDL	0.031	J
TETRACHLOROETHENE	1.4	70	

SB−11B (DEPTH 12−14')

COMPOUND	CRITERIA	RESULT	QUAL.
ETHYLBENZENE	5.5	31	
TOLUENE	1.5	12	J
XYLENES (TOTAL)	1.2	110	

SB−12A (DEPTH 4−6')

COMPOUND	CRITERIA	RESULT	QUAL.
BENZO(A)PYRENE	0.061 OR MDL	0.080	J

SB−9B (DEPTH 12−14')

COMPOUND	CRITERIA	RESULT	QUAL.
BENZENE	0.06	0.31	J

SB−7A (DEPTH 8−10')

COMPOUND	CRITERIA	RESULT	QUAL.
PHENOL	0.030 OR MDL	0.18	J

GP−5A (DEPTH 2−4')

COMPOUND	CRITERIA	RESULT	QUAL.
TETRACHLORIETHENE	1.4	35	

GP−5B (DEPTH 9−11')

COMPOUND	CRITERIA	RESULT	QUAL.
TETRACHLOROETHENE	1.4	37	

GP−3A (DEPTH 6−8')

COMPOUND	CRITERIA	RESULT	QUAL.
TETRACHLOROETHENE	1.4	13	

GP−4A (DEPTH 2−4')

COMPOUND	CRITERIA	RESULT	QUAL.
TETRACHLOROETHENE	1.4	190	

GP−4B (DEPTH 9−11')

COMPOUND	CRITERIA	RESULT	QUAL.
TETRACHLOROETHENE	1.4	32	

GP−2A (DEPTH 6−8')

COMPOUND	CRITERIA	RESULT	QUAL.
TETRACHLOROETHENE	1.4	29	

GP−1A (DEPTH 0−2')

COMPOUND	CRITERIA	RESULT	QUAL.
TETRACHLOROETHENE	1.4	41	

SB−8A (DEPTH 0−2')

COMPOUND	CRITERIA	RESULT	QUAL.
TETRACHLOROETHENE	1.4	65	

SB−8A DUP. (DEPTH 0−2')

COMPOUND	CRITERIA	RESULT	QUAL.
TETRACHLOROETHENE	1.4	53	

LEGEND:

▬ ▪ ▪ ▬	SITE BOUNDARY LOCATION (11A PICONE BOULEVARD)
—x—x—	FENCE LINE
◎	SOIL VOC DELINEATION BORING (AUGUST 2002)
△	SOIL VAPOR SAMPLE LOCATION (AUGUST 2002)
⊕	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF THE HWD SITE)
△	SOIL BORING/HYDROPUNCH™ LOCATION
▲	HYDROPUNCH™ LOCATION ONLY
⦿	SOIL BORING LOCATION ONLY
⌖	GEOPROBE® SOIL BORING LOCATION
●	GEOPROBE® GROUNDWATER SAMPLING LOCATION (APPROXIMATE)
◎	PHASE II SOIL BORING LOCATION (APPROXIMATE)
▨	APPROXIMATE EXTENT OF SOIL CONTAINING TETRACHLOROETHENE AT CONCENTRATIONS EXCEEDING TAGM 4046 SOIL GUIDANCE VALUES.

NOTES:

1. SOIL VOC DELINEATION BORINGS AND SOIL VAPOR SAMPLE LOCATIONS WERE SURVEYED BY BBL DURING AUGUST 2002.
2. THE LOCATION OF THE FORMER OIL TANK FIELD IS APPROXIMATE. THE SOURCE IS A MAP PRODUCED BY TYREE BROTHERS ENVIRONMENTAL SERVICES, INC. (NOT TO SCALE, NO DATE PROVIDED).
3. SOIL BORINGS B−1 THROUGH B−6 WERE INSTALLED BY GIBBS & HILL, INC. AT THE APPROXIMATE LOCATIONS SHOWN, SOURCE IS FIGURE 2 PROVIDED IN THEIR REPORT ENTITLED "ENGINEERING INVESTIGATIONS AT INACTIVE HAZARDOUS WASTE SITES IN THE STATE OF NEW YORK − PHASE II INVESTIGATION, DECEMBER 1991".
4. THE LOCATIONS OF GEOPROBE GROUNDWATER SAMPLING LOCATIONS (GP−4 AND GP−5) AT 13D PICONE BOULEVARD ARE APPROXIMATE. THE SOURCE IS FIGURE 2 − GROUNDWATER SAMPLING LOCATIONS PREPARED BY FANNING, PHILLIPS & MOLMAR (FPM) DATED 8/23/96.

SOURCE:

ALL BASE MAP INFORMATION UNLESS OTHERWISE NOTED WAS TAKEN FROM A MAP ENTITLED "MONITORING WELL AND SOIL BORING LOCATION PLAN, HWD SITE−PICONE BOULEVARD, FARMINGDALE, NEW YORK, PROJECT No. 604.05 #2", PREPARED BY ALBERT W. TAY, FILE No. 99390−3.DWG, SURVEYED 11/22/99 THROUGH 11/29/99. SURVEY REVISED 2/9/2000 AND 5/13/2003.

0 15' 30'
GRAPHIC SCALE

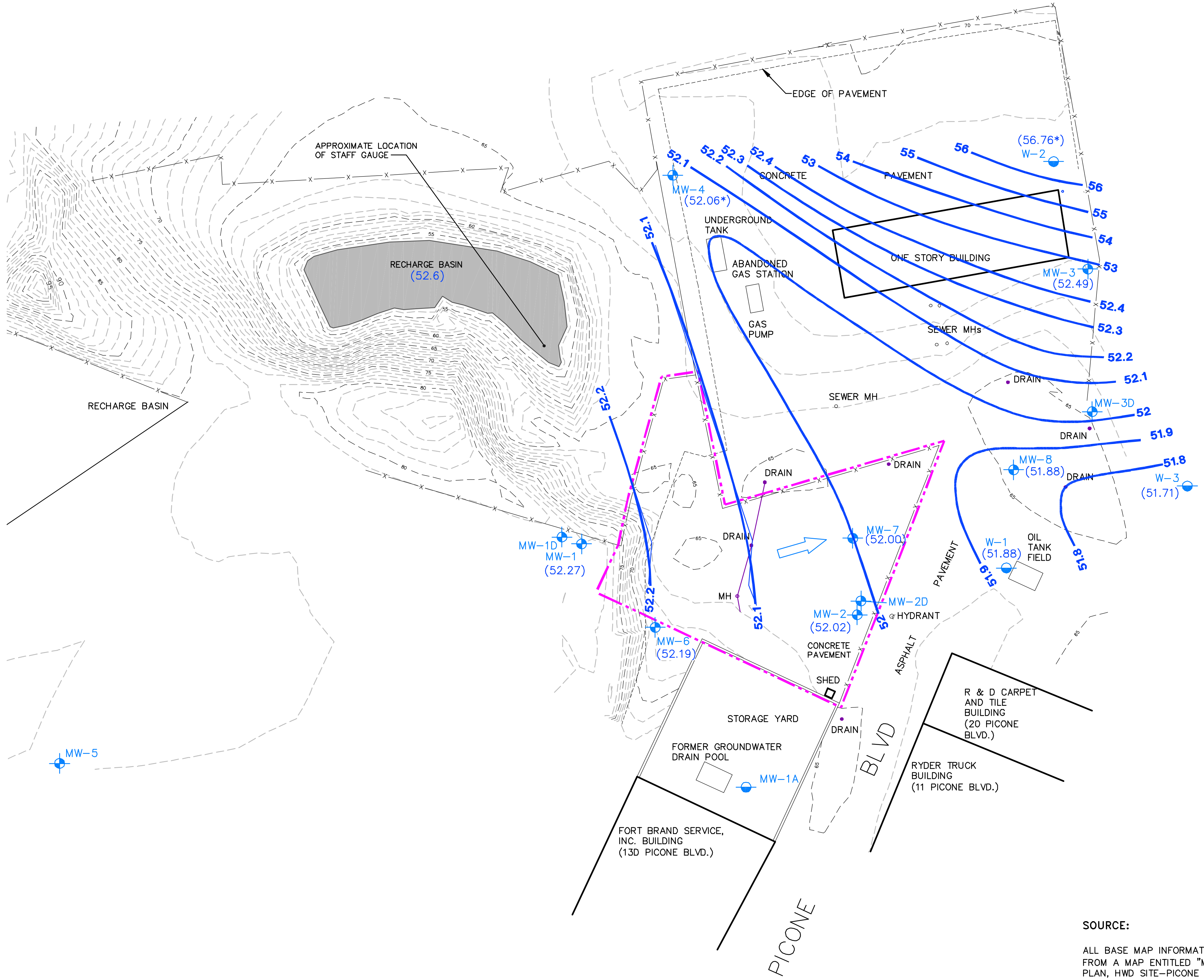
HAZARDOUS WASTE DISPOSAL, INC.
11A PICONE BOULEVARD
FARMINGDALE, NEW YORK
FEASIBILITY STUDY REPORT

DISTRIBUTION OF ORGANIC COMPOUNDS IN SOIL ABOVE NYSDEC TAGM 4046 GUIDANCE VALUES (ppm)

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
7

X: 60405X01.DWG
L: ON=*, OFF=REF*
P: PAGESET/PLT−DL
4/30/04 SYR−85−GMS RCB
60405021/60405C03.DWG



LEGEND:

— · — · —	SITE BOUNDARY LOCATION (11A PICONE BOULEVARD)
——x——x——	FENCE LINE
⌖	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF THE HWD SITE)
⊖	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF OTHER SITES)
(51.88)	GROUNDWATER ELEVATION IN FEET
*	INFERRED GROUNDWATER ELEVATION IN FEET
52.2 ———	INFERRED GROUNDWATER CONTOUR LINE IN FEET
⇦	INFERRED GROUNDWATER FLOW DIRECTION BENEATH HWD SITE

NOTES:

1. WELLS MW–1 THROUGH MW–4 INSTALLED BY GIBBS & HILL, INC. IN SEPTEMBER 1990.
2. WELLS MW–5 AND MW–6 WERE INSTALLED IN JUNE 1994 BY FANNING, PHILIPS & MOLNAR.
3. WELLS W–1, W–2 AND W–3 INSTALLED BY TYREE BROTHERS ENVIRONMENTAL SERVICES, INC., SOURCE IS MAP PROVIDED BY GIBBS & HILL, INC. DATED 6/17/94 (NOT TO SCALE).
4. WELLS MW–1D THROUGH MW–3D INSTALLED BY BLASLAND, BOUCK & LEE, INC. (BBL) IN DECEMBER 1999. WELLS MW–7 AND MW–8 INSTALLED BY BBL DURING FEBRUARY 2001 AND APRIL 2003, RESPECTIVELY.
5. THE LOCATION OF THE OLD TANK FIELD IS APPROXIMATE. THE SOURCE IS A MAP PRODUCED BY TYREE BROTHERS ENVIRONMENTAL SERVICES, INC. (NOT TO SCALE, NO DATE PROVIDED).
6. THE LOCATIONS OF THE FORMER GROUNDWATER DRAINPOOL AND MONITORING WELL MW–1A AT 13D PICONE BOULEVARD ARE APPROXIMATE. THE SOURCE IS FIGURE 2 – GROUNDWATER SAMPLING LOCATIONS PREPARED BY FANNING, PHILLIPS & MOLMAR (FPM) DATED 8/23/96.
7. THE LOCATION OF THE ABANDONED GAS STATION (GAS PUMP AND UNDERGROUND TANK) IS APPROXIMATE. THE SOURCE IS A MAP PROVIDED IN THE GIBBS & HILL, INC. DECEMBER 1991 PHASE II INVESTIGATION REPORT (NOT TO SCALE).
8. WATER LEVEL MEASUREMENTS WERE NOT OBTAINED AT MONITORING WELLS MW–4 AND W–2 ON APRIL 23, 2003. FOR PURPOSES OF DEVELOPING THE GROUNDWATER POTENTIOMETRIC SURFACE MAP, THE GROUNDWATER ELEVATIONS AT THESE TWO WELLS HAVE BEEN INTERPRETED CONSIDERING THE FOLLOWING:

   - BASED ON PREVIOUS MONITORING EVENTS, GROUNDWATER ELEVATIONS HAVE HISTORICALLY BEEN SIMILAR AT MONITORING WELLS MW–2 AND MW–4 (I.E., ELEVATIONS WITHIN 0.01 TO 0.06 FEET OF ONE ANOTHER);

   - GROUNDWATER ELEVATIONS HAVE CONSISTENTLY BEEN HIGHER AT MONITORING WELL W–2 THAN AT OTHER MONITORING WELLS WHERE MEASUREMENTS HAVE BEEN OBTAINED; AND

   - THE MAGNITUDE OF THE INCREASE/DECREASE IN THE WATER LEVELS MEASURED BETWEEN CONSECUTIVE MONITORING EVENTS AT EACH WELL (EXCEPT MW–3) HAS BEEN CONSISTENT (E.G., THE WATER LEVELS INCREASED BY 2.18 FEET TO 2.21 FEET AT EACH WELL BETWEEN FEBRUARY 19, 2001 AND APRIL 11, 2001 AND DECREASED BY 3.06 FEET TO 3.10 FEET AT EACH WELL BETWEEN APRIL 11, 2001 AND APRIL 22, 2003).

0 40' 80'
GRAPHIC SCALE

SOURCE:

ALL BASE MAP INFORMATION UNLESS OTHERWISE NOTED WAS TAKEN FROM A MAP ENTITLED "MONITORING WELL AND SOIL BORING LOCATION PLAN, HWD SITE–PICONE BOULEVARD, FARMINGDALE NEW YORK, PROJECT No. 604.05 #2". PREPARED BY ALBERT W. TAY. FILE No. 99390–3.DWG. SURVEYED 11/22/99 THROUGH 11/29/99. SURVEY REVISED 2/9/2000 AND 5/13/2003.

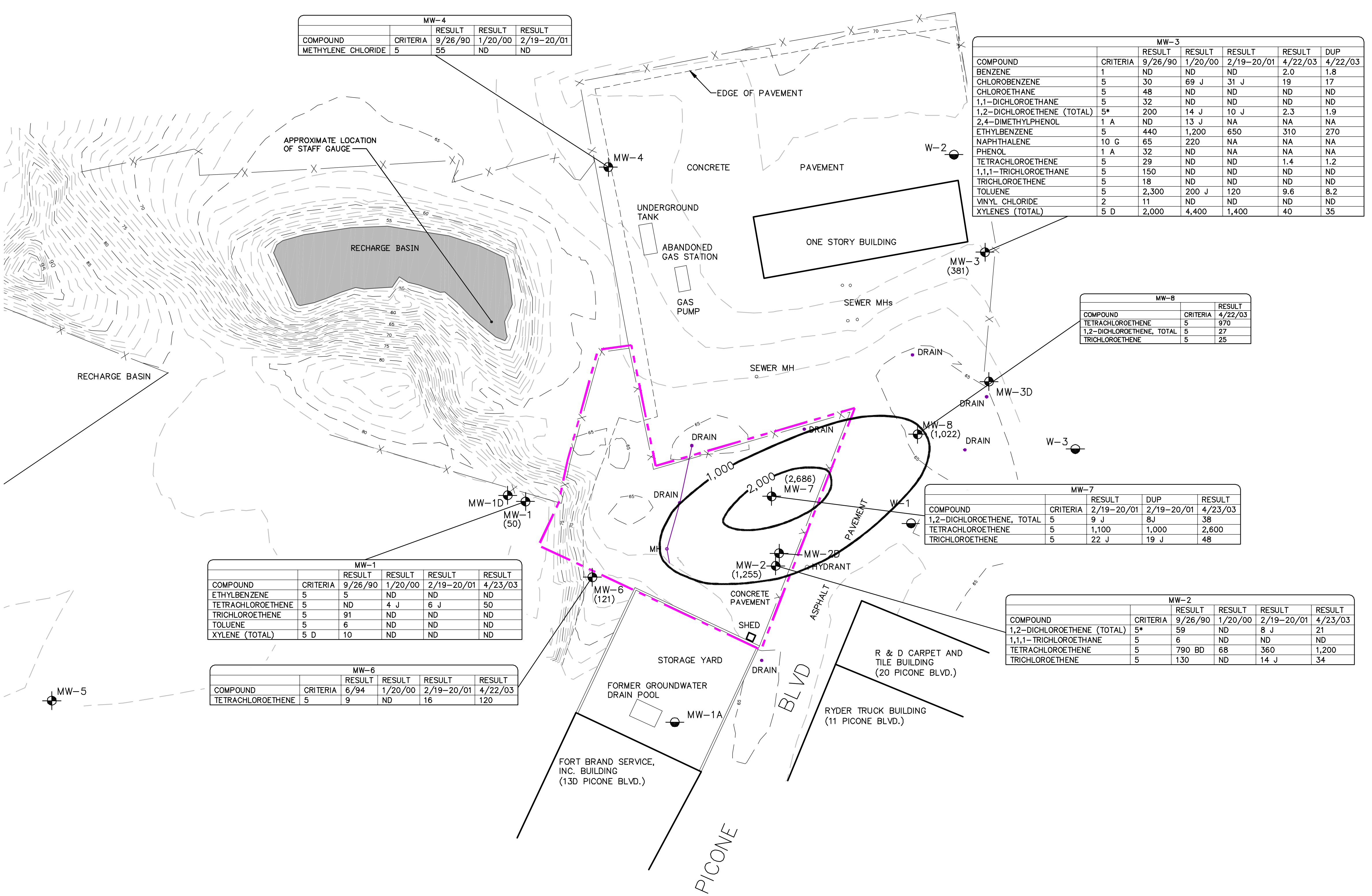
X: 60405X01.DWG
L: ON=*, OFF=REF*
P: PAGESET/PLT–DL
4/30/04 SYR–85–RCB
60405021/60405W02.DWG

HAZARDOUS WASTE DISPOSAL, INC.
11A PICONE BOULEVARD
FARMINGDALE, NEW YORK
FEASIBILITY STUDY REPORT

SHALLOW GROUNDWATER ELEVATION CONTOUR MAP (APRIL 22, 2003)

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
8



MW-4

COMPOUND	CRITERIA	RESULT 9/26/90	RESULT 1/20/00	RESULT 2/19-20/01
METHYLENE CHLORIDE	5	55	ND	ND

MW-3

COMPOUND	CRITERIA	RESULT 9/26/90	RESULT 1/20/00	RESULT 2/19-20/01	RESULT 4/22/03	DUP 4/22/03
BENZENE	1	ND	ND	ND	2.0	1.8
CHLOROBENZENE	5	30	69 J	31 J	19	17
CHLOROETHANE	5	48	ND	ND	ND	ND
1,1-DICHLOROETHANE	5	32	ND	ND	ND	ND
1,2-DICHLOROETHENE (TOTAL)	5*	200	14 J	10 J	2.3	1.9
2,4-DIMETHYLPHENOL	1 A	ND	13 J	NA	NA	NA
ETHYLBENZENE	5	440	1,200	650	310	270
NAPHTHALENE	10 G	65	220	NA	NA	NA
PHENOL	1 A	32	ND	NA	NA	NA
TETRACHLOROETHENE	5	29	ND	ND	1.4	1.2
1,1,1-TRICHLOROETHANE	5	150	ND	ND	ND	ND
TRICHLOROETHENE	5	18	ND	ND	ND	ND
TOLUENE	5	2,300	200 J	120	9.6	8.2
VINYL CHLORIDE	2	11	ND	ND	ND	ND
XYLENES (TOTAL)	5 D	2,000	4,400	1,400	40	35

MW-8

COMPOUND	CRITERIA	RESULT 4/22/03
TETRACHLOROETHENE	5	970
1,2-DICHLOROETHENE, TOTAL	5	27
TRICHLOROETHENE	5	25

MW-7

COMPOUND	CRITERIA	RESULT 2/19-20/01	DUP 2/19-20/01	RESULT 4/23/03
1,2-DICHLOROETHENE, TOTAL	5	9 J	8J	38
TETRACHLOROETHENE	5	1,100	1,000	2,600
TRICHLOROETHENE	5	22 J	19 J	48

MW-1

COMPOUND	CRITERIA	RESULT 9/26/90	RESULT 1/20/00	RESULT 2/19-20/01	RESULT 4/23/03
ETHYLBENZENE	5	5	ND	ND	ND
TETRACHLOROETHENE	5	ND	4 J	6 J	50
TRICHLOROETHENE	5	91	ND	ND	ND
TOLUENE	5	6	ND	ND	ND
XYLENE (TOTAL)	5 D	10	ND	ND	ND

MW-2

COMPOUND	CRITERIA	RESULT 9/26/90	RESULT 1/20/00	RESULT 2/19-20/01	RESULT 4/23/03
1,2-DICHLOROETHENE (TOTAL)	5*	59	ND	8 J	21
1,1,1-TRICHLOROETHANE	5	6	ND	ND	ND
TETRACHLOROETHENE	5	790 BD	68	360	1,200
TRICHLOROETHENE	5	130	ND	14 J	34

MW-6

COMPOUND	CRITERIA	RESULT 6/94	RESULT 1/20/00	RESULT 2/19-20/01	RESULT 4/22/03
TETRACHLOROETHENE	5	9	ND	16	120

LEGEND:

— — —	SITE BOUNDARY LOCATION (11A PICONE BOULEVARD)
—X—	FENCE LINE
⊕	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF THE HWD SITE)
⊖	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF OTHER SITES)
1,000 ——	INFERRED TOTAL VOC GROUNDWATER ISOCONCENTRATION
(1,022)	TOTAL VOC GROUNDWATER COCCENTRATION (4/23/03)

NOTES:

1. ALL CONCENTRATIONS ARE REPORTED IN MICROGRAMS PER LITER (ug/L) EQUIVALENT TO PARTS PER BILLION (ppb).
2. G = GUIDANCE VALUE
3. * = CRITERIA VALUE LISTED FOR 1,2-DICHLOROETHENE (Total) APPLIES TO THE Cis AND Trans- ISOMERS INDIVIDUALLY.
4. D = VALUE LISTED APPLIES TO EACH ISOMER INDIVIDUALLY.
5. A = VALUE LISTED APPLIES TO THE SUM OF THESE SUBSTANCES.
6. J = THE RESULT IS LESS THAN THE QUANTITATION LIMIT BUT GREATER THAN ZERO. CONCENTRATION GIVEN IS AN APPROXIMATE VALUE.
7. BD = CONTAMINANT ALSO DETECTED IN METHOD BLANK. DILUTED SAMPLE ANALYSIS.
8. ND = NOT DETECTED.
9. NA = NOT ANALYZED.
10. CRITERIA REFERENCE: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) DIVISION OF WATER TECHNICAL AND OPERATIONAL GUIDANCE SERIES (1.1.1), DOCUMENT TITLED AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES AND GROUNDWATER EFFLUENT LIMITATIONS, DATED JUNE 1998, UPDATED APRIL 2000.

SOURCE:

ALL BASE MAP INFORMATION UNLESS OTHERWISE NOTED WAS TAKEN FROM A MAP ENTITLED "MONITORING WELL AND SOIL BORING LOCATION PLAN, HWD SITE-PICONE BOULEVARD, FARMINGDALE NEW YORK, PROJECT No. 604.05 #2". PREPARED BY ALBERT W. TAY. FILE No. 99390-3.DWG. SURVEYED 11/22/99 THROUGH 11/29/99. SURVEY REVISED 2/9/2000 AND 5/13/2003.

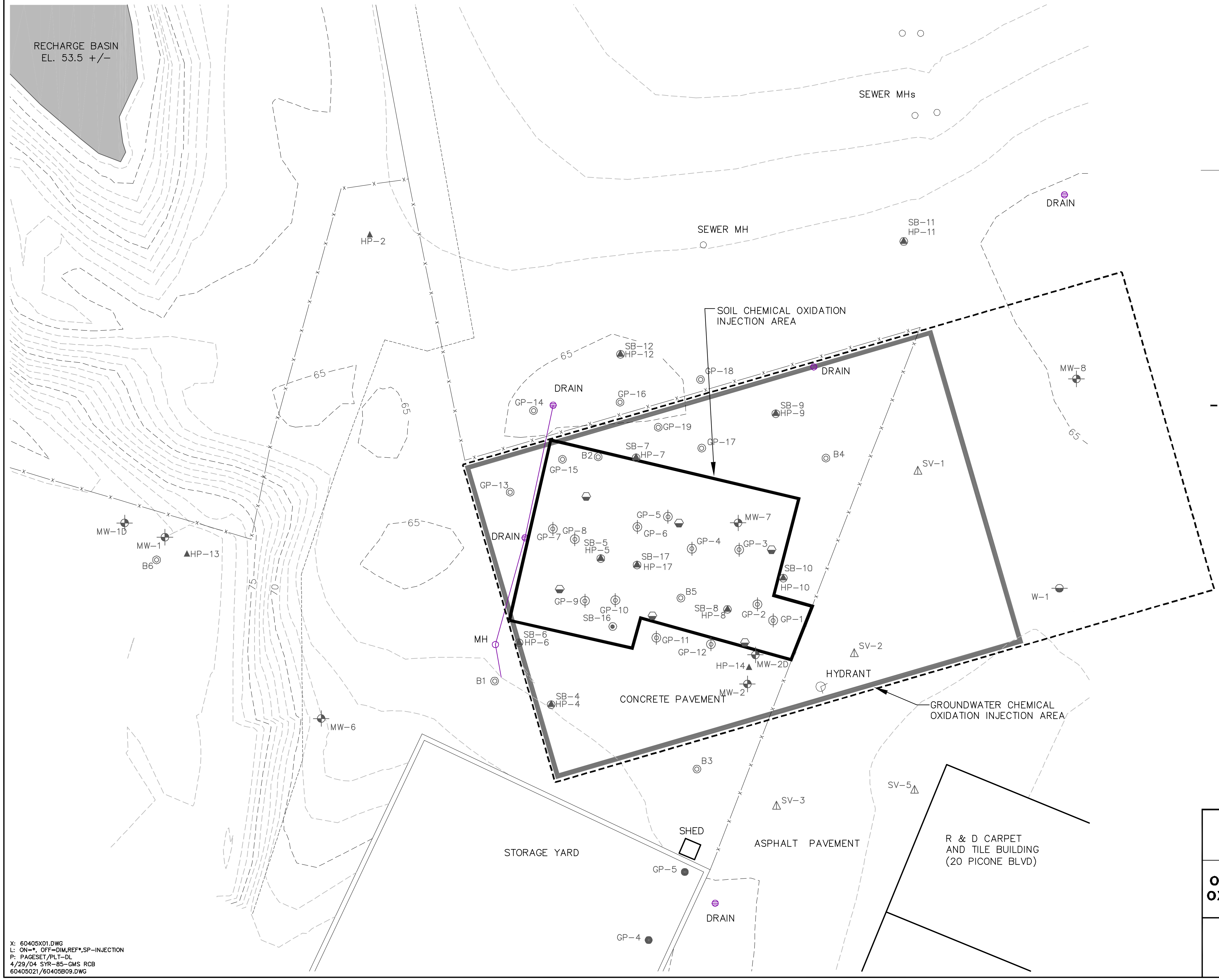
HAZARDOUS WASTE DISPOSAL, INC.
11A PICONE BOULEVARD
FARMINGDALE, NEW YORK
FEASIBILITY STUDY REPORT

DISTRIBUTION OF ORGANIC COMPOUNDS IN GROUNDWATER ABOVE NYSDEC CRITERIA (ppb)

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
9

X: 60405X01.DWG
L: ON=*, OFF=REF*
P: PAGESET/PLT-DL
4/30/04 SYR-85-GMS RCB
60405021/60405C04.DWG



LEGEND:

—x—x—	FENCE LINE
◎	SOIL VOC DELINEATION BORING (AUGUST 2002)
△	SOIL VAPOR SAMPLE LOCATION (AUGUST 2002)
⊕	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF THE HWD SITE)
⊖	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF OTHER SITES)
◬	SOIL BORING/HYDROPUNCH™ LOCATION
▲	HYDROPUNCH™ LOCATION ONLY
◉	SOIL BORING LOCATION ONLY
⌽	GEOPROBE® SOIL BORING LOCATION
●	GEOPROBE® GROUNDWATER SAMPLING LOCATION (APPROXIMATE)
◎	PHASE II SOIL BORING LOCATION (APPROXIMATE)
- - - -	ANTICIPATED AREA OF SATURATED SOIL/ GROUNDWATER TO BE TREATED BY CHEMICAL OXIDATION

NOTES:

1. SOIL VOC DELINEATION BORINGS AND SOIL VAPOR SAMPLE LOCATIONS WERE SURVEYED BY BBL DURING AUGUST 2002.
2. APPROXIMATE LOCATIONS OF SOIL BORINGS B−1 THROUGH B−6 WERE INSTALLED BY GIBBS & HILL, INC., SOURCE IS FIGURE 2 PROVIDED IN THEIR REPORT ENTITLED "ENGINEERING INVESTIGATIONS AT INACTIVE HAZARDOUS WASTE SITES IN THE STATE OF NEW YORK − PHASE II INVESTIGATION, DECEMBER 1991".
3. CONCEPTUAL LOCATIONS FOR SOIL AND GROUNDWATER OXIDANT INJECTION POINTS ARE DESCRIBED IN TABLE 9, NOTES 9 AND 13, RESPECTIVELY.
4. THE OXIDANT DELIVERY SYSTEM(S) AND INJECTION POINT LOCATIONS WILL BE DETERMINED DURING REMEDIAL DESIGN.

SOURCE:

ALL BASE MAP INFORMATION UNLESS OTHERWISE NOTED WAS TAKEN FROM A MAP ENTITLED "MONITORING WELL AND SOIL BORING LOCATION PLAN, HWD SITE−PICONE BOULEVARD, FARMINGDALE, NEW YORK, PROJECT No. 604.05 #2", PREPARED BY ALBERT W. TAY, FILE No. 99390−3.DWG, SURVEYED 11/22/99 THROUGH 11/29/99. SURVEY REVISED 2/9/2000 AND 5/13/2003.

0 15' 30'
GRAPHIC SCALE

HAZARDOUS WASTE DISPOSAL, INC.
11A PICONE BOULEVARD
FARMINGDALE, NEW YORK

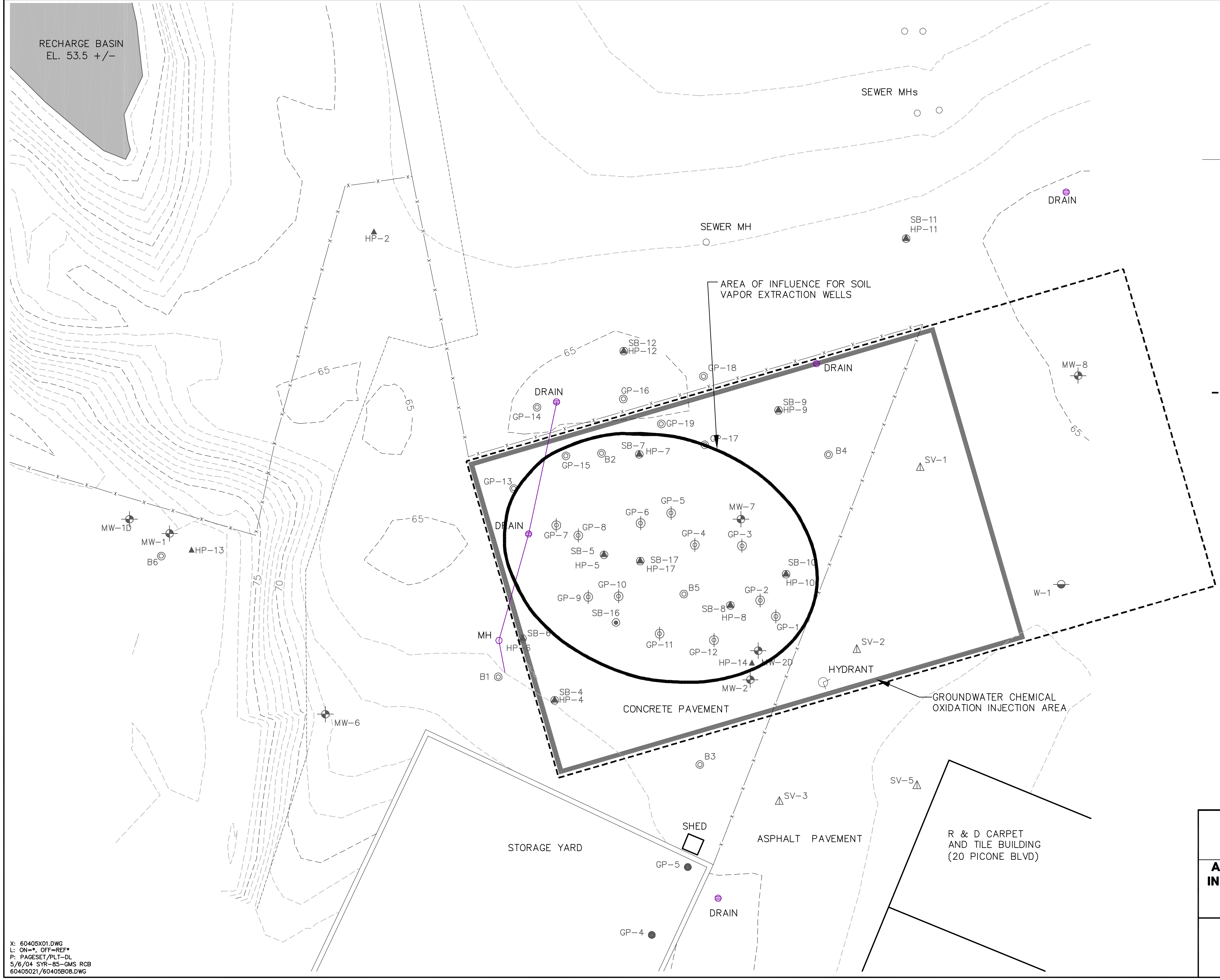
FEASIBILITY STUDY REPORT

ALTERNATIVE 2 - IN-SITU SOIL CHEMICAL OXIDATION, IN-SITU GROUNDWATER CHEMICAL OXIDATION (FOCUSED APPLICATION), AND SITE CONTROLS & MONITORING

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
10

X: 60405X01.DWG
L: ON=*, OFF=DIM,REF*,SP−INJECTION
P: PAGESET/PLT−DL
4/29/04 SYR−85−GMS RCB
60405021/60405B09.DWG



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L: ON=*, OFF=REF*
P: PAGESET/PLT-DL
5/6/04 SYR-85-GMS RCB
60405021/60405B08.DWG

LEGEND:

—x—x—	FENCE LINE
◎	SOIL VOC DELINEATION BORING (AUGUST 2002)
△	SOIL VAPOR SAMPLE LOCATION (AUGUST 2002)
⊕	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF THE HWD SITE)
⊖	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF OTHER SITES)
◬	SOIL BORING/HYDROPUNCH™ LOCATION
▲	HYDROPUNCH™ LOCATION ONLY
⊙	SOIL BORING LOCATION ONLY
⌀	GEOPROBE® SOIL BORING LOCATION
●	GEOPROBE® GROUNDWATER SAMPLING LOCATION (APPROXIMATE)
◎	PHASE II SOIL BORING LOCATION (APPROXIMATE)
------	ANTICIPATED AREA OF SATURATED SOIL/ GROUNDWATER TO BE TREATED BY CHEMICAL OXIDATION

NOTES:

1. SOIL VOC DELINEATION BORINGS AND SOIL VAPOR SAMPLE LOCATIONS WERE SURVEYED BY BBL DURING AUGUST 2002.
2. APPROXIMATE LOCATIONS OF SOIL BORINGS B-1 THROUGH B-6 WERE INSTALLED BY GIBBS & HILL, INC., SOURCE IS FIGURE 2 PROVIDED IN THEIR REPORT ENTITLED "ENGINEERING INVESTIGATIONS AT INACTIVE HAZARDOUS WASTE SITES IN THE STATE OF NEW YORK – PHASE II INVESTIGATION, DECEMBER 1991".
3. CONCEPTUAL CONFIGURATION OF SOIL VAPOR EXTRACTION WELLS AND GROUNDWATER INJECTION POINTS ARE DESCRIBED IN TABLE 10, NOTES 8 AND 14, RESPECTIVELY.
4. SOIL VAPOR EXTRACTION WELL LOCATIONS, GROUNDWATER OXIDANT DELIVERY SYSTEM, AND OXIDANT INJECTION POINT LOCATIONS WILL BE DETERMINED DURING REMEDIAL DESIGN.

SOURCE:

ALL BASE MAP INFORMATION UNLESS OTHERWISE NOTED WAS TAKEN FROM A MAP ENTITLED "MONITORING WELL AND SOIL BORING LOCATION PLAN, HWD SITE–PICONE BOULEVARD, FARMINGDALE, NEW YORK, PROJECT No. 604.05 #2", PREPARED BY ALBERT W. TAY, FILE No. 99390-3.DWG, SURVEYED 11/22/99 THROUGH 11/29/99. SURVEY REVISED 2/9/2000 AND 5/13/2003.

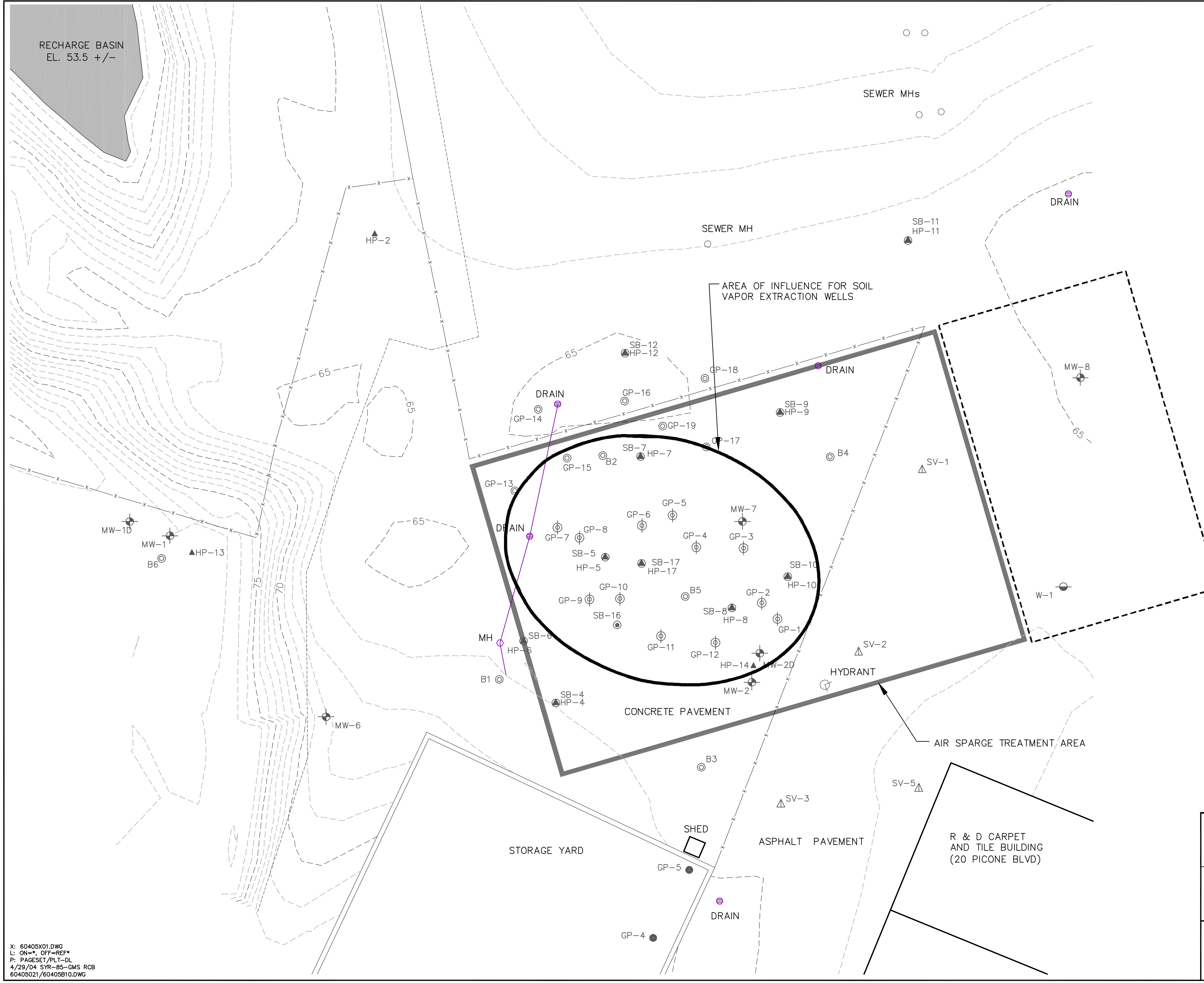
0 15' 30'
GRAPHIC SCALE

HAZARDOUS WASTE DISPOSAL, INC.
11A PICONE BOULEVARD
FARMINGDALE, NEW YORK
FEASIBILITY STUDY REPORT

ALTERNATIVE 3 - SOIL VAPOR EXTRACTION, IN-SITU GROUNDWATER CHEMICAL OXIDATION (FOCUSED APPLICATION), AND SITE CONTROLS & MONITORING

BBL
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
11



X: 60405X01.DWG
L: ON=*, OFF=REF*
P: PAGESET/PLT-DL
4/29/04 SYR-85-GMS RCB
60405021/60405B10.DWG

LEGEND:

—x—x—	FENCE LINE
◎	SOIL VOC DELINEATION BORING (AUGUST 2002)
△	SOIL VAPOR SAMPLE LOCATION (AUGUST 2002)
⊕	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF THE HWD SITE)
⊖	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF OTHER SITES)
◬	SOIL BORING/HYDROPUNCH™ LOCATION
▲	HYDROPUNCH™ LOCATION ONLY
◉	SOIL BORING LOCATION ONLY
⌽	GEOPROBE® SOIL BORING LOCATION
●	GEOPROBE® GROUNDWATER SAMPLING LOCATION (APPROXIMATE)
◎	PHASE II SOIL BORING LOCATION (APPROXIMATE)
- - - - - -	OFF-SITE GROUNDWATER AIR SPARGE TREATMENT AREA TO BE DETERMINED DURING REMEDIAL DESIGN

NOTES:

1. SOIL VOC DELINEATION BORINGS AND SOIL VAPOR SAMPLE LOCATIONS WERE SURVEYED BY BBL DURING AUGUST 2002.
2. APPROXIMATE LOCATIONS OF SOIL BORINGS B-1 THROUGH B-6 WERE INSTALLED BY GIBBS & HILL, INC., SOURCE IS FIGURE 2 PROVIDED IN THEIR REPORT ENTITLED "ENGINEERING INVESTIGATIONS AT INACTIVE HAZARDOUS WASTE SITES IN THE STATE OF NEW YORK – PHASE II INVESTIGATION, DECEMBER 1991".
3. CONCEPTUAL CONFIGURATION OF SOIL VAPOR EXTRACTION WELLS AND GROUNDWATER INJECTION POINTS ARE DESCRIBED IN TABLE 10, NOTES 8 AND 14, RESPECTIVELY.
4. SOIL VAPOR EXTRACTION WELL LOCATIONS, GROUNDWATER OXIDANT DELIVERY SYSTEM, AND OXIDANT INJECTION POINT LOCATIONS WILL BE DETERMINED DURING REMEDIAL DESIGN.

SOURCE:

ALL BASE MAP INFORMATION UNLESS OTHERWISE NOTED WAS TAKEN FROM A MAP ENTITLED "MONITORING WELL AND SOIL BORING LOCATION PLAN, HWD SITE-PICONE BOULEVARD, FARMINGDALE, NEW YORK, PROJECT No. 604.05 #2", PREPARED BY ALBERT W. TAY, FILE No. 99390-3.DWG, SURVEYED 11/22/99 THROUGH 11/29/99. SURVEY REVISED 2/9/2000 AND 5/13/2003.

0 15' 30'
GRAPHIC SCALE

HAZARDOUS WASTE DISPOSAL, INC.
11A PICONE BOULEVARD
FARMINGDALE, NEW YORK

FEASIBILITY STUDY REPORT

ALTERNATIVE 4 - SOIL VAPOR EXTRACTION, GROUNDWATER AIR SPARGING, AND SITE CONTROLS AND MONITORING

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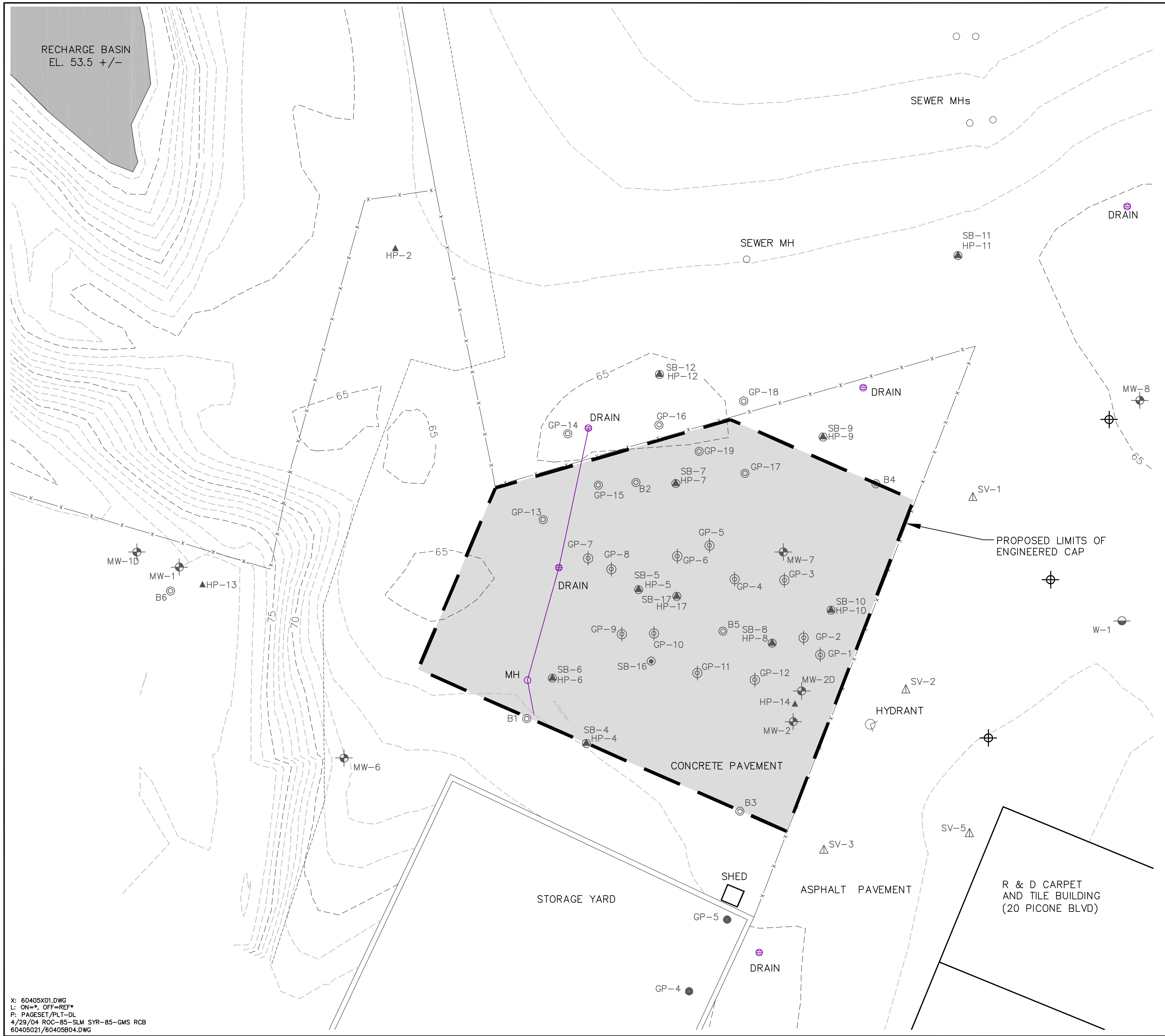
FIGURE
12



LEGEND:

▨	PROPOSED LIMITS OF ENGINEERED CAP
⌖	PROPOSED GROUNDWATER PUMPING WELL
—x—x—	FENCE LINE
◎	SOIL VOC DELINEATION BORING (AUGUST 2002)
△	SOIL VAPOR SAMPLE LOCATION (AUGUST 2002)
⊕	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF THE HWD SITE)
⊖	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF OTHER SITES)
◬	SOIL BORING/HYDROPUNCH™ LOCATION
▲	HYDROPUNCH™ LOCATION ONLY
◉	SOIL BORING LOCATION ONLY
⦶	GEOPROBE® SOIL BORING LOCATION
●	GEOPROBE® GROUNDWATER SAMPLING LOCATION (APPROXIMATE)
◎	PHASE II SOIL BORING LOCATION (APPROXIMATE)

NOTES:

1. SOIL VOC DELINEATION BORINGS AND SOIL VAPOR SAMPLE LOCATIONS WERE SURVEYED BY BBL DURING AUGUST 2002.
2. APPROXIMATE LOCATIONS OF SOIL BORINGS B−1 THROUGH B−6 WERE INSTALLED BY GIBBS & HILL, INC., SOURCE IS FIGURE 2 PROVIDED IN THEIR REPORT ENTITLED "ENGINEERING INVESTIGATIONS AT INACTIVE HAZARDOUS WASTE SITES IN THE STATE OF NEW YORK − PHASE II INVESTIGATION, DECEMBER 1991".

SOURCE:

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0 15' 30'
GRAPHIC SCALE

HAZARDOUS WASTE DISPOSAL, INC.
11A PICONE BOULEVARD
FARMINGDALE, NEW YORK
FEASIBILITY STUDY REPORT

ALTERNATIVE 5 - ASPHALT CAP/ INSTITUTIONAL CONTROLS AND GROUNDWATER EXTRACTION/ONSITE TREATMENT

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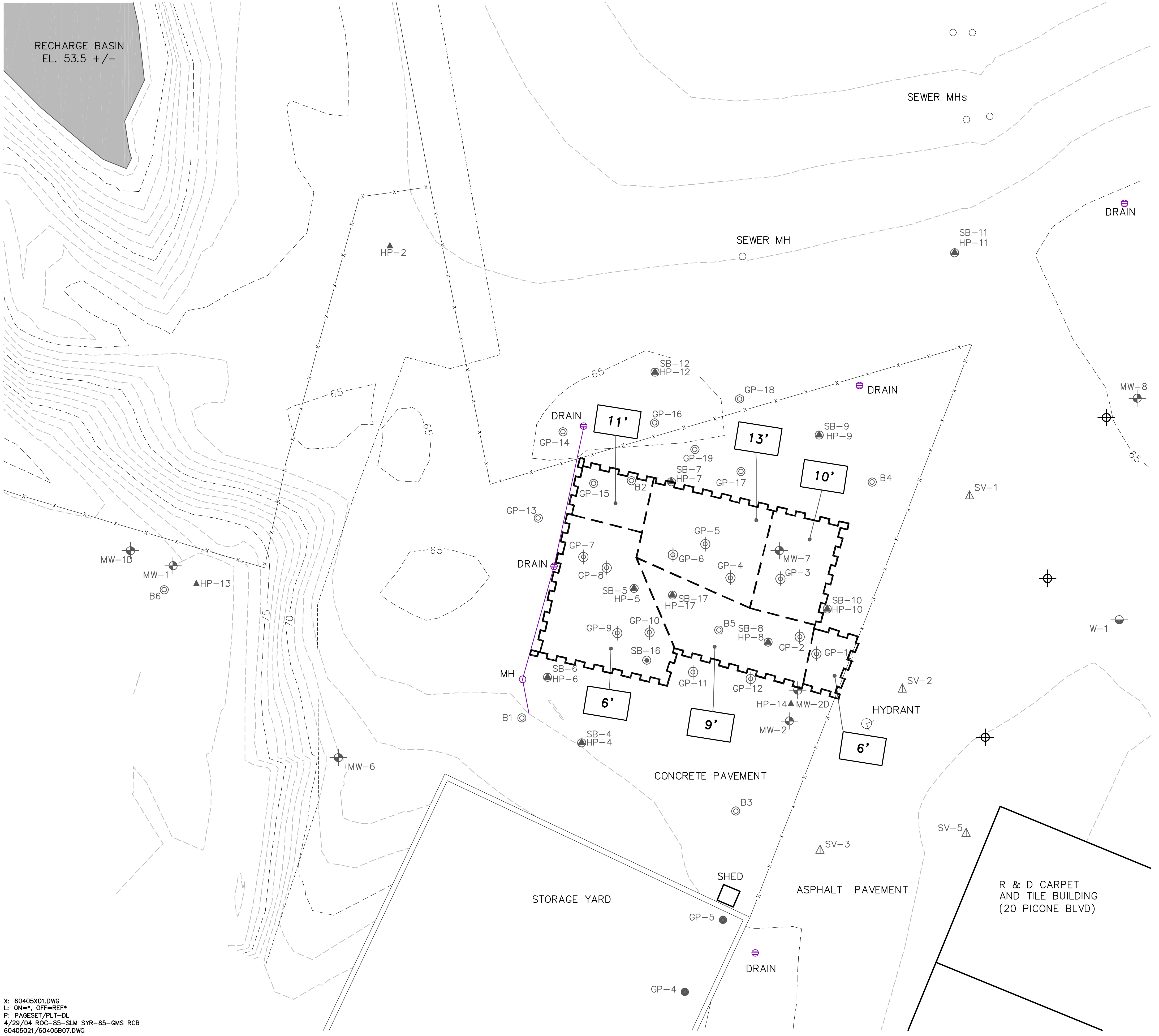
FIGURE
13

X: 60405X01.DWG
L: ON=*, OFF=REF*
P: PAGESET/PLT−DL
4/29/04 ROC−85−SLM SYR−85−GMS RCB
60405021/60405B04.DWG



LEGEND:

⊓⊔⊓⊔	PROPOSED SHEETPILE WALL ALONG BOUNDARY OF SOIL EXCAVATION
⊕	PROPOSED GROUNDWATER PUMPING WELL
10'	PROPOSED DEPTH OF SOIL EXCAVATION
—x—x—	FENCE LINE
◎	SOIL VOC DELINEATION BORING (AUGUST 2002)
△	SOIL VAPOR SAMPLE LOCATION (AUGUST 2002)
⊕	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF THE HWD SITE)
⊖	EXISTING GROUNDWATER MONITORING WELL LOCATION (INSTALLED FOR INVESTIGATION OF OTHER SITES)
◬	SOIL BORING/HYDROPUNCH™ LOCATION
▲	HYDROPUNCH™ LOCATION ONLY
⊙	SOIL BORING LOCATION ONLY
⏀	GEOPROBE® SOIL BORING LOCATION
●	GEOPROBE® GROUNDWATER SAMPLING LOCATION (APPROXIMATE)
◎	PHASE II SOIL BORING LOCATION (APPROXIMATE)

NOTES:

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0 15' 30'
GRAPHIC SCALE

HAZARDOUS WASTE DISPOSAL, INC.
11A PICONE BOULEVARD
FARMINGDALE, NEW YORK
FEASIBILITY STUDY REPORT

ALTERNATIVE 6 - SOIL EXCAVATION AND OFFSITE INCINERATION/DISPOSAL AND GROUNDWATER EXTRACTION/ONSITE TREATMENT

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FIGURE
14

X: 60405X01.DWG
L: ON=*, OFF=REF*
P: PAGESET/PLT-DL
4/29/04 ROC-85-SLM SYR-85-GMS RCB
60405021/60405B07.DWG

Appendix A

October 2, 2002 Letter from BBL to the NYSDEC

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BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Transmitted Via Federal Express

October 2, 2002

Mr. David A. Camp, P.E.
Environmental Engineer 2
New York State Department of Environmental Conservation
Division of Environmental Remediation
Bureau of Eastern Remedial Action
625 Broadway, 11th Floor
Albany, NY 12233-7015

Re: HWD, Inc. Site
Farmingdale, New York
NYSDEC Site No. 152113
BBL Project #: 0604.60405 #2

Dear Mr. Camp:

This letter presents the results obtained for the supplemental soil investigation and soil vapor survey/air pathway evaluation completed during August 2002 in connection with the Remedial Investigation/ Feasibility Study (RI/FS) of the Hazardous Waste Disposal, Inc. (HWD) site located in Farmingdale, New York. The investigation activities were requested by the New York State Department of Environmental Conservation (NYSDEC) based on a January 15, 2002 field reconnaissance and the results obtained for indoor air sampling conducted by the New York State Department of Health (NYSDOH) at nearby businesses to the south and west of the HWD site (as summarized in a March 15, 2002 letter from the NYSDOH). The investigation activities were conducted to:

- Complete the delineation of volatile organic compounds (VOCs) in soil at the HWD site; and
- Evaluate the potential for the VOCs identified in soil and groundwater at the HWD site to migrate via soil vapor to nearby businesses located along Picone Boulevard to the south and west of the site.

The investigation field activities were implemented by Blasland, Bouck & Lee, Inc. (BBL) in accordance with a July 19, 2002 e-mail letter from BBL to the NYSDEC. Approval to implement the activities was provided in a July 22, 2002 letter from the NYSDEC.

Based on the supplemental soil investigation results summarized herein, the extent of VOCs in soil at the HWD site has been adequately delineated for purposes of the FS. VOCs have not been detected at concentrations exceeding potentially applicable cleanup criteria at soil sampling locations more than approximately 15 feet north, 12 feet south, 25 feet east, 15 feet west of the former sludge pit.

6723 Towpath Road • P.O. Box 66 • Syracuse, NY 13214-0066
Tel (315) 446-9120 • Fax (315) 449-0017 • www.bbl-inc.com • offices nationwide

Based on the results of the soil vapor survey/air pathway evaluation, selected VOCs (including tetrachloroethene [PCE]) were detected in soil vapor samples collected along Picone Boulevard to the south and west of the HWD site. However, there are a number of sources (besides the HWD site) for the PCE detected by the NYSDOH in ambient air samples collected inside the R&D Carpet and Tile, Ryder Truck, and Fort Brand Service buildings located near the HWD site. The maximum indoor air concentration detected by the NYSDOH [890 micrograms per cubic meter ($\mu g/m^3$)] is three orders of magnitude below applicable occupational exposure criteria established by the Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental and Industrial Hygienists (ACGIH). These OSHA/ACGIH criteria were designed to protect commercial/industrial workers from unacceptable occupational exposures. The results of the indoor air sampling conducted by the NYSDOH and the soil vapor survey/air pathway evaluation do not indicate the need for an interim remedial measure (IRM).

An analytical sample summary that lists each sample collected by BBL during the supplemental soil investigation and soil vapor survey/air pathway evaluation activities, including sample identification, sample date, sample selection rationale, and analyses performed, is presented in Table 1. Laboratory analytical data reports (Form 1 results) are included in Attachment A.

The supplemental soil investigation activities and results are summarized below, followed by a detailed discussion of the soil vapor survey/air pathway evaluation and conclusions that are supported by the supplemental soil investigation and soil vapor survey/air pathway evaluation.

SUPPLEMENTAL SOIL INVESTIGATION

As indicated above, the purpose of the supplemental soil investigation was to complete the delineation of VOCs in soil at the HWD site. The soil investigation included the completion of seven direct-push soil borings (borings GP-13 through GP-19, as shown on Figure 1) to the east of the former sludge pit at the site. The soil borings were completed in an area of "disturbed" soil identified from a geophysical survey completed as part of the RI. The approximate locations of the sludge pit and the disturbed soil area were identified in the field during a January 15, 2002 site visit with the NYSDEC. The location of the former sludge pit was identified using an undistorted version of an April 7, 1980 aerial photograph that showed the HWD site during its period of operations.

Approximately two weeks prior to the start of the supplemental soil investigation activities, a BBL survey crew conducted field surveying activities to identify the proposed soil boring locations (as shown on a figure included with BBL's July 19, 2002 e-mail letter to the NYSDEC). Each boring location was marked with a PK-nail and survey flagging. Soil boring location GP-15 was marked approximately 2 feet west of its original proposed location to avoid a concrete barrier. The remaining soil borings were marked at their original proposed locations.

The supplemental soil investigation activities were completed on August 13-14, 2002, after underground utilities in the vicinity of the sampling locations had been identified. A description of the supplemental soil investigation work activities is presented below followed by a summary of the investigation results.

Soil Investigation Work Activities

At each proposed soil boring location, BBL used a concrete coring machine and/or jackhammer to core through approximately 4 to 8 inches of concrete to expose the underlying soil. Following coring at each location, soil borings were completed using a direct-push sampling unit equipped with a rotary drive adapter (a truck-mounted AMS 9600 PowerProbe™ device). Soil samples were collected continuously to a depth of approximately 20 feet below ground surface (bgs) using a 4-foot long, 1.5-inch inside diameter macrocore sampling device (lined with a disposable acetate liner). Groundwater was encountered within the borings at depths of between approximately 16.5 and 18.5 feet bgs.

Soil recovered at each boring location was visually characterized for color, texture, and moisture content. The soil recovered from the borings consisted primarily of brown, fine to medium sand and fine to medium gravel. No visible staining or obvious odors were identified in any of the soil samples. A portion of the soil recovered from each 6-inch depth interval of each boring was field screened for VOCs using a photoionization detector (PID). The PID field screening measurements are summarized in Table 2. Two soil samples collected from each boring were submitted for laboratory analysis for Target Compound List (TCL) VOCs, as indicated below:

- At each boring location (except boring GP-14), the sample from the 6-inch interval that exhibited the highest PID reading and the sample from the 6-inch interval directly above the water table were submitted for laboratory analysis; and
- Based on the absence of detectable PID readings at boring location GP-14, the sample from the 18 to 24-inch depth interval and the sample from the 6-inch depth interval directly above the groundwater table at this boring location were submitted for laboratory analysis.

Quality assurance/quality control (QA/QC) samples (including blind duplicate, matrix spike, and matrix spike duplicate) were collected as part of the supplemental soil investigation activities in accordance with the NYSDEC 2000 Analytical Services Protocol (ASP). The soil samples were submitted to Severn Trent Laboratories, Inc. (STL) of Edison, New Jersey for laboratory analysis using United States Environmental Protection Agency (USEPA) SW-846 Method 8260 as referenced in the NYSDEC 2000 ASP.

During completion of the soil borings at locations GP-17 and GP-19, BBL encountered an approximately 4- to 5-inch thick layer of concrete debris, beginning approximately 2 feet below grade. The location of the debris appears to be consistent with the suspected location of a buried concrete structure that was identified by the geophysical survey completed during the RI.

Following completion, each soil boring was backfilled to grade using a cement/bentonite grout. Investigation-derived wastes (excess soil cuttings, personal protective equipment, acetate sample liners, and decontamination washwaters) were containerized in 55-gallon drums for characterization prior to off-site disposal in accordance with applicable rules and regulations.

Soil Investigation Results

Analytical results obtained from the laboratory analysis of the soil samples for TCL VOCs are presented in Table 3. As indicated in Table 3, tetrachloroethene (PCE) was detected in sample GP-15 (6-6.5') at a concentration of 2.3 parts per million (ppm), which exceeds the 1.4 ppm soil guidance value presented in the NYSDEC Technical and Administrative Guidance Memorandum entitled, "Determination of Soil Cleanup Objectives and Cleanup Levels," HWR-94-4046 (TAGM 4046), dated January 24, 1994 (revised December 20, 2000). The PCE concentration detected in sample GP-15 (6-6.5') does not exceed the following criteria:

- 12 ppm soil action level presented in NYSDEC TAGM 3028 entitled, "Contained-in Criteria for Environmental Media," dated November 30, 1992 (revised March 14, 1997);

- 19 ppm USEPA Region 9 Preliminary Remediation Goal (PRG) for industrial soil as downloaded from the USEPA Region 9 website (http://www.epa.gov/region09/waste/sfund/prg/index.htm) on February 29, 2000; and

- 110 ppm USEPA Region 3 Risk-Based Concentration (RBC) for commercial/industrial soil as downloaded from the USEPA Region 3 website (http://www.epa.gove/reg3hwmd/risk/riskmenu.htm) on February 29, 2000.

VOCs were not detected in any of the other supplemental soil investigation samples at concentrations exceeding the TAGM 4046 soil guidance values or the other criteria presented above.

SOIL VAPOR SURVEY/AIR PATHWAY EVALUATION

The soil vapor survey/air pathway evaluation was conducted to determine if there is a potential connection between the VOCs in soil/groundwater at the HWD site and the presence of PCE detected in indoor air samples collected by the NYSDOH at the following buildings located to the south and west of the site along Picone Boulevard (shown on Figure 1):

- R&D Carpet and Tile Building – 20 Picone Boulevard. The southern section of this building consists of garage area used to store new carpet and various adhesives, coatings/sealers, base fillers, cleaners, paints/stain, etc. The northern section of the building consists of an office area;

- Fort Brand Service Building – 13D Picone Boulevard. This building is primarily used as a service garage for heavy equipment used in connection with the aviation industry. A small office area is located within the building; and

- Ryder Truck Building – 11 Picone Boulevard. This building is primarily used as a service garage for medium and heavy-duty trucks.

BBL completed the following work activities as part of the soil vapor survey/air pathway evaluation:

- A building integrity survey to evaluate the potential for VOCs to enter the above-mentioned buildings;

- A building VOC inventory to identify potential non-site related sources of PCE that may contribute to the PCE levels detected in the above-mentioned buildings;

- An air handling system evaluation to provide a qualitative understanding of the ability of the air handing systems in the above-mentioned buildings to adequately ventilate the indoor air; and

- Soil vapor sampling to evaluate the potential presence VOC soil vapor in subsurface soil between the HWD site and the above-mentioned buildings.

Relevant background information related to the soil vapor survey/air pathway evaluation (including the results of the indoor air monitoring conducted by the NYSDOH) is presented below, followed by a summary of the soil vapor survey/air pathway evaluation, and an evaluation of the indoor air and soil vapor analytical results.

Background Information

The NYSDOH conducted air monitoring on January 9-10, 2002 to evaluate the potential presence of PCE (the primary constituent of concern identified for soil and groundwater at the HWD site) in indoor air at the R&D Carpet and Tile, Fort Brand Service, and Ryder Truck buildings. Based on the results of the January 2002 air monitoring activities, the NYSDEC requested that a soil vapor survey/air pathway evaluation be conducted to evaluate if there is a potential connection between the VOCs in soil/groundwater at the HWD site and PCE detected by the NYSDOH in indoor air samples collected at the nearby buildings. The NYSDOH conducted follow-up air monitoring within the same three buildings on August 13-14, 2002 in connection with the soil vapor survey/air pathway evaluation conducted by BBL.

For both the January 2002 and August 2002 monitoring events, the NYSDOH installed organic vapor monitoring badges at selected locations inside the buildings to collect ambient air samples (via passive diffusion). Each sample was collected over an approximately 24-hour period. At the conclusion of the sampling period, the organic vapor monitoring badges were submitted to the NYSDOH Wadsworth Center for laboratory analysis of PCE. Analytical results obtained from the laboratory analysis of the ambient air samples from the R&D Carpet and Tile, the Fort Brand Service, and Ryder Truck buildings are summarized below.

Sampling Location	PCE Concentration (µg/m^3)	
	January 9-10, 2002	August 13-14, 2002
R&D Carpet and Tile Building		
Office Lobby	890	200
Secretary Station	780	190
Garage – Carpet Storage Area	NA	30
Outdoors	5	5
Fort Brand Service, Inc. Building		
Office Lobby	170	NA
Secretary Station	180	NA
Outdoors	5	NA
Ryder Truck Building		
Garage/Repair Shop – Middle Section	22	NA
Garage/Repair Shop – Southern Section	23	NA
Outdoors	5	NA

Notes:
1. µg/m^3 = Micrograms per cubic meter.
2. NA = Not available.
3. Analytical results for the January 2002 monitoring event are from NYSDOH letters to the building managers for the above-listed facilities, dated February 21, 2002, February 25, 2002, and March 1, 2002.
4. Analytical results for the August 2002 monitoring event are from an August 27, 2002 NYSDOH letter to the manager at the R&D Carpet and Tile building (for all samples except the garage area sample) and as verbally reported by the NYSDEC (for the garage area sample).

Soil Vapor Survey/Air Pathway Evaluation Work Activities and Results

Work activities performed and results obtained for the building integrity survey, building VOC inventory, air handling system evaluation, and soil vapor sampling are summarized below.

Building Integrity Survey/Identification of PCE Migration Pathways

BBL conducted a reconnaissance inside the R&D Carpet and Tile, the Fort Brand Service, and Ryder Truck buildings to evaluate the physical condition of the buildings and identify potential preferential pathways for VOC vapors to migrate from the area of impacted soil/groundwater at the HWD site into the buildings. During the reconnaissance, it was noted that each of the above-mentioned buildings has a concrete slab-on-grade with no basement. No significant cracks were observed in exposed sections of the cinderblock walls or the concrete floors inside the buildings. Sumps were not identified inside any of the buildings. A waste oil tank was identified within the Fort Brand Service and Ryder Truck buildings. The results of the reconnaissance are summarized on the building integrity survey forms included in Attachment B.

As part of this activity, BBL also measured the barometric pressure inside and outside each building. The garage doors at each building and the office door to the Fort Brand Service building were open at the time the measurements were made. The barometric pressure measured indoors and outdoors was approximately the same for each building (i.e, 30.10 to 30.11 inches).

BBL also measured the depth to groundwater at the following five nearby flush-mount monitoring wells (which are shown on Figure 1):

- Three wells located in the southern portion of the HWD site (wells MW-2, MW-2D, and MW-7). Groundwater was encountered approximately 17.8 to 17.9 feet bgs at these wells;
- One well located near the embankment on the west side of the HWD site (well MW-6). Groundwater was encountered approximately 20 feet bgs at this location; and
- One off-site well located across Picone Boulevard to the east of the HWD site (well W-1, which was installed by others as part of another investigation in the immediate vicinity of a former oil tank field not associated with the HWD site). Light non-aqueous phase liquid (LNAPL) described as viscous black product was encountered on the groundwater surface within this well at approximately 17.7 feet bgs. The thickness of LNAPL in the well was not determined.

No evidence of sheens or LNAPL was observed in any of the wells at the HWD site.

Building VOC Inventory/Identification of Non-Environmental PCE Sources

As indicated above, a building VOC inventory was conducted to identify potential sources of PCE (unrelated to the HWD site) that may contribute to the PCE levels detected in the nearby R&D Carpet and Tile, Fort Brand Service, and Ryder Truck buildings to the south and west of the HWD site. As part of the building VOC inventory, BBL developed a listing of products potentially containing VOCs (including PCE) that are used, handled, or stored in the buildings. Specifically, BBL documented the type of containers holding the product, size of the container, quantity of containers, manufacturer's name, and other relevant observations/notes on the integrity of the containers. The building VOC inventory is presented in Table 4. BBL also contacted product manufacturers and utilized several internet web sites to obtain material safety data sheets (MSDS sheets) for selected products that were observed in use/storage in the buildings (that were suspected of containing VOCs and/or were present in large quantities). Copies of the MSDS sheets are included in Attachment C. As indicated in Table 4, the following products within the buildings were found to contain PCE:

- One 20-ounce spray can of brake cleaner (manufactured by the Gunk/Radiator Specialty Company) found inside the Fort Brand Service building. Based on the MSDS sheet, the brake cleaner composition is approximately 90 to 100% PCE;
- Degreaser/parts washer fluid (supplied by Safety Kleen) found in the Ryder Truck building. Based on review of a waste manifest, PCE is a primary component of the waste degreaser/washer fluid. The degreaser/parts washer is dispensed from and collected within a roughly 3 foot wide by 2 foot deep by 4 foot high unit located at the back of the Ryder Truck building (along the south wall); and
- One 12.75 ounce spray can of a battery corrosion inhibitor (manufactured by Castle Products) found inside the Ryder Truck building. Based on the MSDS sheet, the corrosion inhibitor composition is approximately 20 to 30% PCE.

It should be noted that a solvent-type odor was noticed emanating from the Ryder Truck building garage area during a site walkover prior to the building VOC inventory. The source of the odors was not identified.

BBL identified numerous adhesives, coatings/sealers, base fillers, cleaners, paints/stains, and paint strippers/thinners in storage within the R&D Carpet and Tile building garage area. PCE was not listed as a chemical component on the MSDS sheets obtained for any of these products. However, the composition of several products was listed as proprietary materials.

Copies of Emergency Planning & Community Right-to-Know Act (EPCRA) Tier I and Tier II reporting records were requested as part of the building VOC inventory, but were unavailable.

Air Handling System Evaluation

The garage areas at the R&D Carpet and Tile, Fort Brand Service, and Ryder Truck buildings are heated via unit space-heaters and ventilated by opening overhead garage doors or operating exhaust fans. The garage areas are not air-conditioned. The office areas at the R&D Carpet and Tile building and Ryder Truck building have heating and air conditioning (AC) systems. An AC system was not identified within the office area at the Fort Brand Service building. Information on the operating speeds of fans and number of air exchanges provided by the heating and cooling systems was unavailable.

Soil Vapor Survey

The purpose of the soil vapor survey was to evaluate the potential presence VOC soil vapor in subsurface soil between the HWD site and the R&D Carpet and Tile, Fort Brand Service, and Ryder Truck buildings. The soil vapor survey field activities were completed on August 13-14, 2002.

Approximately two weeks prior to the start of the soil vapor survey activities, a BBL survey crew conducted field surveying activities to identify the proposed soil vapor sampling locations. Each boring location was marked with a PK-nail and survey flagging. The surveyed sampling locations were later adjusted, as necessary, based on a field mark-out of underground utilities in the area. Locations were also adjusted slightly to permit truck traffic through the area.

The soil vapor survey field activities and results are summarized below.

Soil Vapor Survey Field Activities

The soil vapor survey included the completion of seven direct-push soil borings (borings SV-1 through SV-7, as shown on Figure 1) and the collection of one soil gas sample from each boring. BBL's subcontractor, Columbia Technologies, LLC (Columbia) of Baltimore, Maryland completed each boring using a Geoprobe™ 5400 truck-mounted direct-push sampling rig. The borings were completed after BBL cored through approximately 4 to 8 inches of asphalt and concrete to expose the underlying soil. Each soil vapor sample was collected at a depth of approximately 3 feet bgs (except for sample SV-2, which was collected at 2.5 feet bgs). The sampling depths coincided with the first soil interval below the asphalt/concrete pavement and underlying stone base course (to avoid potential surface interferences).

Prior to collecting each soil vapor sample, Columbia used nitrogen gas to purge the entire sampling assembly. After the sampling assembly was purged, Columbia advanced a borehole to the desired depth using a hydraulic probe on the direct-push sampling rig. Next, Columbia hydraulically advanced the first part of the sampling assembly (a 4-foot length of 1¼-inch diameter steel rod attached to a post-run tubing expendable point holder with an expendable point at the downhole end) to the desired sampling depth. Bentonite was then used to seal the borehole annulus from the atmosphere. The sampling assembly was then hydraulically retracted approximately 4 inches to allow the expendable point to fall off. This created a small void in the subsurface soil that was isolated from the atmosphere.

The next step consisted of attaching a second post-run tubing assembly to the end (the downhole end) of a section of small diameter Teflon tubing. This assembly was then lowered through the inside of the 1¼-inch diameter steel rod to the bottom of the borehole. The top end of the tubing was then threaded into another post-run tubing expendable point holder with an "O" ring to isolate the sampling zone from the annular space inside of the steel rods. The tubing was attached to a vacuum box system set on the ground surface.

The vacuum box system was designed to collect small, measured, uniform sample volumes, which minimizes potential sampling bias and allows for collection of representative samples at each sample location. An inline flow meter was used to measure the flow of soil vapor through the vacuum system to ensure that a flow of less than 0.2 liters per minute (L/min) was achieved. An initial gas draw was expelled from the system to 'charge' the sampling apparatus with soil vapor and remove purge gases from the system. After the initial gas draw was expelled from the system, a 0.5-liter Tedlar bag installed inside the vacuum box was filled with soil vapor. Because the Tedlar bags are prone to damage during shipment to the laboratory, a second purge volume was expelled from the system, and a second 0.5-liter Tedlar bag installed inside the vacuum box was filled with soil vapor.

The soil vapor samples (two Tedlar bags per location) were submitted for laboratory analysis of the VOC constituents listed in the table below.

Constituent	Rationale
Tetrachloroethene (PCE)	Detected in several RI soil and groundwater samples
Trichloroethene (TCE)	Detected at trace levels in on-site soil and groundwater samples. Geochemical degradation daughter product of PCE.
cis-1,2-Dichloroethene	Detected at trace concentration in soil sample SB-7A. Geochemical degradation daughter product of TCE.
1,1-Dichloroethene	Detected at trace levels in groundwater. Geochemical degradation daughter product of TCE.
1,1-Dichloroethane	Detected at trace levels in groundwater. Geochemical degradation daughter product of TCE.
Chloroethane	Geochemical degradation daughter product of TCE.
Vinyl Chloride	Geochemical degradation daughter product of TCE.

Laboratory analysis of the soil vapor samples was performed by STL of Burlington, Vermont using USEPA Method TO-14A. The laboratory is certified in the State of New York to perform air sample analyses. Following completion of the sampling activities, the sampling holes were backfilled with cement grout applied from the ground surface.

Soil Vapor Analytical Results

Analytical results obtained from laboratory analysis of the soil vapor samples for VOCs are presented in Table 5. As indicated in Table 5, five VOCs (including PCE, TCE, cis-1,2-dichloroethene, 1,1-dichloroethane, and vinyl chloride) were detected in the soil vapor samples. A review of the soil vapor VOC analytical data reveals the following:

- The highest concentration of VOCs in soil vapor was identified at sampling location SV-2, located to the south of the HWD site;
- PCE was detected in each soil vapor sample at concentrations ranging from 0.012 parts per million (ppmv) in sample SV-1 to 97 ppmv in sample SV-2;
- TCE was detected in each soil vapor sample at concentrations ranging from 0.035 ppmv in sample SV-1 to 6.3 ppmv in sample SV-2;
- Cis-1,2-dichloroethene was detected in each soil vapor sample at concentrations ranging from 0.067 ppmv in sample SV-7 to 2.4 ppmv in sample SV-2; and
- 1,1-dichloroethene and vinyl chloride were detected in soil vapor sample SV-1 at concentrations of 0.0017 ppmv and 0.01 ppmv, respectively.

In general, the PCE concentrations detected in the soil vapor samples were the highest of the individual VOC constituents. The distribution of PCE detected in the soil vapor samples is shown on Figure 2.

Evaluation of Air Monitoring/Soil Vapor Survey Results

An evaluation of the results obtained for the above-described air monitoring and soil vapor survey activities is presented below, including a discussion of potential sources of PCE to indoor air and a comparison of the results to potentially applicable regulatory criteria.

Potential PCE Sources

Potential sources of PCE to ambient air inside the R&D Carpet and Tile, the Fort Brand Service, and Ryder Truck buildings are summarized below:

- Use of the degreaser/parts washer and battery corrosion inhibitor in the Ryder Truck building would likely result in elevated PCE levels in indoor air within the Ryder Truck building and potentially within the adjoining R&D Carpet and Tile building;
- Use of the brake cleaner found inside the Fort Brand Service building could potentially result in elevated PCE levels in indoor air within the building;
- Although PCE was not identified on the MSDS sheets for the products in storage at the R&D Carpet and Tile building (the composition of several products was identified as proprietary), the new carpeting, tile, adhesives, and related products within the building may potentially be a source for PCE to indoor air within the building;
- Regionally-impaired groundwater in the vicinity of the buildings (resulting from additional sources besides the HWD site) could be contributing PCE to indoor air;
- Other previously undiscovered PCE sources, such as old septic tanks, drainlines, etc., could potentially exist; and
- PCE detected in soil vapor near the HWD site may be contributing to the PCE levels identified in ambient air within the R&D Carpet and Tile, the Fort Brand Service, and Ryder Truck buildings.

PCE vapors from sources inside the buildings could migrate through the buildings and through wall penetrations.

Comparison with Potentially Applicable Criteria

Although multiple sources of PCE to ambient indoor air have been identified, the PCE air concentrations detected by the NYSDOH are three orders of magnitude less than the occupational exposure guidelines established by OSHA and the ACGIH, which include:

- ACGIH short-term exposure limit (STEL), which is a 15-minute time-weighted-average exposure that should not be exceeded at anytime during a workday even if the 8 hour time-weighted-average is within the threshold limit;
- OSHA permissible exposure limit (PEL) expressed as a time-weighted average, which is the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-hour workday or a 40-hour workweek; and
- ACGIH threshold limit value (TLV) expressed as a time-weighted average, which is the concentration of a substance to which most workers can be exposed without adverse effects.

The above-listed workplace exposure criteria are summarized below.

Workplace Exposure Criteria	Concentration	
	(mg/m^3)	(ppm)
ACGIH STEL	685	100
OSHA PEL	685	100
ACGIH TLV	170	25

The workplace exposure criteria recognize that a significant amount of time each day will be spent away from exposure, allowing the body to recover.

In letters transmitting the indoor PCE air sampling results to the respective building managers at the R&D Carpet and Tile and the Fort Brand Service facilities, the NYSDOH compares the results to the residential indoor air quality guideline of 100 µg/m^3 (which is equivalent to 0.1 mg/m^3) as presented in the NYSDOH's chemical information fact sheet entitled, "Tetrachloroethene (PERC) in Indoor and Outdoor Air," (www.health.state.ny.us/nysdoh/environ/btsa/fs_perc.htm). The NYSDOH does not mention in the letters that the 100 µg/m^3 criteria was developed for a residential community (as opposed to a commercial/industrial workplace) or that the criteria is also an average recommended air level (as opposed to a maximum air level). It should be noted that the NYSDOH's residential guideline is "based on the assumption that people are continuously exposed to PCE in air all day, every day for as long as a lifetime," which is not applicable for employees in a workplace setting.

Based on Figure 1 of the chemical information fact sheet, the NYSDOH's guideline also incorporates a safety factor of 1,000. In the fact sheet, the NYSDOH specifically states that their "guideline of 0.1 mg/m^3 is not a line between air levels that cause health effects and those that do not. The guideline is much lower than the air levels that caused either non-cancer or cancer effects." The fact sheet also recommends that "the need to take immediate action to reduce exposure should be considered when an air level is 1 mg/m^3 or higher." As indicated above, the highest PCE concentration identified in indoor air (0.89 mg/m^3 in a January 2002 sample collected from the R&D Carpet and Tile building) does not exceed this value. In addition, the PCE concentrations detected in the August 2002 indoor ambient air samples were much lower than the concentrations detected in the January 2002 samples.

CONCLUSIONS

Although the HWD site appears to be a possible contributing source of the PCE identified within the R&D Carpet and Tile, Fort Brand Service, and Ryder Truck buildings located to the south/west, the PCE concentrations in indoor air do not appear to warrant implementation of an IRM for the reasons listed below.

- The indoor air levels detected by the NYSDOH are three orders of magnitude below the OSHA/ACGIH occupational exposure guidelines for PCE.
- The PCE concentrations do not exceed the 1 mg/m^3 guideline presented in the NYSDOH fact sheet for taking immediate action.
- The 100 µg/m^3 NYSDOH guideline is based on continuous residential exposure. This criterion is not appropriate for commercial/industrial workers spending only part of the day in the buildings. As

indicated by the NYSDOH's fact sheet, the guideline is much lower than air levels that cause potential non-cancer or cancer effects.

In addition, the results of the supplemental soil investigation indicate that the extent of soil east of the former sludge pit at the HWD site that contains VOCs at concentrations exceeding potentially applicable criteria has been delineated. As previously mentioned, VOCs have not been detected at concentrations exceeding potentially applicable cleanup criteria at soil sampling locations more than approximately 15 feet north, 12 feet south, 25 feet east, 15 feet west of the former sludge pit.

The HWD site technical committee is prepared, if necessary, to attend a meeting or participate on a conference call with the NYSDEC to discuss the findings/conclusions summarized above. BBL will contact you during the week of October 7, 2002 to schedule the meeting/conference call. In the meantime, please do not hesitate to contact the undersigned or Mr. John C. Brussel, P.E. of this office if you have any questions or require additional information.

Sincerely,

BLASLAND, BOUCK & LEE, INC.

David J. Ulm/mbg

David J. Ulm
Senior Vice President

JCB/mbg
Enclosures

cc: Mr. Robert Cozzy, P.E., New York State Department of Environmental Conservation
Ms. Jacquelyn Nealon, New York State Department of Health
HWD, Inc., Site Technical Committee Members
Mr. Stephen A. Cox, P.G., Blasland, Bouck & Lee, Inc.
Mr. Jay D. Keough, CIH, Blasland, Bouck & Lee, Inc.
Mr. Michael C. Jones, Blasland, Bouck & Lee, Inc.
Mr. John C. Brussel, P.E., Blasland, Bouck & Lee, Inc.

Tables

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Table 1

Hazardous Waste Disposal, Inc. Site
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Field Activities
Analytical Sample Summary

Sample Matrix/ID	Sample Interval	Date Sampled	SDG	Depth to Water (feet bgs)	Sample Selection Rationale	Laboratory Analytical Target Parameters
Soil Samples						
GP-13	(12-12.5')	8/13/02	Z443	17.5	Highest PID reading at boring (2.5 ppm)	Target Compound List (TCL) Volatile Organic Compounds (VOCs)
	BD081302 (12-12.5')	8/13/02	Z443		Blind duplicate sample	
	(17-17.5')	8/13/02	Z443		Interval directly above water table	
GP-14	(1.5-2')	8/14/02	Z443	17.5	No detectable PID readings at boring.	
	(17-17.5')	8/14/02	Z443		Interval directly above water table	
GP-15	(6-6.5')	8/13/02	Z443	16.5	Highest PID reading at boring (11.3 ppm)	
	(16-16.5')	8/13/02	Z443		Interval directly above water table	
GP-16	(4-4.5')	8/14/02	Z443	17.5	Highest PID reading at boring (0.9 ppm)	
	(17-17.5')	8/14/02	Z443		Interval directly above water table	
GP-17	(14.5-15')	8/13/02	Z443	18	Highest PID reading at boring (6.7 ppm)	
	(17.5-18')	8/13/02	Z443		Interval directly above water table	
GP-18	(16.5-17')	8/14/02	Z443	18.5	Highest PID reading at boring (15.0 ppm)	
	(18-18.5')	8/14/02	Z443		Interval directly above water table	
GP-19	(3.5-4')	8/13/02	Z443	18	Highest PID reading at boring (13.4 ppm)	
	(17.5-18')	8/13/02	Z443		Interval directly above water table	
Soil Vapor Samples						
SV-1	(3')	8/13/02	Z435	NA	First soil interval below the base course for the concrete/asphalt pavement.	Perchloroethylene (PCE), Trichloroethylene (TCE), cis-1,2-Dichloroethene, 1,1-Dichloroethene, 1,1-Dichloroethane, Chloroethane, and Vinyl Chloride
SV-2	(2.5')	8/13/02	Z435	NA		
SV-3	(3')	8/13/02	Z435	NA		
SV-4	(3')	8/13/02	Z435	NA		
SV-5	(3')	8/13/02	Z435	NA		
SV-6	(3')	8/13/02	Z435	NA		
SV-7	(3')	8/13/02	Z435	NA		

Notes:

1. SDG = Sample delivery group.
2. Samples collected by Blasland, Bouck & Lee, Inc., (BBL) on the dates indicated.
3. Sample designations indicate the following:
   - GP = Soil sample collected from a PowerProbe™ soil boring;
   - SV = Soil vapor sample; and
   - BD = Blind duplicate [sample BD081302 is a blind duplicate of sample GP-13 (12-12.5')].
4. Soil samples were analyzed for TCL VOCs using United States Environmental Protection Agency (USEPA) SW-846 Method 8260 as referenced in the New York State Department of Environmental Conservation (NYSDEC) 2000 Analytical Services Protocol (ASP).
5. Soil vapor samples were analyzed for PCE, TCE, cis-1,2-dichloroethene, 1,1-dichloroethene, 1,1-dichloroethane, chloroethane, and vinyl chloride using USEPA Method TO-14A.
6. Laboratory analysis of the soil samples was performed by Severn Trent Laboratories, Inc. (STL) of Edison, New Jersey.
7. Laboratory analysis of the soil vapor samples was performed by STL of Burlington, Vermont.
8. PID = Photoionization detector.

Table 2

Hazardous Waste Disposal, Inc. Site
11A Picone Boulevard
Farmingdale, New York

Supplemental Soil VOC Delineation
Field Screening Summary

Sample Location	Sample Depth (feet)	Sample Recovery (feet)	PID Measurement (ppm)
Note: PID measurements presented in the last column are for each 6-inches of soil recovery from each soil boring. Individual results are separated by a back-slash "/".			
GP-13	0-0.4	Concrete	NA
	0.4-4	2.3 / 3.6	0.4 / 0.5 / 1.1 / 0.4
	4-8	2.5 / 4.0	0.8 / 0.4 / 1.1 / 1.3 / 0.2 / 0.2
	8-12	4.0 / 4.0	0 / 0.1 / 0.1 / 0.1 / 0.2 / 0.1 / 0.1 / 0
	12-16	2.8 / 4.0	**2.5** / 0.4 / 0.2 / 0.1 / 0.7
	16-20	2.7 / 4.0	0.2 / 0.2 / 0.8 / 0.1 / 1.1
GP-14	0-0.7	Concrete	NA
	0.7-4	2.4 / 3.3	0 / 0 / 0 / 0 / 0
	4-8	2.9 / 4.0	0 / 0 / 0 / 0 / 0 / 0
	8-12	3.1 / 4.0	0 / 0 / 0 / 0 / 0 / 0
	12-16	2.4 / 4.0	0 / 0 / 0 / 0 / 0
	16-20	2.5 / 4.0	0 / 0 / 0 / 0 / 0
GP-15	0-0.6	Concrete	NA
	0.6-4	2.4 / 3.4	3.2 / 1.2 / 0.6 / 0.5
	4-8	3.2 / 4.0	0.9 / 7.4 / **11.3** / 3.9 / 1.4 / 0.8
	8-12	3.0 / 4.0	0.4 / 0.3 / 0.4 / 0.2 / 1.0 / 0.2
	12-16	2.7 / 4.0	0.2 / 0.1 / 0.2 / 0 / 0.4 / 0
	16-20	2.3 / 4.0	0.3 / 4.3 / 2.1 / 0.2
GP-16	0-0.3	Concrete	NA
	0.3-4	(Pulverized Concrete @ 1.6 - 2.1')	NA
	4-8	2.4 / 4.0	**0.9** / 0.5 / 0.3 / 0 / 0
	8-12	3.0 / 4.0	0 / 0 / 0 / 0 / 0 / 0
	12-16	3.3 / 4.0	0 / 0 / 0 / 0 / 0 / 0 / 0
	16-20	2.6 / 4.0	0.6 / 0.1 / 0 / 0.1 / 0.1
GP-17	0-0.4	Concrete	NA
	0.4-4	2.7 / 3.6	0 / 0.1 / 0.3 / 5.6 / 3.7
	4-8	1.2 / 4.0	6.6 / 4.2 / 2.7
	8-12	2.7 / 4.0	4.1 / 2.5 / 3.7 / 1.9 / 2.6
	12-16	2.8 / 4.0	0.5 / 1.3 / 3.4 / **6.7** / 2.2
	16-20	2.4 / 4.0	0.6 / 3.5 / 1.1 / 0.8 / 0
GP-18	0-0.6	Concrete	NA
	0.6-4	1.8 / 2.6	0.2 / 0.1 / 0 / 1.4
	4-8	1.5 / 4.0	0.1 / 0 / 0
	8-12	3.4 / 4.0	0.8 / 0.4 / 0.6 / 0 / 0.3
	12-16	3.0 / 4.0	0 / 0 / 0 / 0 / 0 / 0
	16-20	2.9 / 4.0	0.9 / **15.0** / 5.6 / 3.2 / 0 / 0
GP-19	0-0.4	Concrete	NA
	0.4-4	2.1 / 3.6	0.1 / 0.2 / 0.2 / **13.4**
	4-8	0.8 / 4.0	12.0 / 1.8
	8-12	3.1 / 4.0	0.7 / 0.4 / 0.1 / 0.1 / 1.1 / 0.9 / 1.7
	12-16	3.0 / 4.0	0 / 0.1 / 0.3 / 0.1 / 0.2 / 0.4
	16-20	2.1 / 4.0	0.2 / 0.4 / 0.2 / 1.4

See Notes on Page 2.

Table 2

Hazardous Waste Disposal, Inc. Site
11A Picone Boulevard
Farmingdale, New York

Supplemental Soil VOC Delineation
Field Screening Summary

Notes:
1. VOC = Volatile organic compound.
2. PID = photoionization detector.
3. ppm = Parts per million.
4. Highest PID measurements for each soil boring are shown in bold.
5. NA = Not applicable.

Table 3

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Supplemental Soil VOC Delineation
Soil Analytical Results for Detected TCL VOCs (ppm)

Compound	[illegible] RBC (Industrial) Soil	[illegible] PRG (Industrial) Soil	[illegible]	[illegible] 4046 Soil Guidance Values	[illegible]			GP-14		GP-15		GP-16		GP-17		GP-18		GP-19	
					(12-12.5')	BD081302 (12-12.5')	(17-17.5')	(1.5-2')	(17-17.5')	(6-6.5')	(15-15.5')	(4-4.5')	(17-17.5')	(14.5-15')	(17.5-18')	(16.5-17')	(18-18.5')	(3.5-4.0')	(17.5-18')
Methylene Chloride	760	21	85	0.1	<0.012	<0.010	<0.009	<0.010	<0.010	<0.85	<0.011	<0.010	<0.011	0.0005 J	0.0007 J	<0.011	<0.010	0.0009 J	<0.011
Acetone	200,000	6,200	7,800	0.2	0.036	0.034	<0.009	<0.010	<0.010	<0.85	<0.011	0.030	<0.011	<0.010	<0.012	<0.011	<0.010	0.19	<0.011
Carbon Disulfide	200,000	720	7,800	2.7	0.0008 J	0.0006 J	<0.009	<0.010	<0.010	<0.85	<0.011	0.0005 J	<0.011	<0.010	<0.012	<0.011	<0.010	0.003 J	<0.011
1,2-Dichloroethene (total)	20,000*	150*	780*	0.3*	<0.012	<0.010	<0.009	<0.010	<0.010	<0.85	<0.011	0.003 J	<0.011	<0.010	<0.012	<0.011	<0.010	0.002 J	<0.011
2-Butanone	1,200,000	28,000	47,000	0.3	0.008 J	0.007 J	<0.009	<0.010	<0.010	<0.85	<0.011	0.003 J	<0.011	<0.010	<0.012	<0.011	<0.010	0.14	<0.011
Trichloroethene	520	6.1	58	0.7	0.0008 J	0.0006 J	<0.009	0.004 J	<0.010	<0.85	<0.011	0.006 J	<0.011	<0.010	<0.012	<0.011	<0.010	0.002 J	<0.011
Bromoform	720	310	81	NA	0.003 J	0.002 J	0.003 J	0.006 J	0.004 J	<0.85	0.005 J	0.005 J	0.005 J	0.003 J	0.005 J	0.005 J	0.005 J	0.006 J	0.005 J
4-Methyl-2-Pentanone	160,000	2,900	6,300	1.0	<0.012	<0.010	<0.009	<0.010	<0.010	<0.85	<0.011	<0.010	<0.011	<0.010	<0.012	<0.011	<0.010	0.002 J	<0.011
Tetrachloroethene	110	19	12	1.4	0.017	0.006 J	<0.009	0.013	<0.010	[illegible]	<0.011	0.16	0.002 J	0.002 J	<0.012	0.001 J	0.005 J	0.007 J	<0.011
Toluene	410,000	520	16,000	1.5	<0.012	<0.010	<0.009	<0.010	<0.010	<0.85	<0.011	0.002 J	<0.011	<0.010	<0.012	<0.011	<0.010	0.005 J	<0.011
Xylenes (total)	4,100,000	210	160,000	1.2	<0.012	<0.010	<0.009	<0.010	<0.010	<0.85	<0.011	<0.010	<0.011	<0.010	<0.012	<0.011	<0.010	0.003 J	<0.011
Total VOC TICs	NA	NA	NA	NA	0.158 NJ	0.095 NJ	0	0.007 J	0.007 J	0	0.008 J	0	0.007 J	0	0	0.013 J	0.014 J	0.376 NJ	0

Notes:

1. Soil samples collected by Blasland, Bouck & Lee, Inc. (BBL) on August 13-14, 2002.
2. Samples analyzed by Severn Trent Laboratories, Inc. (STL) of Edison, New Jersey using United States Environmental Protection Agency (USEPA) SW-846 Method 8260 as referenced in the New York State Department of Environmental Conservation (NYSDEC) 2000 Analytical Services Protocol (ASP).
3. Concentrations reported in parts per million (ppm), which are eqivalent to milligrams per kilogram (mg/kg).
4. Sample designations indicate the following:
   - GP = Soil sample collected from a PowerProbe™ soil boring; and
   - BD = Blind duplicate [sample BD081302 is a blind duplicate of sample GP-13 (12-12.5')].
5. TCL = Target Compound List.
6. VOCs = Volatile organic compounds.
7. TICs = Tentatively identified compounds.
8. < = Compound was not detected at a concentration exceeding the presented laboratory detection limit.
9. J = Indicates an estimated value.
10. References:
    - USEPA Region 3 Risk-Based Concentration (RBC) Table was obtained from USEPA Region 3 website (http://www.epa.gov/reg3hwmd/risk/riskmenu.htm) on February 29, 2000.
    - USEPA Region 9 Preliminary Remediation Goals (PRGs) were downloaded from USEPA Region 9 website (http://www.epa.gov/region09/waste/sfund/prg/index.htm) on February 29, 2000.
    - NYSDEC, Division of Hazardous Substances Regulation, Technical and Administrative Guidance Memorandum 3028 (TAGM 3028) entitled, "Contained-In Criteria for Environmental Media," dated November 30, 1992, revised March 14, 1997.
    - NYSDEC TAGM entitled, "Determination of Soil Cleanup Objectives and Cleanup Levels," HWR-94-4046 (TAGM 4046), dated January 24, 1994, revised December 20, 2000.
11. * = The presented guidance value is for cis-1,2-dichloroethene.
12. Shaded value indicates that the compound was detected at a concentration exceeding the soil guidance value presented in TAGM 4046.
13. NA = Indicates that a guidance value was not listed in TAGM 4046, TAGM 3028, Region 3 RBC Table, or Region 9 PRGs for this compound.
14. Analytical results have not been validated.

Table 4

Hazardous Waste Disposal, Inc. Site
11A Picone Boulevard
Farmingdale, New York

Air Pathway Evaluation
Adjacent Building VOC Inventory

Building Location Product Name	Container Quantity	Type	Size	Manufacturer's Name City, State	Comments	MSDS Obtained
R & D Carpet and Tile Building, 20 Picone Boulevard						
Adhesives						
205 CoveBase Adhesive (Fortified Acrylic Solvent Free)	8	Buckets	4 gal.	Roppe Corp., Fostoria, OH		X
Clear Spread Tile Adhesive	24	Buckets	4 gal.	Chapco, Dalton, GA	Low VOC Emissions	X
ECO 350 Floor Adhesive	13	Buckets	15 L	Mapei Corp., Garland, TX	Solvent Free	X
Epoxy Terraza Mix BC-204 Part A	6	Buckets	5 gal.	Tec		
Flextile 200 Multipurpose Ceramic Tile Adhesive	12	Buckets	3.5 gal.	FlexTile LTD, Toronto, Ontario	Low VOC	X
Linoleum L910	50	Buckets	4 gal.	Forbo Industries	Adhesive	X
Plani/Patch Plus	15	Buckets	5 gal.	Mapei, Garland, TX		
Polyurethane Premium Construction Adhesive	12	Cartridges	10.6 fl. oz.	Sovereign Specialty Chemicals, Mentor, OH		X
Powerhold 4000 Premium	75	Buckets	4 gal.	Chicago Adhesive Products, Co. FCDA/Powerhold, Las Vegas, NV		X
Thin Spread Floor Tile Adhesive	7	Buckets	4 gal.	Henry 130/WW Henry Co., PA		X
Top Gun Premium Multipurpose Adhesive	25	Buckets	4 gal.	Chapco, Dalton, GA		X
Universal Vinyl Floor Covering Adhesive #5050	2	Buckets	2.5 gal.	Toli International		X
Coatings/Sealers						
Enduit Sealer	4	Box	5 gal.	Johnson Wax Professional, Sturtevant, WI	Water-Based Acrylic Sealer (MSDS obtained for water-based penetrating sealer and concrete/hard floor surface sealer)	X
Epoxy Resin	3	Metal Can	32 fl. oz.	Tuff-Lite 5 TEC Specialty Products, Inc., Palatine IL		
FCP-102 Floor Sealer	5	Plastic Bottle	1 gal.	Fritz Industries, Inc., Dallas, TX		X
FCP-300 Duro Floor Glass Sealer & Finish	8	Plastic Bottle	1 gal.	Fritz Industries, Inc., Dallas, TX		X

Table 4

Hazardous Waste Disposal, Inc. Site
11A Picone Boulevard
Farmingdale, New York

Air Pathway Evaluation
Adjacent Building VOC Inventory

Building Location/ Product Name	Container			Manufacturer's Name City, State	Comments	MSDS Obtained
	Quantity	Type	Size			
Nitroflor FC140	5	Metal Can	1 gal.	Fosroc Inc., Georgetown, KY	Epoxy Floor Coating	X
Nitroflor UR512	25	Metal Can	1 gal.	Fosroc Inc., Georgetown, KY	Aliphatic Polyurethane Coating	X
Polycoat	10	Metal Can	1 gal.	Delta Polymers, North Bayshore, NY	Polymers	X
Polyurethane Coating	5	Metal Can	1 gal.	Duraback 18/Cotel 18 Enterprises, Teaneck, NJ	32% Toluene	
Polyurethane Coating	2	Metal Can	1 qt.	Duraback 18/Cotel 18 Enterprises, Teaneck, NJ		
Terra Glaze Acrylic Polymer Terrazo Seal	1	Plastic Bottle	1 gal.	Spartan Chemcial Co., Maumee, OH		X
Tuffclad Mix A Seamless Decorative Quart Broadcast System	3	Buckets	4 gal.	Topaz, Deer Park, NY		
Tuffclad Mix B Epoxy Liquid Coat	13	Buckets	4 gal.	Topaz, Deer Park, NY		
Tuffclad Mix B Epoxy Liquid Coat	4	Buckets	2.5 gal.	Topaz, Deer Park, NY		
Zip Guard, Water Based Urethane Finish	1	Metal Can	1 gal.	<Label Not Accessible>		X
Base Filler						
DuraFlex Latex Fortified Mortar	1/2 pallet	Bags	50 lbs.	DAP, Inc., Baltimore, MD	(MSDS obtained for thin-set mortar by Bostik Findley)	X
Multi-Purpose Cementitous Patch	1 pallet	Bags	50 lbs.	Para-Crum/Bancrift Bag, Inc., West Monroe, LA		
RP110 - Fast-Setting Cement-Based Polymer Modified Patching Compound	1 pallet	Bags	50 lbs.	Mapei, Garland, TX		X

Table 4

Hazardous Waste Disposal, Inc. Site
11A Picone Boulevard
Farmingdale, New York

Air Pathway Evaluation
Adjacent Building VOC Inventory

Building Location Product Name	Container			Manufacturer's Name City, State	Comment	MSDS Obtained?
	Quantity	Type	Size			
Cleaners						
Bridgepoint Fabric Prespray	1	Plastic Bottle	1 gal.	Bridgeport Systems, Salt Lake City, UT		
Con Luster Floor Polish	1	Plastic Bottle	1 gal.	GemTec Solid Vinyl, Inc., Brooklyn, NY		
Liquid Defoamer Concentrate	1	Plastic Bottle	1 gal.	ChemSpec		X
Murphy's Oil Soap	3	Plastic Bottle	1 gal.	Colgate Palmolive Co., Morristown, NJ		
On and On	1	Plastic Bottle	1 gal.	Spartan Chemical Co., Maymee, OH		X
Water Based Carpet and Upholstry Cleaner	1	Plastic Bottle	1 gal.	Bridgeport Systems, Salt Lake City, UT		
Paint/Stain						
Interior Stain Enamel	2	Metal Can	1 gal.	BEHR Process Corp., Santa Anna, CA		
Wood Finish	4	Metal Can	1 gal.	Minwax Co. Inc., Montvale, NJ		
Wood Finish	10	Metal Can	1 qt.	Minwax Co. Inc., Montvale, NJ		
Paint Stripper/Thinner						
K-1 Kerosene	1	Plastic Bottle	1 gal.	<Label Not Accessible>		
Lacquer Thinner	1	Metal Can	1 gal.	<Label Not Accessible>		
Fort Brand Services Inc. Building, 11D Picone Boulevard						
Lubricants/Hydraulic Fluids						
CRC Technical Grade 3-36 Multipurpose Lubricant	1	Spray Can	11 oz.	CRC Industries, Warminster, PA		X
Globo M2000 Quad Oil	1	Spray Can	12 oz.	Globo/Casten Enterprises, Elgin, IL		
Gunk Industrial Chain Lube	1	Spray Can	15 oz.	Radiator Speciality Co., Charlotte, NC		
Jax Chain & Cable Lubricant	1	Spray Can	10 oz.	Pressure Lube, Inc., Butler, WI		X
Motor Oil	4	Bucket	5 gal.	Miles Petroleum Co., Farmingdale, NY		
Rotella T Motor Oil SAE30	12	Plastic Bottles	1 gal.	Shell/Equilon Enterprises LLC, Houston, TX		
Value-One AW Hydraulic Fluid 46	5	Bucket	5 gal.	Hydraulic Oil		
WD-40	1	Spray Can	8 oz.	WD-40 Co., San Diego, CA		

Table 4

Hazardous Waste Disposal, Inc. Site
11A Picone Boulevard
Farmingdale, New York

Air Pathway Evaluation
Adjacent Building VOC Inventory

Building Location Product Name	Container Quantity	Type	Size	Manufacturer Name City, State	Comments	MSDS Obtained
Paint/Stain						
Centari Acrylic Enamel	2	Metal Can	1 gal.	DuPont	Automotive Paint Product	
Enamel Finish	2	Spray Can	12 oz.	Demi-Kote/Dayton Electric Mfg. Co., Niles, IL		
Gloss Protective Enamel	3	Spray Can	12 oz.	Rust-Oleum, Vernon Hills, IL		
Interior/Exterior Alley & Gloss Porch & Floor Enamel	1	Metal Can	1 gal.	ServiStar		
Metallics	1	Spray Can	12 oz.	Rust-Oleum, Vernon Hills, IL		
Oil Based Enamel	5	Metal Can	1 gal.	Rust-Oleum, Vernon Hills, IL		
Painter's Touch	2	Spray Can	12 oz.	Rust-Oleum, Vernon Hills, IL		
Sandable Primer	1	Spray Can	12 oz.	Sherwin Williams/Krylon Products Group, Solon, OH		
Paint Stripper/Thinner						
Lacquer Thinner	1	Metal Can	1 gal.	W.M. Barr & Company, Memphis, TN	Klean-Strip Prod. No. ML-170	X
Odorless Mineral Spirits (Klean Strip)	2	Metal Can	1 gal.	W.M. Barr & Company, Memphis, TN	Klean-Strip Prod. No. GMS-44	X
Cleaners						
Brake Cleaner	1	Spray Can	20 oz.	Gunk/Radiator Speciality Co., Charlotte, NC	Composition is 90-100% PCE	X
Sana-Care Crème Cleaner	1	Plastic Bottle	32 fl. oz.	San-a-Care, Inc., Waukesha, WI		X
Stainless Steel Polish	2	Spray Can	18 oz.	Midco Products Co., Maryland-Heights, MO	(Generic MSDS obtained)	X
Base Filler						
Plastic Filler	1	Metal Can	1 gal.	Dynalite	Contains Space Age Microsphere	
Miscellaneous						
Battery Corrosion Preventative Spray	1	Spray Can	12.75 oz.	NoCo Co., Cleveland, OH		X
CRC Battery Terminal Protector	1	Spray Can	7.5 oz.	CRC Industries, Warminster, PA		X
Cyanograr	1	Drum	90.71 kg	<Label not legible>	Sodum Cyanide UN1689	X
Fabulous Blaster	2	Spray Can	12 oz.	Blaster/B. CCI, Cleveland, OH		

Table 4

Hazardous Waste Disposal, Inc. Site
11A Picone Boulevard
Farmingdale, New York

Air Pathway Evaluation
<u>Adjacent Building VOC Inventory</u>

Building/[illegible]/ Product Name	Container			Manufacturer's Name City, State	Comment	MSDS Obtained
	Quantity	Type	Size			
No Touch Winter Tire Care	1	Spray Can	12 oz.	No Touch, Lake Forest, CA		
Starting Fluid	2	Spray Can	11 oz.	HD America, Inc., St. Louis, MS		
Wasp & Hornet Killer	1	Spray Can	17 oz.	Realex, St. Louis, MO		
Windshield DeIcer	1	Spray Can	11 oz.	Gold Eagle Co., Chicago, IL		
Ryder Truck Building, [illegible] Picone Boulevard						
Cleaners						
CRC Battery Cleaner	10	Spray Can	7.5 oz.	CRC Industries, Warminster, PA		X
CRC Heavy Duty Glass Cleaner	1	Spray Can	18 oz.	CRC Industries, Warminster, PA		X
Parts Washer Fluid	1	Sink/Reservoir	NA	Safety Kleen	Based on waste manifest, contents include PCE, TCE, cadmium, lead, mercury, silver, o-cresol, and m/p-cresol) N.O.S. petroleum naphtha	
Siloo Air Brake Conditioner	16	Plastic Bottle	1 qt.	CRC Industries, Warminster, PA		X
Lubricants/Hydraulic Fluids						
Anti-Seize & Lubricating Compound	1	Plastic	8 oz.	Dynatex, Elizabethtown, KY		X
Automatic Transmission Fluid	1	Drum	55 gal.	Chevron Texaco, San Ramon, CA		
Brake & Caliper Lubricant	2	Plastic Container	8 oz.	Dynatex, Elizabethtown, KY		X
CRC White Lithium Grease	1	Spray Can	10 oz.	CRC Industries, Warminster, PA		X
Delo 400 Multipgrade SAE 15W-40	5	Drum	55 gal.	Chevron Texaco, San Ramon, CA		
Delo Grease EP NLG I2	1	Cardboard	14 oz.	Chevron Products, San Francisco, CA		
Engard Synthetic Transmission Lubricant	3	Drum	55 gal.	Cognis Corp, Cincinnati, OH	SAE50	
Starbrite Heavy Duty Brake Fluid	4	Plastic Bottle	12 fl. oz.	Starbrite, Ft. Lauderdale, FL		
Starbrite Power Steering Fluid	13	Plastic Bottle	32 fl. oz.	Starbrite, Ft. Lauderdale, FL		
Paint Stripper/Thinner						
Odorless Mineral Spirits	1	Metal Can	1 gal.	W.M. Barr & Company, Memphis, TN	Klean-Strip Product No. GMS-44	X

Table 4

Hazardous Waste Disposal, Inc. Site
11A Picone Boulevard
Farmingdale, New York

Air Pathway Evaluation
Adjacent Building VOC Inventory

Building Location Product Name	Container			Manufacturer's Name City, State	Comments	MSDS Obtained
	Quantity	Type	Size			
Miscellaneous						
Castle Long Life Battery Protector	5	Spray Can	12.75 oz.	Castle Products, Buffalo, NY	Composition is 20-30% PCE	X
CRC Battery Terminal Protector	18	Spray Can	7.5 oz.	CRC Industries, Warminster, PA	In flammable cabinet	X
CRC Ice Off	32	Spray Can	12 oz.	CRC Industries, Warminster, PA		X
Siloo Diesel Fuel Anti-Gel	36	Plastic Bottles	1 qt.	CRC Industries, Warminster, PA		X
Texaco E/L Coolant/Antifreeze	3	Drum	55 gal.	Texaco		X

Notes:

1. Building inventory completed by Blasland, Bouck & Lee, Inc. (BBL) on August 14, 2002.
2. VOC = Volatile Organic Compound.
3. MSDS = Material Safety Data Sheet.
4. NA = Not Available.

Table 5

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Soil Vapor Survey
Soil Vapor Analytical Results for VOCs (ppmv)

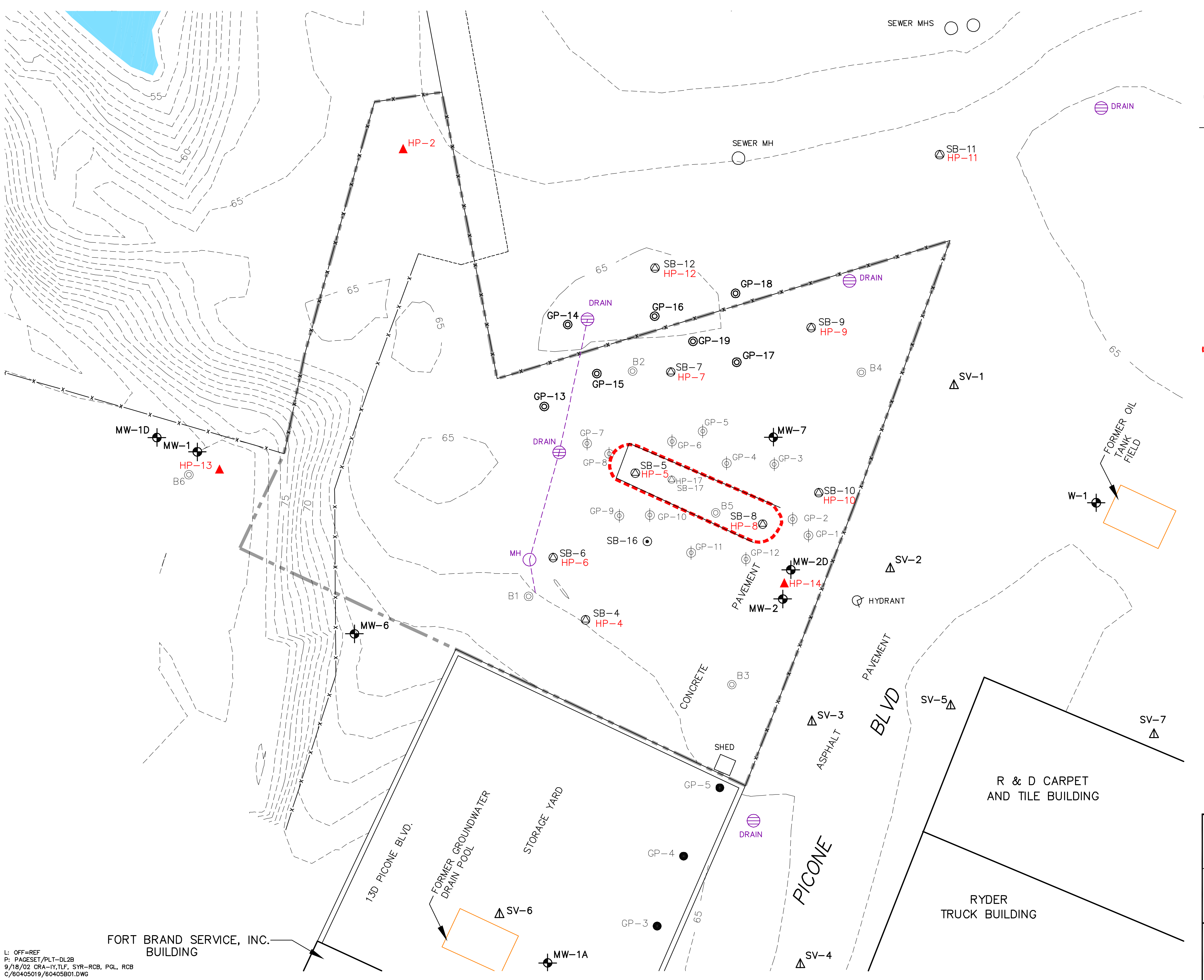
Compound	SV-1	SV-2	SV-3	SV-4	SV-5	SV-6	SV-7
Vinyl Chloride	0.01	<0.5	<0.2	<0.010	<0.2	<0.010	<0.05
Chloroethane	<0.0005	<0.5	<0.2	<0.010	<0.2	<0.010	<0.05
1,1-Dichloroethene	<0.0005	<0.5	<0.2	<0.010	<0.2	<0.010	<0.05
1,1-Dichloroethane	0.0017	<0.5	<0.2	<0.010	<0.2	<0.010	<0.05
cis-1,2-Dichloroethene	0.082 D	2.4	0.48	0.18	0.43	0.27	0.067
Trichloroethene	0.035	6.3	3.1	0.10	1.8	0.82 D	0.42
Tetrachloroethene	0.012	97 D	25 D	0.9 D	29 D	0.77	5.4 D

Notes:

1. Soil vapor samples collected by Blasland, Bouck & Lee, Inc. (BBL) on August 13, 2002.
2. VOCs = Volatile organic compounds.
3. Samples analyzed by Severn Trent Laboratories, Inc. (STL) of Burlington, Vermont for the individual VOC constituents identifed above using United States Environmental Protection Agency (USEPA) Method TO-14A.
4. Concentrations reported in parts per million (ppmv).
5. < = Compound was not detected at a concentration exceeding the presented laboratory detection limit.
6. D = Compound was identified in the analysis at a secondary dilution factor.
7. Analytical results have not been validated.

Figures

BLASLAND, BOUCK & LEE, INC.
engineers & scientists



L: OFF=REF
P: PAGESET/PLT−DL2B
9/18/02 CRA−IY,TLF, SYR−RCB, PGL, RCB
C/60405019/60405B01.DWG

LEGEND:

SITE BOUNDARY LOCATION (11A PICONE BOULEVARD)
—x— FENCE LINE
◎ SOIL VOC DELINEATION BORING (AUGUST 2002)
△ SOIL VAPOR SAMPLE LOCATION (AUGUST 2002)
⊕ EXISTING MONITORING WELL LOCATION
SOIL BORING/HYDROPUNCH™ LOCATION
▲ HYDROPUNCH™ LOCATION ONLY
⊙ SOIL BORING LOCATION ONLY
GEOPROBE® SOIL BORING LOCATION
APPROXIMATE LOCATION OF FORMER SLUDGE PIT
● GEOPROBE® GROUNDWATER SAMPLING LOCATION
◎ PHASE II SOIL BORINGS

SOURCE:

ALL BASE MAP INFORMATION UNLESS OTHERWISE NOTED WAS TAKEN FROM A MAP ENTITLED "MONITORING WELL AND SOIL BORING LOCATION PLAN, HWD SITE−PICONE BOULEVARD, FARMINGDALE NEW YORK, PROJECT No. 604.05 #2". PREPARED BY ALBERT W. TAY. FILE No. 99390−3.DWG. SURVEYED 11/22/99 THROUGH 11/29/99. SURVEY LAST REVISED 2/9/2000.

NOTES:

1. SOIL VOC DELINEATION BORINGS AND SOIL VAPOR SAMPLE LOCATIONS WERE SURVEYED BY BBL DURING AUGUST 2002.
2. THE LOCATION OF THE FORMER OIL TANK FIELD IS APPROXIMATE. THE SOURCE IS A MAP PRODUCED BY TYREE BROTHERS ENVIRONMENTAL SERVICES, INC. (NOT TO SCALE, NO DATE PROVIDED).
3. APPROXIMATE LOCATIONS OF SOIL BORINGS B−1 THROUGH B−6 WERE INSTALLED BY GIBBS & HILL, INC., SOURCE IS FIGURE 2 PROVIDED IN THEIR REPORT ENTITLED "ENGINEERING INVESTIGATIONS AT INACTIVE HAZARDOUS WASTE SITES IN THE STATE OF NEW YORK − PHASE II INVESTIGATION, DECEMBER 1991".
4. THE LOCATIONS OF THE FORMER GROUNDWATER DRAINPOOL, MONITORING WELL MW−1A AND GEOPROBE GROUNDWATER SAMPLING LOCATIONS (GP−3 THROUGH GP−5) AT 13D PICONE BOULEVARD ARE APPROXIMATE. THE SOURCE IS FIGURE 2 − GROUNDWATER SAMPLING LOCATIONS PREPARED BY FANNING, PHILLIPS & MOLMAR (FPM) DATED 8/23/96.
5. MONITORING WELL W−1, INSTALLED BY TYREE BROTHERS ENVIRONMENTAL SERVICES, INC. SOURCE IS A MAP PROVIDED BY GIBBS & HILL, INC., DATED 6/17/94 (NOT TO SCALE). WELL W−1 WAS SURVEYED BY ALBERT W. TAY.
6. EXISTING WELLS MW−1 THROUGH MW−4 INSTALLED BY GIBBS & HILL, INC. IN SEPTEMBER 1990; WELLS MW−5 AND MW−6 WERE INSTALLED IN JUNE 1994 BY FANNING, PHILLIPS & MOLNAR. WELLS SURVEYED BY ALBERT W. TAY.

DRAFT

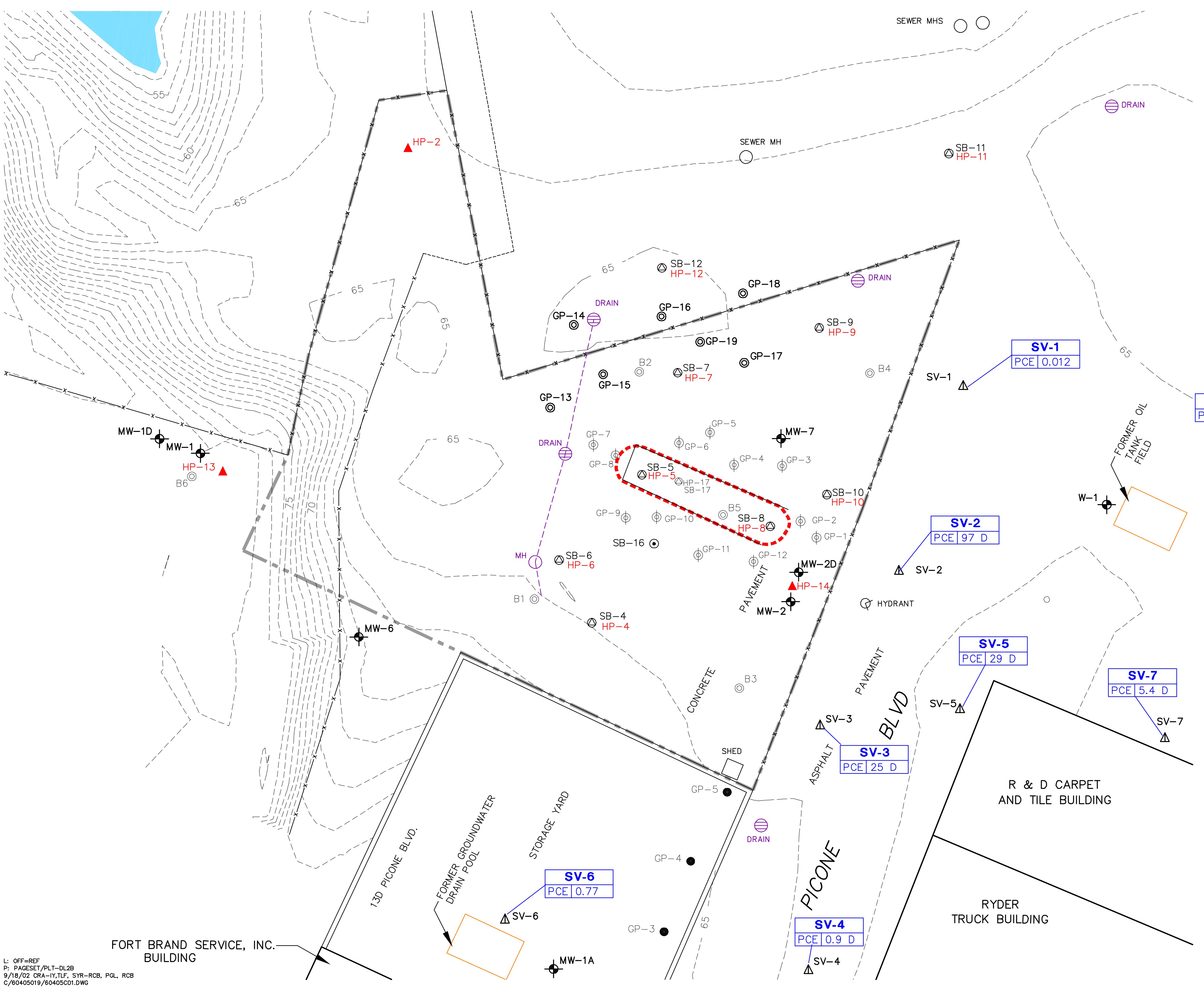
0 30' 60'
GRAPHIC SCALE

HAZARDOUS WASTE DISPOSAL, INC. SITE
11A PICONE BOULEVARD
FARMINGDALE, NEW YORK

SAMPLING LOCATIONS

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
1



LEGEND:

- ▬ SITE BOUNDARY LOCATION (11A PICONE BOULEVARD)
- —x— FENCE LINE
- ◎ SOIL VOC DELINEATION BORING (AUGUST 2002)
- △ SOIL VAPOR SAMPLE LOCATION (AUGUST 2002)
- ⌖ EXISTING MONITORING WELL LOCATION
- ◬ SOIL BORING/HYDROPUNCH™ LOCATION
- ▲ HYDROPUNCH™ LOCATION ONLY
- ⊙ SOIL BORING LOCATION ONLY
- ⌀ GEOPROBE® SOIL BORING LOCATION
- ⬭ APPROXIMATE LOCATION OF FORMER SLUDGE PIT
- ● GEOPROBE® GROUNDWATER SAMPLING LOCATION
- ◎ PHASE II SOIL BORINGS

SV-1		← SAMPLE IDENTIFICATION
PCE	0.012	← SAMPLE CONCENTRATION (PPMV)

SOURCE:

ALL BASE MAP INFORMATION UNLESS OTHERWISE NOTED WAS TAKEN FROM A MAP ENTITLED "MONITORING WELL AND SOIL BORING LOCATION PLAN, HWD SITE–PICONE BOULEVARD, FARMINGDALE NEW YORK, PROJECT No. 604.05 #2". PREPARED BY ALBERT W. TAY. FILE No. 99390–3.DWG. SURVEYED 11/22/99 THROUGH 11/29/99. SURVEY LAST REVISED 2/9/2000.

NOTES:

1. SOIL VOC DELINEATION BORINGS AND SOIL VAPOR SAMPLE LOCATIONS WERE SURVEYED BY BBL DURING AUGUST 2002.
2. THE LOCATION OF THE FORMER OIL TANK FIELD IS APPROXIMATE. THE SOURCE IS A MAP PRODUCED BY TYREE BROTHERS ENVIRONMENTAL SERVICES, INC. (NOT TO SCALE, NO DATE PROVIDED).
3. APPROXIMATE LOCATIONS OF SOIL BORINGS B–1 THROUGH B–6 WERE INSTALLED BY GIBBS & HILL, INC., SOURCE IS FIGURE 2 PROVIDED IN THEIR REPORT ENTITLED "ENGINEERING INVESTIGATIONS AT INACTIVE HAZARDOUS WASTE SITES IN THE STATE OF NEW YORK – PHASE II INVESTIGATION, DECEMBER 1991".
4. THE LOCATIONS OF THE FORMER GROUNDWATER DRAINPOOL, MONITORING WELL MW–1A AND GEOPROBE GROUNDWATER SAMPLING LOCATIONS (GP–3 THROUGH GP–5) AT 13D PICONE BOULEVARD ARE APPROXIMATE. THE SOURCE IS FIGURE 2 – GROUNDWATER SAMPLING LOCATIONS PREPARED BY FANNING, PHILLIPS & MOLMAR (FPM) DATED 8/23/96.
5. MONITORING WELL W–1, INSTALLED BY TYREE BROTHERS ENVIRONMENTAL SERVICES, INC. SOURCE IS A MAP PROVIDED BY GIBBS & HILL, INC., DATED 6/17/94 (NOT TO SCALE). WELL W–1 WAS SURVEYED BY ALBERT W. TAY.
6. EXISTING WELLS MW–1 THROUGH MW–4 INSTALLED BY GIBBS & HILL, INC. IN SEPTEMBER 1990; WELLS MW–5 AND MW–6 WERE INSTALLED IN JUNE 1994 BY FANNING, PHILLIPS & MOLNAR. WELLS SURVEYED BY ALBERT W. TAY.
7. TCE = TETRACHLOROETHENE.
8. CONCENTRATIONS ARE REPORTED IN PARTS PER MILLION (ppmv).
9. D = COMPOUND WAS IDENTIFIED IN THE ANALYSIS AT A SECONDARY DILUTION FACTOR.

DRAFT

0 30' 60'

GRAPHIC SCALE

HAZARDOUS WASTE DISPOSAL, INC. SITE
11A PICONE BOULEVARD
FARMINGDALE, NEW YORK

SOIL VAPOR ANALYTICAL RESULTS FOR TETRACHLOROETHENE (ppmv)

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
2

L: OFF=REF
P: PAGESET/PLT–DL2B
9/18/02 CRA–IY,TLF, SYR–RCB, PGL, RCB
C/60405019/60405C01.DWG

Attachment A

Laboratory Analytical Data Reports

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Soil Analytical Results

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

STL EDISON
777 New Durham Road
Edison, New Jersey 08817
Phone: (732) 549-3900 Fax: (732) 549-3679

CHAIN OF CUSTODY / ANALYSIS REQUEST

PAGE 1 OF 2

Name (for report and invoice) John Brussel	Samplers Name (Printed) Glenn Palmer	Site/Project Identification HWD, Farmingdale
Company BBL	P.O. # 60405.017	State (Location of site): NJ: ☐ NY: ☒ Other: Regulatory Program: NYSDEC ASP
Address 6723 towpath Rd Box 66 ~~8 South River Rd~~	Analysis Turnaround Time Standard ☒ Rush Charges Authorized For: 2 Week ☐ 1 Week ☐ Other ☐	LAB USE ONLY Project No: Job No: 2443
City Syracuse ~~Cranbury~~ State NY ~~NJ~~		
Phone 315-446-9120 Fax 315-449-4111 ~~609 860-8072~~ ~~609-860-8002~~		

ANALYSIS REQUESTED (ENTER "X" BELOW TO INDICATE REQUEST)

Sample Identification	Date	Time	Matrix	No. of. Cont.	VOC NYSDEC 1995 ASP	Moisture	MS/MSD	Sample Numbers
# GP-17 (17.5-18.0)	8/13/02	1150	Soil	5	✓	✓		369140
GP-17 (14.5-15.0)	8/13/02	1200	Soil	5	✓	✓		369141
GP-15 (6.0-6.5)	8/13/02	1250	Soil	5	✓	✓		369142
GP-15 (16-16.5)		1335	Soil	5	✓	✓		369143
GP-19 (3.5-4.0)*		1420	Soil	9	✓	✓	✓	369144
GP-19 (17.5-18.0)		1510	Soil	5	✓	✓		369145
GP-13 (12-12.5)		1630	Soil	5	✓	✓		369146
GP-13 (17-17.5)		1650	Soil	5	✓	✓		369147
BD081302	↓	-	Soil	5	✓	✓		369148

Preservation Used: 1 = ICE, 2 = HCl, 3 = H$_2$SO$_4$, 4 = HNO$_3$, 5 = NaOH
6 = Other ________, 7 = Other ________

Soil: 1 1
Water:

Special Instructions * Extra volume provided for MS/MSD.

Water Metals Filtered (Yes/No)? ____

Relinquished by 1) Kurt Roth	Company BBL	Date / Time 8/14/02 1500	Received by 1)	Company STL
Relinquished by 2)	Company	Date / Time /	Received by 2)	Company
Relinquished by 3)	Company	Date / Time /	Received by 3)	Company
Relinquished by 4)	Company	Date / Time /	Received by 4)	Company

Laboratory Certifications: New Jersey (12028), New York (11452), Pennsylvania (68-522), Connecticut (PH-0200), Rhode Island (132).

STL DISON
777 Ne urham Road
Edison, New Jersey 08817
Phone: (732) 549-3900 Fax: (732) 549-3679

CHAIN OF CUSTODY / ANALYSIS REQUEST

PAGE 2 OF 2

Name (for report and invoice) John Brussel Kersten Robbins
Company BBL
Address 6723 towpath Rd Box 66
City Syracuse State NY
Phone 315-446-9120 Fax 315-449-4111

Samplers Name (Printed) ~~Glenn Palmer~~ Jay Boland
P.O. # 60405.017

Site/Project Identification HWD, Farmingdale
State (Location of site): NJ: ☐ NY: ☒ Other:
Regulatory Program: NYSDEC ASP

Analysis Turnaround Time
Standard ☒
Rush Charges Authorized For:
2 Week ☐
1 Week ☐
Other ☐

ANALYSIS REQUESTED (ENTER "X" BELOW TO INDICATE REQUEST)

LAB USE ONLY
Project No:
Job No: Z443

Sample Identification	Date	Time	Matrix	No. of. Cont.	VOC NYSDEC 1995 ASP	Moisture										Sample Numbers
GP-18 (16.5-17)	8/13/02	0920	Soil	5	X	X										369149
GP-18 (18-18.5)		0930	Soil	5	X	X										369150
GP-16 (4-4.5)		1010	Soil	5	X	X										369151
GP-16 (17-17.5)		1020	Soil	5	X	X										369152
GP-14 (1.5-2)		1045	Soil	5	X	X										369153
GP-14 (17-17.5)		1055	Soil	5	X	X										369154
Preservation Used: 1 = ICE, 2 = HCl, 3 = H_2SO_4, 4 = HNO_3, 5 = NaOH				Soil:	1	1										
6 = Other ______, 7 = Other ______				Water:												

Special Instructions

Water Metals Filtered (Yes/No)?

Relinquished by 1) Kirst Robb	Company BBL	Date / Time 8/14/02 1800	Received by 1)	Company STL
Relinquished by 2)	Company	Date / Time |	Received by 2)	Company
Relinquished by 3)	Company	Date / Time |	Received by 3)	Company
Relinquished by 4)	Company	Date / Time |	Received by 4)	Company

Laboratory Certifications: New Jersey (12028), New York (11452), Pennsylvania (68-522), Connecticut (PH-0200), Rhode Island (132).

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

NYSDEC SAMPLE NO.

GP-17_17.5-18.0

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369140

Sample wt/vol: 4.3 (g/mL) G Lab File ID: J29845

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 5 Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg	Q
74-87-3	Chloromethane	12	U
74-83-9	Bromomethane	12	U
75-01-4	Vinyl Chloride	12	U
75-00-3	Chloroethane	12	U
75-09-2	Methylene Chloride	0.7	J
67-64-1	Acetone	12	U
75-15-0	Carbon Disulfide	12	U
75-35-4	1,1-Dichloroethene	12	U
75-34-3	1,1-Dichloroethane	12	U
540-59-0	1,2-Dichloroethene (total)	12	U
67-66-3	Chloroform	12	U
107-06-2	1,2-Dichloroethane	12	U
78-93-3	2-Butanone	12	U
71-55-6	1,1,1-Trichloroethane	12	U
56-23-5	Carbon Tetrachloride	12	U
75-27-4	Bromodichloromethane	12	U
78-87-5	1,2-Dichloropropane	12	U
10061-01-5	cis-1,3-Dichloropropene	12	U
79-01-6	Trichloroethene	12	U
124-48-1	Dibromochloromethane	12	U
79-00-5	1,1,2-Trichloroethane	12	U
71-43-2	Benzene	12	U
10061-02-6	trans-1,3-Dichloropropene	12	U
75-25-2	Bromoform	5	J
108-10-1	4-Methyl-2-Pentanone	12	U
591-78-6	2-Hexanone	12	U
127-18-4	Tetrachloroethene	12	U
79-34-5	1,1,2,2-Tetrachloroethane	12	U
108-88-3	Toluene	12	U
108-90-7	Chlorobenzene	12	U
100-41-4	Ethylbenzene	12	U
100-42-5	Styrene	12	U
1330-20-7	Xylenes (Total)	12	U

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NYSDEC SAMPLE NO.

GP-17_17.5-18.0

Lab Name: STL Edison

Contract: N/A

Lab Code: N/A

Case No.: N/A

SAS No.: N/A

SDG No.: Z4431

Matrix: (soil/water) SOIL

Lab Sample ID: 369140

Sample wt/vol: 4.3 (g/mL) g

Lab File ID: J29845

Level: (low/med) LOW

Date Received: 08/14/02

% Moisture: not dec. 5

Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm)

Dilution Factor: 1.0

Soil Extract Volume:________(mL)

Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 0

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
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1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

NYSDEC SAMPLE NO.

GP-17_14.5-15.0

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369141

Sample wt/vol: 5.0 (g/mL) G Lab File ID: J29846

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 2 Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:_______(mL) Soil Aliquot Volume: _______(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg	Q
74-87-3	Chloromethane	10	U
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	0.5	J
67-64-1	Acetone	10	U
75-15-0	Carbon Disulfide	10	U
75-35-4	1,1-Dichloroethene	10	U
75-34-3	1,1-Dichloroethane	10	U
540-59-0	1,2-Dichloroethene (total)	10	U
67-66-3	Chloroform	10	U
107-06-2	1,2-Dichloroethane	10	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	10	U
56-23-5	Carbon Tetrachloride	10	U
75-27-4	Bromodichloromethane	10	U
78-87-5	1,2-Dichloropropane	10	U
10061-01-5	cis-1,3-Dichloropropene	10	U
79-01-6	Trichloroethene	10	U
124-48-1	Dibromochloromethane	10	U
79-00-5	1,1,2-Trichloroethane	10	U
71-43-2	Benzene	10	U
10061-02-6	trans-1,3-Dichloropropene	10	U
75-25-2	Bromoform	3	J
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	2	J
79-34-5	1,1,2,2-Tetrachloroethane	10	U
108-88-3	Toluene	10	U
108-90-7	Chlorobenzene	10	U
100-41-4	Ethylbenzene	10	U
100-42-5	Styrene	10	U
1330-20-7	Xylenes (Total)	10	U

FORM I CLP-VOA 10/95

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NYSDEC SAMPLE NO.

GP-17_14.5-15.0

Lab Name: STL Edison

Contract: N/A

Lab Code: N/A

Case No.: N/A

SAS No.: N/A

SDG No.: Z4431

Matrix: (soil/water) SOIL

Lab Sample ID: 369141

Sample wt/vol: 5.0 (g/mL) g

Lab File ID: J29846

Level: (low/med) LOW

Date Received: 08/14/02

% Moisture: not dec. 2

Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm)

Dilution Factor: 1.0

Soil Extract Volume:________(mL)

Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 0

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
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VOLATILE ORGANICS ANALYSIS DATA SHEET

NYSDEC SAMPLE NO.

GP-15_6.0-6.5

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369142

Sample wt/vol: 6.2 (g/mL) G Lab File ID: B19541

Level: (low/med) MED Date Received: 08/14/02

% Moisture: not dec. 6 Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: 10000(uL) Soil Aliquot Volume: 100(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg	Q
74-87-3	Chloromethane	850	U
74-83-9	Bromomethane	850	U
75-01-4	Vinyl Chloride	850	U
75-00-3	Chloroethane	850	U
75-09-2	Methylene Chloride	850	U
67-64-1	Acetone	850	U
75-15-0	Carbon Disulfide	850	U
75-35-4	1,1-Dichloroethene	850	U
75-34-3	1,1-Dichloroethane	850	U
540-59-0	1,2-Dichloroethene (total)	850	U
67-66-3	Chloroform	850	U
107-06-2	1,2-Dichloroethane	850	U
78-93-3	2-Butanone	850	U
71-55-6	1,1,1-Trichloroethane	850	U
56-23-5	Carbon Tetrachloride	850	U
75-27-4	Bromodichloromethane	850	U
78-87-5	1,2-Dichloropropane	850	U
10061-01-5	cis-1,3-Dichloropropene	850	U
79-01-6	Trichloroethene	850	U
124-48-1	Dibromochloromethane	850	U
79-00-5	1,1,2-Trichloroethane	850	U
71-43-2	Benzene	850	U
10061-02-6	trans-1,3-Dichloropropene	850	U
75-25-2	Bromoform	850	U
108-10-1	4-Methyl-2-Pentanone	850	U
591-78-6	2-Hexanone	850	U
127-18-4	Tetrachloroethene	2300	
79-34-5	1,1,2,2-Tetrachloroethane	850	U
108-88-3	Toluene	850	U
108-90-7	Chlorobenzene	850	U
100-41-4	Ethylbenzene	850	U
100-42-5	Styrene	850	U
1330-20-7	Xylenes (Total)	850	U

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NYSDEC SAMPLE NO.

GP-15_6.0-6.5

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369142

Sample wt/vol: 6.2 (g/mL) g Lab File ID: B19541

Level: (low/med) MED Date Received: 08/14/02

% Moisture: not dec. 6 Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: 10000(uL) Soil Aliquot Volume: 100(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 0

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
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VOLATILE ORGANICS ANALYSIS DATA SHEET

NYSDEC SAMPLE NO.

GP-15_16-16.5

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369143

Sample wt/vol: 4.5 (g/mL) G Lab File ID: J29860

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 3 Date Analyzed: 08/22/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NO.	COMPOUND		Q
74-87-3	Chloromethane	11	U
74-83-9	Bromomethane	11	U
75-01-4	Vinyl Chloride	11	U
75-00-3	Chloroethane	11	U
75-09-2	Methylene Chloride	11	U
67-64-1	Acetone	11	U
75-15-0	Carbon Disulfide	11	U
75-35-4	1,1-Dichloroethene	11	U
75-34-3	1,1-Dichloroethane	11	U
540-59-0	1,2-Dichloroethene (total)	11	U
67-66-3	Chloroform	11	U
107-06-2	1,2-Dichloroethane	11	U
78-93-3	2-Butanone	11	U
71-55-6	1,1,1-Trichloroethane	11	U
56-23-5	Carbon Tetrachloride	11	U
75-27-4	Bromodichloromethane	11	U
78-87-5	1,2-Dichloropropane	11	U
10061-01-5	cis-1,3-Dichloropropene	11	U
79-01-6	Trichloroethene	11	U
124-48-1	Dibromochloromethane	11	U
79-00-5	1,1,2-Trichloroethane	11	U
71-43-2	Benzene	11	U
10061-02-6	trans-1,3-Dichloropropene	11	U
75-25-2	Bromoform	5	J
108-10-1	4-Methyl-2-Pentanone	11	U
591-78-6	2-Hexanone	11	U
127-18-4	Tetrachloroethene	11	U
79-34-5	1,1,2,2-Tetrachloroethane	11	U
108-88-3	Toluene	11	U
108-90-7	Chlorobenzene	11	U
100-41-4	Ethylbenzene	11	U
100-42-5	Styrene	11	U
1330-20-7	Xylenes (Total)	11	U

FORM I CLP-VOA 10/95

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NYSDEC SAMPLE NO.

GP-15_16-16.5

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369143

Sample wt/vol: 4.5 (g/mL) g Lab File ID: J29860

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 3 Date Analyzed: 08/22/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:_______(mL) Soil Aliquot Volume: _______(uL)

Number TICs found: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	15.46	8	J
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FORM I CLP VOA-TIC 10/95

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

NYSDEC SAMPLE NO.

GP-19_3.5-4.0

Lab Name: STL Edison
Contract: N/A

Lab Code: N/A
Case No.: N/A
SAS No.: N/A
SDG No.: Z4431

Matrix: (soil/water) SOIL
Lab Sample ID: 369144

Sample wt/vol: 5.2 (g/mL) G
Lab File ID: J29881

Level: (low/med) LOW
Date Received: 08/14/02

% Moisture: not dec. 6
Date Analyzed: 08/22/02

GC Column: DB624 ID: 0.53 (mm)
Dilution Factor: 1.0

Soil Extract Volume:________(mL)
Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg	Q
74-87-3	Chloromethane	10	U
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	0.9	J
67-64-1	Acetone	190	
75-15-0	Carbon Disulfide	3	J
75-35-4	1,1-Dichloroethene	10	U
75-34-3	1,1-Dichloroethane	10	U
540-59-0	1,2-Dichloroethene (total)	2	J
67-66-3	Chloroform	10	U
107-06-2	1,2-Dichloroethane	10	U
78-93-3	2-Butanone	140	
71-55-6	1,1,1-Trichloroethane	10	U
56-23-5	Carbon Tetrachloride	10	U
75-27-4	Bromodichloromethane	10	U
78-87-5	1,2-Dichloropropane	10	U
10061-01-5	cis-1,3-Dichloropropene	10	U
79-01-6	Trichloroethene	2	J
124-48-1	Dibromochloromethane	10	U
79-00-5	1,1,2-Trichloroethane	10	U
71-43-2	Benzene	10	U
10061-02-6	trans-1,3-Dichloropropene	10	U
75-25-2	Bromoform	6	J
108-10-1	4-Methyl-2-Pentanone	2	J
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	7	J
79-34-5	1,1,2,2-Tetrachloroethane	10	U
108-88-3	Toluene	5	J
108-90-7	Chlorobenzene	10	U
100-41-4	Ethylbenzene	10	U
100-42-5	Styrene	10	U
1330-20-7	Xylenes (Total)	3	J

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NYSDEC SAMPLE NO.

GP-19_3.5-4.0

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369144

Sample wt/vol: 5.2 (g/mL) g Lab File ID: J29881

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 6 Date Analyzed: 08/22/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 20

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 67-63-0	2-PROPANOL	5.57	7	NJ
2.	UNKNOWN ALKANE	14.08	10	J
3.	C10H20 CYCLOALKANE	14.62	18	J
4.	C11H24 ALKANE	14.87	32	J
5.	UNKNOWN	15.05	8	J
6.	UNKNOWN	15.10	10	J
7.	C10H20 CYCLOALKANE	15.27	45	J
8.	UNKNOWN	15.48	41	J
9.	UNKNOWN	15.64	15	J
10.	DECAHYDRONAPHTHALENE ISOMER	15.83	35	J
11.	UNKNOWN HYDROCARBON	15.95	14	J
12.	UNKNOWN	16.04	32	J
13.	UNKNOWN	16.25	11	J
14.	UNKNOWN	16.32	11	J
15.	UNKNOWN	16.46	17	J
16.	UNKNOWN ALKANE	16.58	23	J
17.	DECAHYDROMETHYLNAPHTHALENE I	16.70	11	J
18.	UNKNOWN	16.79	10	J
19.	UNKNOWN	17.00	13	J
20.	UNKNOWN	17.08	13	J
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FORM I CLP VOA-TIC 10/95

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

NYSDEC SAMPLE NO.

GP-19_17.5-18.0

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369145

Sample wt/vol: 4.8 (g/mL) G Lab File ID: J29850

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 2 Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NO.	COMPOUND	ug/Kg	Q
74-87-3	Chloromethane	11	U
74-83-9	Bromomethane	11	U
75-01-4	Vinyl Chloride	11	U
75-00-3	Chloroethane	11	U
75-09-2	Methylene Chloride	11	U
67-64-1	Acetone	11	U
75-15-0	Carbon Disulfide	11	U
75-35-4	1,1-Dichloroethene	11	U
75-34-3	1,1-Dichloroethane	11	U
540-59-0	1,2-Dichloroethene (total)	11	U
67-66-3	Chloroform	11	U
107-06-2	1,2-Dichloroethane	11	U
78-93-3	2-Butanone	11	U
71-55-6	1,1,1-Trichloroethane	11	U
56-23-5	Carbon Tetrachloride	11	U
75-27-4	Bromodichloromethane	11	U
78-87-5	1,2-Dichloropropane	11	U
10061-01-5	cis-1,3-Dichloropropene	11	U
79-01-6	Trichloroethene	11	U
124-48-1	Dibromochloromethane	11	U
79-00-5	1,1,2-Trichloroethane	11	U
71-43-2	Benzene	11	U
10061-02-6	trans-1,3-Dichloropropene	11	U
75-25-2	Bromoform	5	J
108-10-1	4-Methyl-2-Pentanone	11	U
591-78-6	2-Hexanone	11	U
127-18-4	Tetrachloroethene	11	U
79-34-5	1,1,2,2-Tetrachloroethane	11	U
108-88-3	Toluene	11	U
108-90-7	Chlorobenzene	11	U
100-41-4	Ethylbenzene	11	U
100-42-5	Styrene	11	U
1330-20-7	Xylenes (Total)	11	U

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NYSDEC SAMPLE NO.

GP-19_17.5-18.0

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369145

Sample wt/vol: 4.8 (g/mL) g Lab File ID: J29850

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 2 Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
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FORM I CLP VOA-TIC 10/95

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

NYSDEC SAMPLE NO.

GP-13_12-12.5

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369146

Sample wt/vol: 4.2 (g/mL) G Lab File ID: J29851

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 2 Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg	Q
74-87-3	Chloromethane	12	U
74-83-9	Bromomethane	12	U
75-01-4	Vinyl Chloride	12	U
75-00-3	Chloroethane	12	U
75-09-2	Methylene Chloride	12	U
67-64-1	Acetone	36	
75-15-0	Carbon Disulfide	0.8	J
75-35-4	1,1-Dichloroethene	12	U
75-34-3	1,1-Dichloroethane	12	U
540-59-0	1,2-Dichloroethene (total)	12	U
67-66-3	Chloroform	12	U
107-06-2	1,2-Dichloroethane	12	U
78-93-3	2-Butanone	8	J
71-55-6	1,1,1-Trichloroethane	12	U
56-23-5	Carbon Tetrachloride	12	U
75-27-4	Bromodichloromethane	12	U
78-87-5	1,2-Dichloropropane	12	U
10061-01-5	cis-1,3-Dichloropropene	12	U
79-01-6	Trichloroethene	0.8	J
124-48-1	Dibromochloromethane	12	U
79-00-5	1,1,2-Trichloroethane	12	U
71-43-2	Benzene	12	U
10061-02-6	trans-1,3-Dichloropropene	12	U
75-25-2	Bromoform	3	J
108-10-1	4-Methyl-2-Pentanone	12	U
591-78-6	2-Hexanone	12	U
127-18-4	Tetrachloroethene	17	
79-34-5	1,1,2,2-Tetrachloroethane	12	U
108-88-3	Toluene	12	U
108-90-7	Chlorobenzene	12	U
100-41-4	Ethylbenzene	12	U
100-42-5	Styrene	12	U
1330-20-7	Xylenes (Total)	12	U

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NYSDEC SAMPLE NO.

GP-13_12-12.5

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369146

Sample wt/vol: 4.2 (g/mL) g Lab File ID: J29851

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 2 Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 8

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 115-07-1	1-PROPENE	3.14	42	NJ
2.	UNKNOWN ALKENE	3.61	9	J
3. 106-97-8	BUTANE	3.77	13	NJ
4.	UNKNOWN ALKENE	3.93	7	J
5. 109-67-1	1-PENTENE	4.73	7	NJ
6. 109-66-0	PENTANE	4.82	13	NJ
7. 110-62-3	PENTANAL	10.07	8	NJ
8. 66-25-1	HEXANAL	12.12	59	NJ
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FORM I CLP VOA-TIC 10/95

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

NYSDEC SAMPLE NO.

GP-13_17-17.5

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369147

Sample wt/vol: 5.6 (g/mL) G Lab File ID: J29852

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 3 Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg	Q
74-87-3	Chloromethane	9	U
74-83-9	Bromomethane	9	U
75-01-4	Vinyl Chloride	9	U
75-00-3	Chloroethane	9	U
75-09-2	Methylene Chloride	9	U
67-64-1	Acetone	9	U
75-15-0	Carbon Disulfide	9	U
75-35-4	1,1-Dichloroethene	9	U
75-34-3	1,1-Dichloroethane	9	U
540-59-0	1,2-Dichloroethene (total)	9	U
67-66-3	Chloroform	9	U
107-06-2	1,2-Dichloroethane	9	U
78-93-3	2-Butanone	9	U
71-55-6	1,1,1-Trichloroethane	9	U
56-23-5	Carbon Tetrachloride	9	U
75-27-4	Bromodichloromethane	9	U
78-87-5	1,2-Dichloropropane	9	U
10061-01-5	cis-1,3-Dichloropropene	9	U
79-01-6	Trichloroethene	9	U
124-48-1	Dibromochloromethane	9	U
79-00-5	1,1,2-Trichloroethane	9	U
71-43-2	Benzene	9	U
10061-02-6	trans-1,3-Dichloropropene	9	U
75-25-2	Bromoform	3	J
108-10-1	4-Methyl-2-Pentanone	9	U
591-78-6	2-Hexanone	9	U
127-18-4	Tetrachloroethene	9	U
79-34-5	1,1,2,2-Tetrachloroethane	9	U
108-88-3	Toluene	9	U
108-90-7	Chlorobenzene	9	U
100-41-4	Ethylbenzene	9	U
100-42-5	Styrene	9	U
1330-20-7	Xylenes (Total)	9	U

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

NYSDEC SAMPLE NO.

GP-13_17-17.5

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369147

Sample wt/vol: 5.6 (g/mL) g Lab File ID: J29852

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 3 Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:

Number TICs found: 0 (ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
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1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

NYSDEC SAMPLE NO.

BD081302

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369148

Sample wt/vol: 5.1 (g/mL) G Lab File ID: J29853

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 3 Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg	Q
74-87-3	Chloromethane	10	U
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	10	U
67-64-1	Acetone	34	
75-15-0	Carbon Disulfide	0.6	J
75-35-4	1,1-Dichloroethene	10	U
75-34-3	1,1-Dichloroethane	10	U
540-59-0	1,2-Dichloroethene (total)	10	U
67-66-3	Chloroform	10	U
107-06-2	1,2-Dichloroethane	10	U
78-93-3	2-Butanone	7	J
71-55-6	1,1,1-Trichloroethane	10	U
56-23-5	Carbon Tetrachloride	10	U
75-27-4	Bromodichloromethane	10	U
78-87-5	1,2-Dichloropropane	10	U
10061-01-5	cis-1,3-Dichloropropene	10	U
79-01-6	Trichloroethene	0.6	J
124-48-1	Dibromochloromethane	10	U
79-00-5	1,1,2-Trichloroethane	10	U
71-43-2	Benzene	10	U
10061-02-6	trans-1,3-Dichloropropene	10	U
75-25-2	Bromoform	2	J
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	6	J
79-34-5	1,1,2,2-Tetrachloroethane	10	U
108-88-3	Toluene	10	U
108-90-7	Chlorobenzene	10	U
100-41-4	Ethylbenzene	10	U
100-42-5	Styrene	10	U
1330-20-7	Xylenes (Total)	10	U

FORM I CLP-VOA 10/95

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NYSDEC SAMPLE NO.

BD081302

Lab Name: STL Edison   Contract: N/A

Lab Code: N/A   Case No.: N/A   SAS No.: N/A   SDG No.: Z4431

Matrix: (soil/water) SOIL   Lab Sample ID: 369148

Sample wt/vol: 5.1 (g/mL) g   Lab File ID: J29853

Level: (low/med) LOW   Date Received: 08/14/02

% Moisture: not dec. 3   Date Analyzed: 08/21/02

GC Column: DB624   ID: 0.53 (mm)   Dilution Factor: 1.0

Soil Extract Volume:_______(mL)   Soil Aliquot Volume: _______(uL)

Number TICs found: 7

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 115-07-1	1-PROPENE	3.14	36	NJ
2.	UNKNOWN ALKENE	3.61	7	J
3.	UNKNOWN	3.77	11	J
4.	UNKNOWN ALKENE	3.93	6	J
5. 109-67-1	1-PENTENE	4.73	6	NJ
6. 109-66-0	PENTANE	4.82	11	NJ
7. 66-25-1	HEXANAL	12.12	18	NJ
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VOLATILE ORGANICS ANALYSIS DATA SHEET

NYSDEC SAMPLE NO.

GP-18_16.5-17

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369149

Sample wt/vol: 4.7 (g/mL) G Lab File ID: J29854

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 6 Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg	Q
74-87-3	Chloromethane	11	U
74-83-9	Bromomethane	11	U
75-01-4	Vinyl Chloride	11	U
75-00-3	Chloroethane	11	U
75-09-2	Methylene Chloride	11	U
67-64-1	Acetone	11	U
75-15-0	Carbon Disulfide	11	U
75-35-4	1,1-Dichloroethene	11	U
75-34-3	1,1-Dichloroethane	11	U
540-59-0	1,2-Dichloroethene (total)	11	U
67-66-3	Chloroform	11	U
107-06-2	1,2-Dichloroethane	11	U
78-93-3	2-Butanone	11	U
71-55-6	1,1,1-Trichloroethane	11	U
56-23-5	Carbon Tetrachloride	11	U
75-27-4	Bromodichloromethane	11	U
78-87-5	1,2-Dichloropropane	11	U
10061-01-5	cis-1,3-Dichloropropene	11	U
79-01-6	Trichloroethene	11	U
124-48-1	Dibromochloromethane	11	U
79-00-5	1,1,2-Trichloroethane	11	U
71-43-2	Benzene	11	U
10061-02-6	trans-1,3-Dichloropropene	11	U
75-25-2	Bromoform	5	J
108-10-1	4-Methyl-2-Pentanone	11	U
591-78-6	2-Hexanone	11	U
127-18-4	Tetrachloroethene	1	J
79-34-5	1,1,2,2-Tetrachloroethane	11	U
108-88-3	Toluene	11	U
108-90-7	Chlorobenzene	11	U
100-41-4	Ethylbenzene	11	U
100-42-5	Styrene	11	U
1330-20-7	Xylenes (Total)	11	U

FORM I CLP-VOA 10/95

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NYSDEC SAMPLE NO.

GP-18_16.5-17

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369149

Sample wt/vol: 4.7 (g/mL) g Lab File ID: J29854

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 6 Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:_______(mL) Soil Aliquot Volume: _______(uL)

Number TICs found: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN ALKANE	16.93	13	J
2.				
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VOLATILE ORGANICS ANALYSIS DATA SHEET

NYSDEC SAMPLE NO.

GP-18_18-18.5

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369150

Sample wt/vol: 5.4 (g/mL) G Lab File ID: J29855

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 5 Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg	Q
74-87-3	Chloromethane	10	U
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	10	U
67-64-1	Acetone	10	U
75-15-0	Carbon Disulfide	10	U
75-35-4	1,1-Dichloroethene	10	U
75-34-3	1,1-Dichloroethane	10	U
540-59-0	1,2-Dichloroethene (total)	10	U
67-66-3	Chloroform	10	U
107-06-2	1,2-Dichloroethane	10	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	10	U
56-23-5	Carbon Tetrachloride	10	U
75-27-4	Bromodichloromethane	10	U
78-87-5	1,2-Dichloropropane	10	U
10061-01-5	cis-1,3-Dichloropropene	10	U
79-01-6	Trichloroethene	10	U
124-48-1	Dibromochloromethane	10	U
79-00-5	1,1,2-Trichloroethane	10	U
71-43-2	Benzene	10	U
10061-02-6	trans-1,3-Dichloropropene	10	U
75-25-2	Bromoform	5	J
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	5	J
79-34-5	1,1,2,2-Tetrachloroethane	10	U
108-88-3	Toluene	10	U
108-90-7	Chlorobenzene	10	U
100-41-4	Ethylbenzene	10	U
100-42-5	Styrene	10	U
1330-20-7	Xylenes (Total)	10	U

FORM I CLP-VOA 10/95

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NYSDEC SAMPLE NO.

GP-18_18-18.5

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369150

Sample wt/vol: 5.4 (g/mL) g Lab File ID: J29855

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 5 Date Analyzed: 08/21/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 2

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN SILOXANE	16.03	6	J
2.	UNKNOWN ALKANE	16.94	8	J
3.				
4.				
5.				
6.				
7.				
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VOLATILE ORGANICS ANALYSIS DATA SHEET

NYSDEC SAMPLE NO.

GP-16_4-4.5

Lab Name: STL Edison   Contract: N/A

Lab Code: N/A   Case No.: N/A   SAS No.: N/A   SDG No.: Z4431

Matrix: (soil/water) SOIL   Lab Sample ID: 369151

Sample wt/vol: 5.5 (g/mL) G   Lab File ID: J29873

Level: (low/med) LOW   Date Received: 08/14/02

% Moisture: not dec. 6   Date Analyzed: 08/22/02

GC Column: DB624   ID: 0.53 (mm)   Dilution Factor: 1.0

Soil Extract Volume:________(mL)   Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg	Q
74-87-3	Chloromethane	10	U
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	10	U
67-64-1	Acetone	30	
75-15-0	Carbon Disulfide	0.5	J
75-35-4	1,1-Dichloroethene	10	U
75-34-3	1,1-Dichloroethane	10	U
540-59-0	1,2-Dichloroethene (total)	3	J
67-66-3	Chloroform	10	U
107-06-2	1,2-Dichloroethane	10	U
78-93-3	2-Butanone	3	J
71-55-6	1,1,1-Trichloroethane	10	U
56-23-5	Carbon Tetrachloride	10	U
75-27-4	Bromodichloromethane	10	U
78-87-5	1,2-Dichloropropane	10	U
10061-01-5	cis-1,3-Dichloropropene	10	U
79-01-6	Trichloroethene	6	J
124-48-1	Dibromochloromethane	10	U
79-00-5	1,1,2-Trichloroethane	10	U
71-43-2	Benzene	10	U
10061-02-6	trans-1,3-Dichloropropene	10	U
75-25-2	Bromoform	5	J
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	160	
79-34-5	1,1,2,2-Tetrachloroethane	10	U
108-88-3	Toluene	2	J
108-90-7	Chlorobenzene	10	U
100-41-4	Ethylbenzene	10	U
100-42-5	Styrene	10	U
1330-20-7	Xylenes (Total)	10	U

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NYSDEC SAMPLE NO.

GP-16_4-4.5

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369151

Sample wt/vol: 5.5 (g/mL) g Lab File ID: J29873

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 6 Date Analyzed: 08/22/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 0

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
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FORM I CLP VOA-TIC 10/95

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

NYSDEC SAMPLE NO.
GP-16_17-17.5

Lab Name: STL Edison
Contract: N/A

Lab Code: N/A
Case No.: N/A
SAS No.: N/A
SDG No.: Z4431

Matrix: (soil/water) SOIL
Lab Sample ID: 369152

Sample wt/vol: 5.2 (g/mL) G
Lab File ID: J29874

Level: (low/med) LOW
Date Received: 08/14/02

% Moisture: not dec. 15
Date Analyzed: 08/22/02

GC Column: DB624 ID: 0.53 (mm)
Dilution Factor: 1.0

Soil Extract Volume:________(mL)
Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg	Q
74-87-3	Chloromethane	11	U
74-83-9	Bromomethane	11	U
75-01-4	Vinyl Chloride	11	U
75-00-3	Chloroethane	11	U
75-09-2	Methylene Chloride	11	U
67-64-1	Acetone	11	U
75-15-0	Carbon Disulfide	11	U
75-35-4	1,1-Dichloroethene	11	U
75-34-3	1,1-Dichloroethane	11	U
540-59-0	1,2-Dichloroethene (total)	11	U
67-66-3	Chloroform	11	U
107-06-2	1,2-Dichloroethane	11	U
78-93-3	2-Butanone	11	U
71-55-6	1,1,1-Trichloroethane	11	U
56-23-5	Carbon Tetrachloride	11	U
75-27-4	Bromodichloromethane	11	U
78-87-5	1,2-Dichloropropane	11	U
10061-01-5	cis-1,3-Dichloropropene	11	U
79-01-6	Trichloroethene	11	U
124-48-1	Dibromochloromethane	11	U
79-00-5	1,1,2-Trichloroethane	11	U
71-43-2	Benzene	11	U
10061-02-6	trans-1,3-Dichloropropene	11	U
75-25-2	Bromoform	5	J
108-10-1	4-Methyl-2-Pentanone	11	U
591-78-6	2-Hexanone	11	U
127-18-4	Tetrachloroethene	2	J
79-34-5	1,1,2,2-Tetrachloroethane	11	U
108-88-3	Toluene	11	U
108-90-7	Chlorobenzene	11	U
100-41-4	Ethylbenzene	11	U
100-42-5	Styrene	11	U
1330-20-7	Xylenes (Total)	11	U

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NYSDEC SAMPLE NO.

GP-16_17-17.5

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369152

Sample wt/vol: 5.2 (g/mL) g Lab File ID: J29874

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 15 Date Analyzed: 08/22/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 1

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	15.50	7	J
2.				
3.				
4.				
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1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

NYSDEC SAMPLE NO.

GP-14_1.5-2

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369153

Sample wt/vol: 5.1 (g/mL) G Lab File ID: J29875

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 3 Date Analyzed: 08/22/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg	Q
74-87-3	Chloromethane	10	U
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	10	U
67-64-1	Acetone	10	U
75-15-0	Carbon Disulfide	10	U
75-35-4	1,1-Dichloroethene	10	U
75-34-3	1,1-Dichloroethane	10	U
540-59-0	1,2-Dichloroethene (total)	10	U
67-66-3	Chloroform	10	U
107-06-2	1,2-Dichloroethane	10	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	10	U
56-23-5	Carbon Tetrachloride	10	U
75-27-4	Bromodichloromethane	10	U
78-87-5	1,2-Dichloropropane	10	U
10061-01-5	cis-1,3-Dichloropropene	10	U
79-01-6	Trichloroethene	4	J
124-48-1	Dibromochloromethane	10	U
79-00-5	1,1,2-Trichloroethane	10	U
71-43-2	Benzene	10	U
10061-02-6	trans-1,3-Dichloropropene	10	U
75-25-2	Bromoform	6	J
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	13	
79-34-5	1,1,2,2-Tetrachloroethane	10	U
108-88-3	Toluene	10	U
108-90-7	Chlorobenzene	10	U
100-41-4	Ethylbenzene	10	U
100-42-5	Styrene	10	U
1330-20-7	Xylenes (Total)	10	U

FORM I CLP-VOA 10/95

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NYSDEC SAMPLE NO.

GP-14_1.5-2

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369153

Sample wt/vol: 5.1 (g/mL) g Lab File ID: J29875

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 3 Date Analyzed: 08/22/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 1

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	15.49	7	J
2.				
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FORM I CLP VOA-TIC 10/95

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

NYSDEC SAMPLE NO.

GP-14_17-17.5

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369154

Sample wt/vol: 5.6 (g/mL) G Lab File ID: J29859

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 12 Date Analyzed: 08/22/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg	Q
74-87-3	Chloromethane	10	U
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	10	U
67-64-1	Acetone	10	U
75-15-0	Carbon Disulfide	10	U
75-35-4	1,1-Dichloroethene	10	U
75-34-3	1,1-Dichloroethane	10	U
540-59-0	1,2-Dichloroethene (total)	10	U
67-66-3	Chloroform	10	U
107-06-2	1,2-Dichloroethane	10	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	10	U
56-23-5	Carbon Tetrachloride	10	U
75-27-4	Bromodichloromethane	10	U
78-87-5	1,2-Dichloropropane	10	U
10061-01-5	cis-1,3-Dichloropropene	10	U
79-01-6	Trichloroethene	10	U
124-48-1	Dibromochloromethane	10	U
79-00-5	1,1,2-Trichloroethane	10	U
71-43-2	Benzene	10	U
10061-02-6	trans-1,3-Dichloropropene	10	U
75-25-2	Bromoform	4	J
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	10	U
79-34-5	1,1,2,2-Tetrachloroethane	10	U
108-88-3	Toluene	10	U
108-90-7	Chlorobenzene	10	U
100-41-4	Ethylbenzene	10	U
100-42-5	Styrene	10	U
1330-20-7	Xylenes (Total)	10	U

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NYSDEC SAMPLE NO.

GP-14_17-17.5

Lab Name: STL Edison Contract: N/A

Lab Code: N/A Case No.: N/A SAS No.: N/A SDG No.: Z4431

Matrix: (soil/water) SOIL Lab Sample ID: 369154

Sample wt/vol: 5.6 (g/mL) g Lab File ID: J29859

Level: (low/med) LOW Date Received: 08/14/02

% Moisture: not dec. 12 Date Analyzed: 08/22/02

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 1

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	15.45	7	J
2.				
3.				
4.				
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Soil Vapor Analytical Results

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Z435

STL EDISON
777 New Durham Road
Edison, New Jersey 08817
Phone: (732) 549-3900 Fax: (732) 549-3679

CHAIN OF CUSTODY / ANALYSIS REQUEST

PAGE 1 OF 1

Name (for report and invoice): John Brussel
Company: BBL
Address: 6723 Towpath Rd, Box 66
City: Syracuse State: NY
Phone: 315-446-9120 Fax: 315-449-4111

Samplers Name (Printed): Kiersten Robbins
P.O. #: 60405.018
Analysis Turnaround Time
Standard ☒
Rush Charges Authorized For:
2 Week ☐
1 Week ☐
Other ☐

Site/Project Identification: HWD, Farmingdale
State (Location of site): NJ: ☐ NY: ☒ Other:
Regulatory Program: NYSDEC ASP

ANALYSIS REQUESTED (ENTER "X" BELOW TO INDICATE REQUEST)

LAB USE ONLY
Project No:
Job No: Z435

Sample Identification	Date	Time	Matrix	No. of. Cont.	USEPA Method TO-14A	List only:	PCE, TCE, cis-1,2-Dichloroethene	1,1-Dichloroethene 1,1-Dichloroethane	Chloroethane Vinyl Chloride							Sample Numbers
SV-1	8/13/02	1035	Air	2	X	X	X	X	X							369088
SV-2		1130			X	X	X	X	X							369089
SV-7		1205			X	X	X	X	X							369090
SV-5		1320			X	X	X	X	X							369091
SV-6		1350			X	X	X	X	X							369092
SV-3		1430			X	X	X	X	X							369093
SV-4		1510			X	X	X	X	X							369094
																—
																—
																—

Preservation Used: 1 = ICE, 2 = HCl, 3 = H_2SO_4, 4 = HNO_3, 5 = NaOH
6 = Other ______, 7 = Other ______
Soil:
Water:

Special Instructions * Analyze for only the parameters listed above by method TO-14A

Water Metals Filtered (Yes/No)?

Relinquished by	Company	Date / Time	Received by	Company
1)	BBL	8/14/02 0850	1)	STL Edison
2)			2)	
3)			3)	
4)			4)	

Laboratory Certifications: New Jersey (12028), New York (11452), Pennsylvania (68-522), Connecticut (PH-0200), Rhode Island (132).

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

STLNJE SAMPLE NO.

Z435369088
SV-1

Lab Name: STL BURLINGTON Contract: 22019

Lab Code: STLVT Case No.: 22019 SAS No.: SDG No.: 89276

Matrix: (soil/water) AIR Lab Sample ID: 497467

Sample wt/vol: 200.0 (g/mL) ML Lab File ID: 497467

Level: (low/med) LOW Date Received: 08/15/02

% Moisture: not dec. ________ Date Analyzed: 08/15/02

GC Column: DB-1 ID: 0.35 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(uL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) PPBV	Q
75-01-4	Vinyl Chloride	10	
75-00-3	Chloroethane	0.50	U
75-35-4	1,1-Dichloroethene	0.50	U
75-34-3	1,1-Dichloroethane	1.7	
156-59-2	cis-1,2-Dichloroethene	74	E
79-01-6	Trichloroethene	35	
127-18-4	Tetrachloroethene	12	

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

STLNJE SAMPLE NO.

Z435369088DL
SV-1 DL

Lab Name: STL BURLINGTON   Contract: 22019

Lab Code: STLVT   Case No.: 22019   SAS No.:   SDG No.: 89276

Matrix: (soil/water) AIR   Lab Sample ID: 497467D1

Sample wt/vol: 200.0 (g/mL) ML   Lab File ID: 497467D2

Level: (low/med) LOW   Date Received: 08/15/02

% Moisture: not dec. ______   Date Analyzed: 08/15/02

GC Column: DB-1   ID: 0.35 (mm)   Dilution Factor: 3.0

Soil Extract Volume:______(uL)   Soil Aliquot Volume: ______(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) PPBV	Q
75-01-4	Vinyl Chloride	11	D
75-00-3	Chloroethane	1.5	U
75-35-4	1,1-Dichloroethene	1.5	U
75-34-3	1,1-Dichloroethane	1.7	D
156-59-2	cis-1,2-Dichloroethene	82	D
79-01-6	Trichloroethene	43	D
127-18-4	Tetrachloroethene	14	D

FORM I VOA

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

STLNJE SAMPLE NO.

Z435369089
SV-2

Lab Name: STL BURLINGTON Contract: 22019

Lab Code: STLVT Case No.: 22019 SAS No.: SDG No.: 89276

Matrix: (soil/water) AIR Lab Sample ID: 497468

Sample wt/vol: 200.0 (g/mL) ML Lab File ID: 497468D

Level: (low/med) LOW Date Received: 08/15/02

% Moisture: not dec. ________ Date Analyzed: 08/15/02

GC Column: DB-1 ID: 0.35 (mm) Dilution Factor: 1000.0

Soil Extract Volume:________(uL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) PPBV	Q
75-01-4	Vinyl Chloride	500	U
75-00-3	Chloroethane	500	U
75-35-4	1,1-Dichloroethene	500	U
75-34-3	1,1-Dichloroethane	500	U
156-59-2	cis-1,2-Dichloroethene	2400	
79-01-6	Trichloroethene	6300	
127-18-4	Tetrachloroethene	47000	E

FORM I VOA

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

STLNJE SAMPLE NO.

Z435369089DL
SV-2 DL

Lab Name: STL BURLINGTON Contract: 22019

Lab Code: STLVT Case No.: 22019 SAS No.: SDG No.: 89276

Matrix: (soil/water) AIR Lab Sample ID: 497468D1

Sample wt/vol: 200.0 (g/mL) ML Lab File ID: 497468D3

Level: (low/med) LOW Date Received: 08/15/02

% Moisture: not dec. ________ Date Analyzed: 08/16/02

GC Column: DB-1 ID: 0.35 (mm) Dilution Factor: 4000.0

Soil Extract Volume:________(uL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) PPBV	Q
75-01-4	Vinyl Chloride	2000	U
75-00-3	Chloroethane	2000	U
75-35-4	1,1-Dichloroethene	2000	U
75-34-3	1,1-Dichloroethane	2000	U
156-59-2	cis-1,2-Dichloroethene	2000	U
79-01-6	Trichloroethene	6300	D
127-18-4	Tetrachloroethene	97000	D

FORM I VOA

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

STLNJE SAMPLE NO.

Z435369090
SV-7

Lab Name: STL BURLINGTON Contract: 22019

Lab Code: STLVT Case No.: 22019 SAS No.: SDG No.: 89276

Matrix: (soil/water) AIR Lab Sample ID: 497469

Sample wt/vol: 200.0 (g/mL) ML Lab File ID: 497469D

Level: (low/med) LOW Date Received: 08/15/02

% Moisture: not dec. _______ Date Analyzed: 08/15/02

GC Column: DB-1 ID: 0.35 (mm) Dilution Factor: 100.0

Soil Extract Volume:_______(uL) Soil Aliquot Volume: _______(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) PPBV	Q
75-01-4	Vinyl Chloride	50	U
75-00-3	Chloroethane	50	U
75-35-4	1,1-Dichloroethene	50	U
75-34-3	1,1-Dichloroethane	50	U
156-59-2	cis-1,2-Dichloroethene	67	
79-01-6	Trichloroethene	420	
127-18-4	Tetrachloroethene	4600	E

FORM I VOA

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

STLNJE SAMPLE NO.

Z435369090DL
SV-7 DL

Lab Name: STL BURLINGTON Contract: 22019

Lab Code: STLVT Case No.: 22019 SAS No.: SDG No.: 89276

Matrix: (soil/water) AIR Lab Sample ID: 497469D1

Sample wt/vol: 200.0 (g/mL) ML Lab File ID: 497469D2

Level: (low/med) LOW Date Received: 08/15/02

% Moisture: not dec. ________ Date Analyzed: 08/15/02

GC Column: DB-1 ID: 0.35 (mm) Dilution Factor: 200.0

Soil Extract Volume:________(uL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) PPBV	Q
75-01-4	Vinyl Chloride	100	U
75-00-3	Chloroethane	100	U
75-35-4	1,1-Dichloroethene	100	U
75-34-3	1,1-Dichloroethane	100	U
156-59-2	cis-1,2-Dichloroethene	100	U
79-01-6	Trichloroethene	450	D
127-18-4	Tetrachloroethene	5400	D

FORM I VOA

STLNJE SAMPLE NO.

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

Z435369091
SV-5

Lab Name: STL BURLINGTON   Contract: 22019

Lab Code: STLVT   Case No.: 22019   SAS No.:   SDG No.: 89276

Matrix: (soil/water) AIR   Lab Sample ID: 497470

Sample wt/vol: 200.0 (g/mL) ML   Lab File ID: 497470D

Level: (low/med) LOW   Date Received: 08/15/02

% Moisture: not dec. ______   Date Analyzed: 08/15/02

GC Column: DB-1   ID: 0.35 (mm)   Dilution Factor: 400.0

Soil Extract Volume:______(uL)   Soil Aliquot Volume: ______(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) PPBV	Q
75-01-4	Vinyl Chloride	200	U
75-00-3	Chloroethane	200	U
75-35-4	1,1-Dichloroethene	200	U
75-34-3	1,1-Dichloroethane	200	U
156-59-2	cis-1,2-Dichloroethene	430	
79-01-6	Trichloroethene	1800	
127-18-4	Tetrachloroethene	23000	E

FORM I VOA

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

STLNJE SAMPLE NO.

Z435369091DL
SV-5 DL

Lab Name: STL BURLINGTON Contract: 22019

Lab Code: STLVT Case No.: 22019 SAS No.: SDG No.: 89276

Matrix: (soil/water) AIR Lab Sample ID: 497470D1

Sample wt/vol: 200.0 (g/mL) ML Lab File ID: 497470D2

Level: (low/med) LOW Date Received: 08/15/02

% Moisture: not dec. ______ Date Analyzed: 08/15/02

GC Column: DB-1 ID: 0.35 (mm) Dilution Factor: 1000.0

Soil Extract Volume:______(uL) Soil Aliquot Volume: ______(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) PPBV	Q
75-01-4	Vinyl Chloride	500	U
75-00-3	Chloroethane	500	U
75-35-4	1,1-Dichloroethene	500	U
75-34-3	1,1-Dichloroethane	500	U
156-59-2	cis-1,2-Dichloroethene	500	U
79-01-6	Trichloroethene	2200	D
127-18-4	Tetrachloroethene	29000	D

FORM I VOA

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

STLNJE SAMPLE NO.

Z435369092
SV-6

Lab Name: STL BURLINGTON Contract: 22019

Lab Code: STLVT Case No.: 22019 SAS No.: SDG No.: 89276

Matrix: (soil/water) AIR Lab Sample ID: 497471

Sample wt/vol: 200.0 (g/mL) ML Lab File ID: 497471D

Level: (low/med) LOW Date Received: 08/15/02

% Moisture: not dec. ________ Date Analyzed: 08/15/02

GC Column: DB-1 ID: 0.35 (mm) Dilution Factor: 20.0

Soil Extract Volume:________(uL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) PPBV	Q
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-35-4	1,1-Dichloroethene	10	U
75-34-3	1,1-Dichloroethane	10	U
156-59-2	cis-1,2-Dichloroethene	270	
79-01-6	Trichloroethene	1300	E
127-18-4	Tetrachloroethene	770	

FORM I VOA

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

STLNJE SAMPLE NO.

Z435369092DL
SV-6 DL

Lab Name: STL BURLINGTON Contract: 22019

Lab Code: STLVT Case No.: 22019 SAS No.: SDG No.: 89276

Matrix: (soil/water) AIR Lab Sample ID: 497471D1

Sample wt/vol: 200.0 (g/mL) ML Lab File ID: 497471D2

Level: (low/med) LOW Date Received: 08/15/02

% Moisture: not dec. _______ Date Analyzed: 08/15/02

GC Column: DB-1 ID: 0.35 (mm) Dilution Factor: 50.0

Soil Extract Volume:_______(uL) Soil Aliquot Volume: _______(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) PPBV	Q
75-01-4	Vinyl Chloride	25	U
75-00-3	Chloroethane	25	U
75-35-4	1,1-Dichloroethene	25	U
75-34-3	1,1-Dichloroethane	25	U
156-59-2	cis-1,2-Dichloroethene	150	D
79-01-6	Trichloroethene	820	D
127-18-4	Tetrachloroethene	470	D

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

STLNJE SAMPLE NO.

Z435369093
SV-3

Lab Name: STL BURLINGTON Contract: 22019

Lab Code: STLVT Case No.: 22019 SAS No.: SDG No.: 89276

Matrix: (soil/water) AIR Lab Sample ID: 497472

Sample wt/vol: 200.0 (g/mL) ML Lab File ID: 497472D

Level: (low/med) LOW Date Received: 08/15/02

% Moisture: not dec. ________ Date Analyzed: 08/15/02

GC Column: DB-1 ID: 0.35 (mm) Dilution Factor: 400.0

Soil Extract Volume:________(uL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) PPBV	Q
75-01-4	Vinyl Chloride	200	U
75-00-3	Chloroethane	200	U
75-35-4	1,1-Dichloroethene	200	U
75-34-3	1,1-Dichloroethane	200	U
156-59-2	cis-1,2-Dichloroethene	480	
79-01-6	Trichloroethene	3100	
127-18-4	Tetrachloroethene	20000	E

FORM I VOA

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

STLNJE SAMPLE NO.

Z435369093DL
SV-3

Lab Name: STL BURLINGTON Contract: 22019

Lab Code: STLVT Case No.: 22019 SAS No.: SDG No.: 89276

Matrix: (soil/water) AIR Lab Sample ID: 497472D1

Sample wt/vol: 200.0 (g/mL) ML Lab File ID: 497472D2

Level: (low/med) LOW Date Received: 08/15/02

% Moisture: not dec. ________ Date Analyzed: 08/16/02

GC Column: DB-1 ID: 0.35 (mm) Dilution Factor: 1000.0

Soil Extract Volume:________(uL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) PPBV	Q
75-01-4	Vinyl Chloride	500	U
75-00-3	Chloroethane	500	U
75-35-4	1,1-Dichloroethene	500	U
75-34-3	1,1-Dichloroethane	500	U
156-59-2	cis-1,2-Dichloroethene	500	D
79-01-6	Trichloroethene	3600	D
127-18-4	Tetrachloroethene	25000	D

FORM I VOA

FORM I
VOLATILE ORGANICS ANALYSIS DATA SHEET

STLNJE SAMPLE NO.

Z435369094
SV-4

Lab Name: STL BURLINGTON Contract: 22019

Lab Code: STLVT Case No.: 22019 SAS No.: SDG No.: 89276

Matrix: (soil/water) AIR Lab Sample ID: 497473

Sample wt/vol: 200.0 (g/mL) ML Lab File ID: 497473D

Level: (low/med) LOW Date Received: 08/15/02

% Moisture: not dec. ________ Date Analyzed: 08/15/02

GC Column: DB-1 ID: 0.35 (mm) Dilution Factor: 20.0

Soil Extract Volume:________(uL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) PPBV	Q
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-35-4	1,1-Dichloroethene	10	U
75-34-3	1,1-Dichloroethane	10	U
156-59-2	cis-1,2-Dichloroethene	180	
79-01-6	Trichloroethene	100	
127-18-4	Tetrachloroethene	1500	E

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

STLNJE SAMPLE NO.

Z435369094DL
SV-4 DL

Lab Name: STL BURLINGTON Contract: 22019

Lab Code: STLVT Case No.: 22019 SAS No.: SDG No.: 89276

Matrix: (soil/water) AIR Lab Sample ID: 497473D1

Sample wt/vol: 200.0 (g/mL) ML Lab File ID: 497473D2

Level: (low/med) LOW Date Received: 08/15/02

% Moisture: not dec. ________ Date Analyzed: 08/16/02

GC Column: DB-1 ID: 0.35 (mm) Dilution Factor: 50.0

Soil Extract Volume:________(uL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) PPBV	Q
75-01-4	Vinyl Chloride	25	U
75-00-3	Chloroethane	25	U
75-35-4	1,1-Dichloroethene	25	U
75-34-3	1,1-Dichloroethane	25	U
156-59-2	cis-1,2-Dichloroethene	25	U
79-01-6	Trichloroethene	65	D
127-18-4	Tetrachloroethene	900	D

FORM I VOA

Attachment B

Building Integrity Survey Forms

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

R&D Carpet and Tile

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

INDOOR AIR QUALITY - BUILDING SURVEY

Occupant/Building Name: RandD Carpet and Tile Date: 8/14/02

Address: 20 Picone Blvd.

Owner's Name: ______ Address: ______

Completed by: Kiersten Robbins Case #: ______

Building type: residential / office / commercial / [✓ industrial]

Basement size: N/A ft^3

Number of floors
below grade: 0 (full basement / crawl space / slab)

at or above grade: 1

Foundation type: [✓ poured concrete (over gravel)] / cinder blocks / earthen /

other (specify) ______

Building occupants: Children under age 13 ____ Children age 13-18 ____ Adults 10 to 12

Contaminant Source Category	Yes	No	Comments/Locations
Outside Sources			
Garbage dumpsters	x		approx. 25' from garage doors
Heavy motor vehicle traffic		x	just moving vehicles outside
Construction activities		x	
Nearby industries (identify)	x		Fortbrand, Ryder, Trucking companies
NJDEP Comprehensive Site List (identify)	N/A		
UST/AST (gasoline, heating fuel)		x	
Basement Survey	N/A		
Wall construction (cinder block, sheet rock, paneling, etc.)			type: condition:
Floor Construction (earthen, slab, floating, etc.)			type: condition:
Was basement painted recently? oil-base or latex paints?			date: type of paint:
Sump present (PID/FID/CGI #s?)		x	

Location of sump			
New flooring in basement? (list type - carpet, tile)			
using glue			
New furniture added to basement			type: date:
Staining on floors/walls			
Pipes running through walls, floor (conduits - describe, give FID/PID/CGS readings)			
Odors detected by inspector			
Basement used as living space			
Time occupants spend in basement (hours/day per person)			
Items stored in basement: solvents			
gasoline			
paint/thinners			
polishes/waxes			
insecticides			
kerosene			
household cleaning products			
mothballs			
other items?			
☛ *Refer to Building Inventory Form for specific list*			
First Floor Survey			
Wall construction ([✓ cinder block], sheet rock, paneling, etc.)			type: concrete block condition: good
Was painting done recently? oil-base or latex?		X	date: 3to4 years ago type of paint: unknown
New flooring on 1st Floor? (list type - carpet, tile)	X		carpet and tile company numerous adhesives
using glue	X		
New furniture added to 1st Floor		X	type: date:
Staining on floor/walls		X	
Pipes running through walls, floor (describe)		X	external pipes only

Odors detected by inspector		X	
Items stored on this floor: solvents	X		glue solvents
gasoline		X	
paint/thinners	X		
polishes/waxes	X		
insecticides		X	
kerosene		X	
household cleaning products	X		typical bathroom products
mothballs		X	
other items?		X	

☛ *Refer to Building Inventory Form for specific list*

Additional Floors (if necessary) N/A

Wall construction (cinder block, sheet rock, paneling, etc.)			type: condition:
Was painting done recently? oil-based or latex			date: type of paint:
Was new flooring installed? (list type - carpet, tile)			
using glue			
New furniture added			type: date:
Odors detected by inspector			
Items stored on this floor: solvents			
gasoline			
paint/thinners			
polishes/waxes			
insecticides			
kerosene			
household cleaning products			
mothballs			
other items?			

☛ *Refer to Building Inventory Form for specific list*

Personal Activities			
Does anyone in the building smoke?	X		
approx. number of tobacco products per day, per person			only permitted to smoke outside
Does anyone dry-clean their clothes?			unknown
Miscellaneous			
Have the occupants ever noticed unusual odors in building?		X	describe: location:
Known spill outside or inside building (specify location)		X	
Type of heating used in building oil		X	
natural gas	X		
kerosene		X	
electric		X	
other (specify)		X	
If heating oil, identify the location and age of the storage tank			N/A
Is the heating unit properly vented?	X		
Water damage or standing water in building (historic or current)		X	
Fire damage to building		X	date:
Pest control applications	X		date: Ant spray approx. 1/year
Septic system		X	

Field Screening Results	FID	PID	CGI	CO₂	Rel. Hum.
Basement small storage area		0.2ppm			
First Floor large storage area		0.2ppm			
Additional Floors background (in storage area)		0.2ppm			
Other (specify) ________					

Fort Brand Service, Inc.

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

INDOOR AIR QUALITY - BUILDING SURVEY

Occupant/Building Name: Fortbrand Services Inc. Date: 8/14/02

Address: 13D Picone Blvd.

Owner's Name: ______ Address: ______

Completed by: Kiersten Robbins Case #: ______

Building type: residential / office / commercial / [✓ industrial]

Basement size: N/A ft^3

Number of floors
below grade: 0 (full basement / crawl space / slab)

at or above grade: 1

Foundation type: [✓ poured concrete] (over gravel) / cinder blocks / earthen /

other (specify) ______

Building occupants: Children under age 13 ____ Children age 13-18 ____ Adults 2

Contaminant Source Category	Yes	No	Comments/Locations
Outside Sources			
Garbage dumpsters	x		outside entrance to storage yard
Heavy motor vehicle traffic		x	just outside storage yard on road
Construction activities		x	
Nearby industries (identify)	x		Ryder Truck, Piano Company
NJDEP Comprehensive Site List (identify)	N/A		
UST/[✓ AST] (gasoline, heating fuel)	x		waste oil tank
Basement Survey	N/A		
Wall construction (cinder block, sheet rock, paneling, etc.)			type: condition:
Floor Construction (earthen, [✓ slab], floating, etc.)			type: poured concrete condition: good
Was basement painted recently? oil-base or latex paints?			date: type of paint:
Sump present (PID/FID/CGI #s?)		x	

Location of sump			
New flooring in basement? (list type - carpet, tile)			
using glue			
New furniture added to basement			type: date:
Staining on floors/walls			
Pipes running through walls, floor (conduits - describe, give FID/PID/CGS readings)			
Odors detected by inspector			
Basement used as living space			
Time occupants spend in basement (hours/day per person)			
Items stored in basement: solvents			
gasoline			
paint/thinners			
polishes/waxes			
insecticides			
kerosene			
household cleaning products			
mothballs			
other items?			
☛ *Refer to Building Inventory Form for specific list*			
First Floor Survey			
Wall construction [✓ cinder block,] sheet rock, paneling, etc.)			type: cement block condition: good
Was painting done recently? oil-base or latex?	X		date: approx. 2 years ago type of paint: white wash
New flooring on 1st Floor? (list type - carpet, tile)		X	painted floor
using glue		X	
New furniture added to 1st Floor		X	type: date:
Staining on floor/walls		X	
Pipes running through walls, floor (describe)		X	external pipes only

Odors detected by inspector	x		typical garage odors
Items stored on this floor: solvents	x		mineral spirits (maximum of 2 gal. on-site at a time)
gasoline		x	only what is inside of vehicles, majority are diesel
paint/thinners	x		spray paints, oil based enamel
polishes/waxes		x	
insecticides		x	
kerosene		x	
household cleaning products	x		bathroom cleaners
mothballs		x	
other items?	x		motor & hydraulic oils

☛ *Refer to Building Inventory Form for specific list*

Additional Floors (if necessary)	N/A		
Wall construction (cinder block, sheet rock, paneling, etc.)			type: condition:
Was painting done recently? oil-based or latex			date: type of paint:
Was new flooring installed? (list type - carpet, tile)			
using glue			
New furniture added			type: date:
Odors detected by inspector			
Items stored on this floor: solvents			
gasoline			
paint/thinners			
polishes/waxes			
insecticides			
kerosene			
household cleaning products			
mothballs			
other items?			

☛ *Refer to Building Inventory Form for specific list*

Personal Activities			
Does anyone in the building smoke?	x		1 person
approx. number of tobacco products per day, per person			outside only
Does anyone dry-clean their clothes?		x	no cleaning service
Miscellaneous			
Have the occupants ever noticed unusual odors in building?		x	describe: location:
Known spill outside or inside building (specify location)		x	observed oil-absorbant pads on ground
Type of heating used in building oil		x	
natural gas	x		
kerosene		x	
electric		x	
other (specify)		x	
If heating oil, identify the location and age of the storage tank			N/A
Is the heating unit properly vented?	x		
Water damage or standing water in building (historic or current)		x	
Fire damage to building		x	date:
Pest control applications		x	date:
Septic system		x	public sewer

Field Screening Results	FID	PID	CGI	CO₂	Rel. Hum.
~~Basement~~ storage areas		1.4ppm			
~~First Floor~~ work area (inside)		0.4ppm			
~~Additional Floors~~ waste oil tank		0.4ppm			
Other (specify) ________					

Ryder Truck

INDOOR AIR QUALITY - BUILDING SURVEY

Occupant/Building Name: Ryder Truck Date: 8/14/02

Address: 11 Picone Blvd.

Owner's Name: ______ Address: ______

Completed by: Kiersten Robbins Case #: ______

Building type: residential / office / commercial / [✓ industrial]

Basement size: N/A ft³

Number of floors
below grade: 0 (full basement / crawl space / slab)

at or above grade: 1

Foundation type: [✓ poured concrete (over gravel)] / cinder blocks / earthen /

other (specify) ______

Building occupants: Children under age 13 ____ Children age 13-18 ____ Adults 9

Contaminant Source Category	Yes	No	Comments/Locations
Outside Sources			
Garbage dumpsters	x		outside garage doors, adjacent to building
Heavy motor vehicle traffic	x		moving vehicles w/in garage majority are diesel engines
Construction activities		x	
Nearby industries (identify)	x		Fortbrand, Rand D Carpet and Tile, Piano Co.
NJDEP Comprehensive Site List (identify)	N/A		
UST/[✓ AST] (gasoline, heating fuel)	x		waste oil tank
Basement Survey	N/A		
Wall construction (cinder block, sheet rock, paneling, etc.)			type: condition:
Floor Construction (earthen, [✓ slab], floating, etc.)			type: poured concrete condition: good
Was basement painted recently? oil-base or latex paints?			date: type of paint:
Sump present (PID/FID/CGI #s?)		x	

Location of sump			
New flooring in basement? (list type - carpet, tile)			
using glue			
New furniture added to basement			type: date:
Staining on floors/walls			
Pipes running through walls, floor (conduits - describe, give FID/PID/CGS readings)			
Odors detected by inspector			
Basement used as living space			
Time occupants spend in basement (hours/day per person)			
Items stored in basement: solvents			
gasoline			
paint/thinners			
polishes/waxes			
insecticides			
kerosene			
household cleaning products			
mothballs			
other items?			
☞ *Refer to Building Inventory Form for specific list*			
First Floor Survey			
Wall construction ([✓ cinder block,] sheet rock, paneling, etc.)			type: concrete block condition: good
Was painting done recently? oil-base or latex?	x		date: approx. 3 years ago type of paint: oil-base
New flooring on 1st Floor? (list type - carpet, tile)		x	painted floor
using glue		x	
New furniture added to 1st Floor		x	type: date:
Staining on floor/walls		x	
Pipes running through walls, floor (describe)		x	external pipes only

Odors detected by inspector	×		typical garage odors
Items stored on this floor: solvents	×		parts washer (contains: TCE, PCE, cadmium, lead, mercury, silver, o-cresol and m/p-cresol) N.O.S. Petroleum Naphtha NA 1993 PG III D039 ERG #128 6.7 lbs/gal
gasoline	×		only in vehicles, mostly diesel
paint/thinners		×	
polishes/waxes		×	
insecticides		×	
kerosene		×	
household cleaning products	×		
mothballs		×	
other items?	×		motor + hydraulic oils

Refer to Building Inventory Form for specific list

Additional Floors (if necessary)	N/A		
Wall construction (cinder block, sheet rock, paneling, etc.)			type: condition:
Was painting done recently? oil-based or latex			date: type of paint:
Was new flooring installed? (list type - carpet, tile)			
using glue			
New furniture added			type: date:
Odors detected by inspector			
Items stored on this floor: solvents			
gasoline			
paint/thinners			
polishes/waxes			
insecticides			
kerosene			
household cleaning products			
mothballs			
other items?			

Refer to Building Inventory Form for specific list

Personal Activities			
Does anyone in the building smoke?	X		
approx. number of tobacco products per day, per person			only allowed to smoke outside
Does anyone dry-clean their clothes?		X	
Miscellaneous			
Have the occupants ever noticed unusual odors in building?		X	describe: location:
Known spill outside or inside building (specify location)		X	observed antifreeze on concrete (in the seams)
Type of heating used in building oil		X	
natural gas	X		
kerosene		X	
electric		X	
other (specify)		X	
If heating oil, identify the location and age of the storage tank			N/A
Is the heating unit properly vented?	X		
Water damage or standing water in building (historic or current)		X	
Fire damage to building		X	date:
Pest control applications		X	date:
Septic system		X	public sewer

Field Screening Results		**FID**	**PID**	**CGI**	**CO$_2$**	**Rel. Hum.**
~~Basement~~	Drum Storage Area		4.6ppm			
	Flammable Cabinet		4.3 ppm			
~~First Floor~~	Parts Washing Area		5.1 ppm			
~~Additional Floors~~	Background (inside garage)		4.8ppm			
~~Other (specify)~~ _______________						

Attachment C

Material Safety Data Sheets (Refer to Original Letter Submittal)

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Appendix B

Groundwater Monitoring Well Completion Log

Date Start/Finish: 4/10/03
Drilling Company: Delta Well and Pump Co.
Driller's Name: Charles Blumberg Jr.
Drilling Method: Hollow Stem Auger
Auger Size:
Rig Type: Failing F-10
Sampling Method: 2-inch split spoon

Northing:
Easting:
Casing Elevation:

Borehole Depth: 23.0 feet
Surface Elevation:

Geologist: Kiersten Robbins

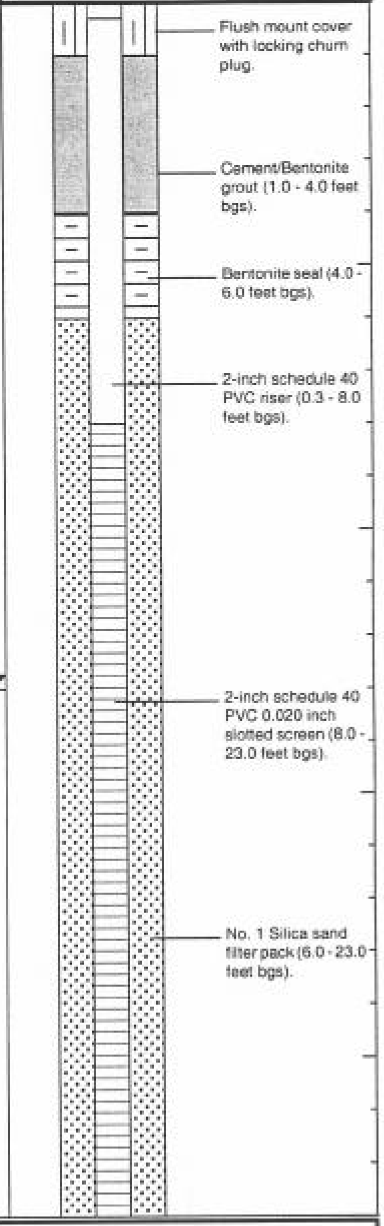
Well/Boring ID: MW-8

Client: HWD Site Group

Location: Hazardous Waste Disposal Site
Farmingdale, New York

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blows / 6 Inches	N - Value	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Water Level
0	0	NA	NA							Asphalt. Concrete. Debris.	
				0.6feet	7 22 16 13	38	0.0 0.0			Brown fine to medium, subrounded SAND and GRAVEL, moist.	
				0.2feet	6 7		0.0				
5	5			0.0feet	refu					Concrete.	
				0.7feet	5 11 26 37	37	0.0 0.0			Brown fine to medium, subrounded SAND and GRAVEL, moist. Wood and brick debris. Dark brown to black fine SAND, little very fine sand, dry.	
				0.5feet	9 14 16 15	30	0.0			Brown to light brown fine SAND, little subangular gravel, dry.	
10	10			0.0feet	refu					Concrete.	
				0.8feet	9 12 15 13	27	11.4 64.9			Tan to brown, medium to coarse, subrounded SAND and GRAVEL, moist. Tan to brown, medium to coarse, subrounded SAND and GRAVEL, wet.	▼
				0.6feet	6 8 8 11	16	152			Petroleum-like odor.	
15	15			1.0feet	10 6 7 4	13	4.8 33.6			Tan to brown, medium to coarse, subrounded SAND, some gravel, wet.	
				0.5feet	5 4 6 8	10	57.0				
20	20			0.6feet	10 40 34 16	74	32.3				
				0.5feet	15 53 41	94	9.4			Tan medium to coarse, subrounded SAND, some gravel, wet.	

Well/Boring Construction



Flush mount cover with locking churn plug.

Cement/Bentonite grout (1.0 - 4.0 feet bgs).

Bentonite seal (4.0 - 6.0 feet bgs).

2-inch schedule 40 PVC riser (0.3 - 8.0 feet bgs).

2-inch schedule 40 PVC 0.020 inch slotted screen (8.0 - 23.0 feet bgs).

No. 1 Silica sand filter pack (6.0 - 23.0 feet bgs).

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Remarks:

Project: 60405.024 Template: F:\PROJECTS\HWD\SB_well.ldf
Data File:F:\PROJECTS\HWD\logs\MW-8.dat

Date:4/11/03

Appendix C

Groundwater Sampling Logs

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Appendix B

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Additional Groundwater Sampling Activities
Groundwater Sampling Log

Well Number:	*MW-1D*	**Well Depth (ft BTIC):**	68.30		
Date:	4/23/2003	**Screen Length (ft):**	10	**Initial Water Level (ft BTIC):**	29.26
Sampling Device:	Perstaltic Pump	**Pump Intake Depth (ft BTIC):**	63.30	**Pre-Pumping Water Level (ft BTIC):**	29.25
Sampling Personnel:	GCP	**Well Diameter (in):**	4	**Tubing Type:**	Polyethylene

Time	**pH**	**Temp.** (degrees C)	**Specific Cond.** (mS/cm)	**Dissolved Oxygen** (mg/l)	**Turbidity** (NTU)	**Redox** (mV)	**Depth to Water** (feet)	**Purge Rate** (mL/min)	**Comments**
10:30	6.39	13.58	0.260	7.48	35.8	122	29.26	500	Colorless / Odorless
10:35	6.21	15.15	0.268	0.77	7.5	129	29.26	500	Colorless / Odorless
10:40	6.20	15.24	0.268	0.56	1.1	126	29.26	500	Colorless / Odorless
10:45	6.19	15.35	0.268	0.51	2.8	123	29.26	500	Colorless / Odorless
10:50	6.19	15.35	0.268	0.47	7.2	121	29.26	500	Colorless / Odorless
10:55	6.18	15.37	0.267	0.48	10.3	120	29.26	500	Colorless / Odorless
11:00	6.20	15.38	0.267	0.46	10.0	117	29.26	500	Colorless / Odorless
11:05	6.19	15.33	0.267	0.45	10.1	116	29.26	500	Colorless / Odorless
11:10									Sample Collected

Sample collected using a Persistaltic Pump for:	Alkalinity, Dissolved Iron, Dissolved Organic Carbon, Ammonia, Nitrate, Nitrite, Phosphate, Chloride, Sulfate, Sulfide, Carbon Dioxide, Ethane, Ethene, Methane, Phospholipid Fatty Acids, Dehalococcoides Ethenogenes
Sample collected using bailer for :	VOC

Notes:

BTIC - Below top of inner casing

Appendix B

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Additional Groundwater Sampling Activities
<u>Groundwater Sampling Log</u>

Well Number:	*MW-1*	**Well Depth (ft BTIC):**	30.97		
Date:	4/23/2003	**Screen Length (ft):**	15	**Initial Water Level (ft BTIC):**	28.36
Sampling Device:	Perstaltic Pump	**Pump Intake Depth (ft BTIC):**	29.66	**Pre-Pumping Water Level (ft BTIC):**	28.36
Sampling Personnel:	GCP	**Well Diameter (in):**	2	**Tubing Type:**	Polyethylene

Time	**pH**	**Temp.** (degrees C)	**Specific Cond.** (mS/cm)	**Dissolved Oxygen** (mg/l)	**Turbidity** (NTU)	**Redox** (mV)	**Depth to Water** (feet)	**Purge Rate** (mL/min)	**Comments**
8:50	6.15	13.28	0.216	9.05	56.2	113	28.45	500	Colorless / Odorless
8:55	6.12	13.52	0.205	8.74	0.0	125	28.45	500	Colorless / Odorless
9:00	6.15	13.58	0.200	8.61	0.0	130	28.45	500	Colorless / Odorless
9:05	6.17	14.19	0.200	7.98	0.0	131	28.45	500	Colorless / Odorless
9:10	6.20	14.09	0.202	8.39	0.0	132	28.45	500	Colorless / Odorless
9:15	6.12	16.30	0.198	8.35	6.1	133	28.45	500	Colorless / Odorless
9:20	6.18	14.07	0.198	8.63	0.0	134	28.45	500	Colorless / Odorless
9:25	6.16	13.98	0.196	8.57	0.0	135	28.45	500	Colorless / Odorless
9:30	6.15	13.94	0.196	8.59	0.0	135	28.45	500	Colorless / Odorless
9:35									Sample Collected

Sample collected using a Persistaltic Pump for: Alkalinity, Dissolved Iron, Dissolved Organic Carbon, Ammonia, Nitrate, Nitrite, Phosphate, Chloride, Sulfate, Sulfide, Carbon Dioxide, Ethane, Ethene, Methane, Phospholipid Fatty Acids, Dehalococcoides Ethenogenes

Sample collected using bailer for : VOC

Notes:
BTIC - Below top of inner casing

Appendix B

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Additional Groundwater Sampling Activities
Groundwater Sampling Log

Well Number:	*MW-2*	**Well Depth (ft BTIC):**	21.85		
Date:	4/23/2003	**Screen Length (ft):**	15	**Initial Water Level (ft BTIC):**	13.37
Sampling Device:	Perstaltic Pump	**Pump Intake Depth (ft BTIC):**	18.51	**Pre-Pumping Water Level (ft BTIC):**	13.35
Sampling Personnel:	GCP	**Well Diameter (in):**	2	**Tubing Type:**	Polyethylene

Time	**pH**	**Temp.** (degrees C)	**Specific Cond.** (mS/cm)	**Dissolved Oxygen** (mg/l)	**Turbidity** (NTU)	**Redox** (mV)	**Depth to Water** (feet)	**Purge Rate** (mL/min)	**Comments**
8:32	6.13	10.42	0.419	8.86	15.1	113	13.35	375	Odorless / Colorless
8:37	6.44	10.72	0.406	7.49	15.5	134	13.35	425	Odorless / Colorless
8:42	6.41	10.86	0.386	7.13	4.1	144	13.35	425	Odorless / Colorless
8:47	6.38	10.92	0.346	7.28	0.0	149	13.35	425	Odorless / Colorless
8:52	6.37	11.00	0.331	7.14	0.0	150	13.35	400	Odorless / Colorless
8:57	6.34	11.07	0.312	7.19	0.0	152	13.35	400	Odorless / Colorless
9:02	6.32	11.10	0.293	7.21	0.0	153	13.35	400	Odorless / Colorless
9:07	6.31	11.04	0.298	7.22	0.0	154	13.35	400	Odorless / Colorless
9:12	6.29	11.14	0.279	7.20	0.0	156	13.35	400	Odorless / Colorless
9:17	6.30	11.19	0.280	7.15	0.0	156	13.35	400	Odorless / Colorless
9:22	6.29	11.27	0.278	7.13	0.0	156	13.35	400	Odorless / Colorless
9:25									Sample Collected

Sample collected using a Persistaltic Pump for:	Alkalinity, Dissolved Iron, Dissolved Organic Carbon, Ammonia, Nitrate, Nitrite, Phosphate, Chloride, Sulfate, Sulfide, Carbon Dioxide, Ethane, Ethene, Methane, Phospholipid Fatty Acids, Dehalococcoides Ethenogenes
Sample collected using bailer for :	VOC

Notes:
BTIC - Below top of inner casing

Appendix B

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Additional Groundwater Sampling Activities
Groundwater Sampling Log

Well Number:	***MW-3***	**Well Depth (ft BTIC):**	21.54		
Date:	4/22/2003	**Screen Length (ft):**	15	**Initial Water Level (ft BTIC):**	15.06
Sampling Device:	Peristaltic Pump	**Pump Intake Depth (ft BTIC):**	18.30	**Pre-Pumping Water Level (ft BTIC):**	15.33
Sampling Personnel:	GVS	**Well Diameter (in):**	2	**Tubing Type:**	Polyethylene

Time	**pH**	**Temp.** (degrees C)	**Specific Cond.** (mS/cm)	**Dissolved Oxygen** (mg/l)	**Turbidity** (NTU)	**Redox** (mV)	**Depth to Water** (feet)	**Purge Rate** (mL/min)	**Comments**
10:05	6.90	12.75	0.366	3.02	363.0	-84	16.04	200	Slight odor
10:10	6.86	12.94	0.385	1.47	276.0	-113	15.95	120	Slight odor / Slight sheen
10:15	6.88	12.96	0.395	1.33	158.0	-122	15.95	120	Slight odor / Slight sheen
10:20	6.86	12.05	0.397	0.74	118.0	-124	15.95	120	Slight odor / Slight sheen
10:25	6.80	12.90	0.393	0.10	89.1	-122	15.94	120	Slight odor / Slight sheen
10:30	6.81	12.95	0.391	0.84	62.7	-123	15.94	120	Slight odor / Slight sheen
10:35	6.79	12.89	0.391	0.54	56.7	-121	15.94	120	Slight odor / Slight sheen
10:40	6.79	12.94	0.387	0.90	39.9	-121	15.94	120	Slight odor / Slight sheen
10:45	6.75	12.91	0.387	0.74	28.1	-121	15.94	120	Slight odor
10:50	6.76	12.88	0.387	0.76	12.4	-120	15.94	120	Slight odor
10:55	6.76	12.88	0.336	0.75	17.5	-121	15.94	120	Slight odor
11:00	6.77	12.95	0.385	0.75	17.5	-121	15.94	120	Slight odor
11:05									Sample Collected

Sample collected using a Persistaltic Pump for:	Alkalinity, Dissolved Iron, Dissolved Organic Carbon, Ammonia, Nitrate, Nitrite, Phosphate, Chloride, Sulfate, Sulfide, Carbon Dioxide, Ethane, Ethene, Methane, Phospholipid Fatty Acids, Dehalococcoides Ethenogenes
Sample collected using bailer for :	VOC

Notes:

BTIC - Below top of inner casing
BD042203 collected here

Appendix B

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Additional Groundwater Sampling Activities
Groundwater Sampling Log

Well Number:	*MW-6*	**Well Depth (ft BTIC):**	27.54		
Date:	4/23/2003	**Screen Length (ft):**	10	**Initial Water Level (ft BTIC):**	15.53
Sampling Device:	Perstaltic Pump	**Pump Intake Depth (ft BTIC):**	22.54	**Pre-Pumping Water Level (ft BTIC):**	15.50
Sampling Personnel:	GVS	**Well Diameter (in):**	4	**Tubing Type:**	Polyethylene

Time	**pH**	**Temp.** (degrees C)	**Specific Cond.** (mS/cm)	**Dissolved Oxygen** (mg/l)	**Turbidity** (NTU)	**Redox** (mV)	**Depth to Water** (feet)	**Purge Rate** (mL/min)	**Comments**
13:25	7.43	14.26	0.209	8.59	8.8	121	15.50	475	Colorless / Odorless
13:30	6.21	14.80	0.185	6.93	7.5	136	15.51	500	Colorless / Odorless
13:35	6.17	15.01	0.181	6.91	7.6	135	15.52	500	Colorless / Odorless
13:40	6.21	14.99	0.179	6.88	4.5	134	15.51	500	Colorless / Odorless
13:45	6.25	15.01	0.176	6.87	3.7	133	15.51	500	Colorless / Odorless
13:50	6.30	15.13	0.175	6.68	3.0	132	15.51	500	Colorless / Odorless
13:55	6.40	15.11	0.174	6.81	2.0	131	15.51	500	Colorless / Odorless
14:00	6.51	15.21	0.173	6.67	1.1	130	15.51	500	Colorless / Odorless
14:05	6.61	15.21	0.172	6.79	0.4	129	15.51	500	Colorless / Odorless
14:10	6.73	15.22	0.171	6.64	0.0	128	15.51	500	Colorless / Odorless
14:15	6.79	15.18	0.170	6.75	0.0	128	15.51	500	Colorless / Odorless
14:20	6.92	15.24	0.170	6.74	0.0	128	15.51	500	Colorless / Odorless
14:25	7.07	15.28	0.170	6.59	0.0	127	15.51	500	Colorless / Odorless
14:30	7.23	15.24	0.169	6.66	0.0	126	15.51	500	Colorless / Odorless
14:35	7.31	15.24	0.169	6.56	0.0	127	15.51	500	Colorless / Odorless
14:40	7.59	15.21	0.169	6.73	0.0	127	15.51	500	Colorless / Odorless
14:45	7.73	15.25	0.169	6.66	0.0	126	15.51	500	Colorless / Odorless
14:50	7.69	15.23	0.168	6.64	0.0	126	15.51	500	Colorless / Odorless
14:55	7.71	15.24	0.168	6.54	0.0	127	15.51	500	Colorless / Odorless
14:59									Sample Collected

Sample collected using a Persistaltic Pump for: Alkalinity, Dissolved Iron, Dissolved Organic Carbon, Ammonia, Nitrate, Nitrite, Phosphate, Chloride, Sulfate, Sulfide, Carbon Dioxide, Ethane, Ethene, Methane, Phospholipid Fatty Acids, Dehalococcoides Ethenogenes

Sample collected using bailer for : VOC

Notes:

BTIC - Below top of inner casing

Appendix B

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Additional Groundwater Sampling Activities
Groundwater Sampling Log

Well Number:	MW-7	**Well Depth (ft BTIC):**	21.40		
Date:	4/22/2003	**Screen Length (ft):**	10	**Initial Water Level (ft BTIC):**	13.31
Sampling Device:	Perstaltic Pump	**Pump Intake Depth (ft BTIC):**	17.35	**Pre-Pumping Water Level (ft BTIC):**	13.31
Sampling Personnel:	GCP	**Well Diameter (in):**	2	**Tubing Type:**	Polyethylene

Time	pH	Temp. (degrees C)	Specific Cond. (mS/cm)	Dissolved Oxygen (mg/l)	Turbidity (NTU)	Redox (mV)	Depth to Water (feet)	Purge Rate (mL/min)	Comments
13:35	7.63	11.05	0.232	6.19	34.2	127	13.31	500	Colorless / Odorless
13:40	6.70	11.10	0.233	5.65	8.5	148	13.31	500	Colorless / Odorless
13:45	6.57	11.12	0.242	5.65	7.9	153	13.31	500	Colorless / Odorless
13:50	6.53	11.17	0.234	5.65	7.8	157	13.31	500	Colorless / Odorless
13:55	6.52	11.16	0.238	5.71	8.3	157	13.31	500	Colorless / Odorless
14:05									Sample Collected

Sample collected using a Persistaltic Pump for:	Alkalinity, Dissolved Iron, Dissolved Organic Carbon, Ammonia, Nitrate, Nitrite, Phosphate, Chloride, Sulfate, Sulfide, Carbon Dioxide, Ethane, Ethene, Methane, Phospholipid Fatty Acids, Dehalococcoides Ethenogenes
Sample collected using bailer for :	VOC

Notes:

BTIC - Below top of inner casing

Appendix B

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Additional Groundwater Sampling Activities
Groundwater Sampling Log

Well Number:	*MW-8*	**Well Depth (ft BTIC):**	23.45		
Date:	4/22/2003	**Screen Length (ft):**	15	**Initial Water Level (ft BTIC):**	12.73
Sampling Device:	Perstaltic Pump	**Pump Intake Depth (ft BTIC):**	18.45	**Pre-Pumping Water Level (ft BTIC):**	12.75
Sampling Personnel:	GCP	**Well Diameter (in):**	2	**Tubing Type:**	Polyethylene

Time	**pH**	**Temp.** (degrees C)	**Specific Cond.** (mS/cm)	**Dissolved Oxygen** (mg/l)	**Turbidity** (NTU)	**Redox** (mV)	**Depth to Water** (feet)	**Purge Rate** (mL/min)	**Comments**
9:50	6.27	11.55	0.247	3.95	6.1	30	12.79	500	Colorless / Odorless
10:00	6.02	11.55	0.252	3.45	1.9	-40	12.79	500	Colorless / Odorless
10:10	5.99	11.55	0.249	3.31	2.0	-41	12.79	500	Colorless / Odorless
10:15	6.01	11.54	0.246	3.34	1.0	-43	12.79	500	Colorless / Odorless
10:20	6.01	11.55	0.249	3.45	2.2	-40	12.79	500	Colorless / Odorless
10:25									Sample Collected

Sample collected using a Persistaltic Pump for: Alkalinity, Dissolved Iron, Dissolved Organic Carbon, Ammonia, Nitrate, Nitrite, Phosphate, Chloride, Sulfate, Sulfide, Carbon Dioxide, Ethane, Ethene, Methane, Phospholipid Fatty Acids, Dehalococcoides Ethenogenes

Sample collected using bailer for : VOC

Notes:

BTIC - Below top of inner casing

Appendix D

Laboratory Analytical Data Reports (Form 1 Results)

Severn Trent Laboratories, Inc.

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Client ID: **MW-1D**
Site: HWD Farmingdale

Lab Sample No: **424031**
Lab Job No: I092

Date Sampled: 04/23/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47647.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	0.5
Bromomethane	ND	0.4
Vinyl Chloride	ND	0.5
Chloroethane	ND	0.5
Methylene Chloride	ND	0.8
Acetone	ND	1.0
Carbon Disulfide	ND	0.2
1,1-Dichloroethene	1.3	0.4
1,1-Dichloroethane	1.8	0.2
trans-1,2-Dichloroethene	ND	0.2
cis-1,2-Dichloroethene	ND	0.2
Chloroform	ND	0.2
1,2-Dichloroethane	ND	0.3
2-Butanone	ND	2.5
1,1,1-Trichloroethane	1.4	0.2
Carbon Tetrachloride	ND	0.2
Bromodichloromethane	ND	0.4
1,2-Dichloropropane	ND	0.2
cis-1,3-Dichloropropene	ND	0.2
Trichloroethene	1.7	0.2
Dibromochloromethane	ND	0.2
1,1,2-Trichloroethane	ND	0.3
Benzene	ND	0.3
trans-1,3-Dichloropropene	ND	0.2
Bromoform	ND	0.3
4-Methyl-2-Pentanone	ND	0.6
2-Hexanone	ND	1.0
Tetrachloroethene	0.8	0.3
1,1,2,2-Tetrachloroethane	ND	0.3
Toluene	ND	0.2
Chlorobenzene	ND	0.2
Ethylbenzene	ND	0.4
Styrene	ND	0.3
Xylene (Total)	ND	0.2

Client ID: **MW-1D**
Site: HWD Farmingdale

Lab Sample No: **424031**
Lab Job No: I092

Date Sampled: 04/23/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47647.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. Propane, 2-methoxy-2-methyl-	6.69	9.7	
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			
21.			
22.			
23.			
24.			
25.			
26.			
27.			
28.			
29.			
30.			

TOTAL ESTIMATED CONCENTRATION 9.7

Client ID: **MW-1**
Site: HWD Farmingdale

Lab Sample No: **424030**
Lab Job No: I092

Date Sampled: 04/23/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47649.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	0.5
Bromomethane	ND	0.4
Vinyl Chloride	ND	0.5
Chloroethane	ND	0.5
Methylene Chloride	ND	0.8
Acetone	ND	1.0
Carbon Disulfide	ND	0.2
1,1-Dichloroethene	ND	0.4
1,1-Dichloroethane	ND	0.2
trans-1,2-Dichloroethene	ND	0.2
cis-1,2-Dichloroethene	ND	0.2
Chloroform	ND	0.2
1,2-Dichloroethane	ND	0.3
2-Butanone	ND	2.5
1,1,1-Trichloroethane	ND	0.2
Carbon Tetrachloride	ND	0.2
Bromodichloromethane	ND	0.4
1,2-Dichloropropane	ND	0.2
cis-1,3-Dichloropropene	ND	0.2
Trichloroethene	ND	0.2
Dibromochloromethane	ND	0.2
1,1,2-Trichloroethane	ND	0.3
Benzene	ND	0.3
trans-1,3-Dichloropropene	ND	0.2
Bromoform	ND	0.3
4-Methyl-2-Pentanone	ND	0.6
2-Hexanone	ND	1.0
Tetrachloroethene	50	0.3
1,1,2,2-Tetrachloroethane	ND	0.3
Toluene	ND	0.2
Chlorobenzene	ND	0.2
Ethylbenzene	ND	0.4
Styrene	ND	0.3
Xylene (Total)	ND	0.2

Client ID: **MW-1**
Site: HWD Farmingdale

Lab Sample No: **424030**
Lab Job No: I092

Date Sampled: 04/23/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47649.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. NO VOLATILE ORGANIC COMPOUNDS FOUND			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
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18.			
19.			
20.			
21.			
22.			
23.			
24.			
25.			
26.			
27.			
28.			
29.			
30.			

TOTAL ESTIMATED CONCENTRATION 0.0

Client ID: **MW-2**
Site: HWD Farmingdale

Lab Sample No: **424029**
Lab Job No: I092

Date Sampled: 04/23/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47653.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 10.0

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	4.6
Bromomethane	ND	4.4
Vinyl Chloride	ND	5.3
Chloroethane	ND	4.6
Methylene Chloride	ND	8.1
Acetone	ND	9.7
Carbon Disulfide	ND	2.4
1,1-Dichloroethene	ND	4.3
1,1-Dichloroethane	ND	2.4
trans-1,2-Dichloroethene	ND	2.5
cis-1,2-Dichloroethene	21	2.4
Chloroform	ND	1.9
1,2-Dichloroethane	ND	2.6
2-Butanone	ND	25
1,1,1-Trichloroethane	ND	1.6
Carbon Tetrachloride	ND	1.9
Bromodichloromethane	ND	3.6
1,2-Dichloropropane	ND	2.3
cis-1,3-Dichloropropene	ND	2.4
Trichloroethene	34	1.8
Dibromochloromethane	ND	2.5
1,1,2-Trichloroethane	ND	3.4
Benzene	ND	2.6
trans-1,3-Dichloropropene	ND	2.1
Bromoform	ND	3.4
4-Methyl-2-Pentanone	ND	5.5
2-Hexanone	ND	9.7
Tetrachloroethene	1200	3.1
1,1,2,2-Tetrachloroethane	ND	2.8
Toluene	ND	1.5
Chlorobenzene	ND	1.8
Ethylbenzene	ND	3.7
Styrene	ND	2.8
Xylene (Total)	ND	1.8

Client ID: **MW-2**
Site: HWD Farmingdale

Lab Sample No: **424029**
Lab Job No: I092

Date Sampled: 04/23/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47653.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 10.0

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. NO VOLATILE ORGANIC COMPOUNDS FOUND			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			
21.			
22.			
23.			
24.			
25.			
26.			
27.			
28.			
29.			
30.			

TOTAL ESTIMATED CONCENTRATION 0.0

Client ID: **MW-3**
Site: HWD Farmingdale

Lab Sample No: **424026**
Lab Job No: I092

Date Sampled: 04/22/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47650.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 2.0

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	0.9
Bromomethane	ND	0.9
Vinyl Chloride	ND	1.1
Chloroethane	ND	0.9
Methylene Chloride	ND	1.6
Acetone	ND	1.9
Carbon Disulfide	ND	0.5
1,1-Dichloroethene	ND	0.9
1,1-Dichloroethane	ND	0.5
trans-1,2-Dichloroethene	ND	0.5
cis-1,2-Dichloroethene	2.3	0.5
Chloroform	ND	0.4
1,2-Dichloroethane	ND	0.5
2-Butanone	ND	4.9
1,1,1-Trichloroethane	ND	0.3
Carbon Tetrachloride	ND	0.4
Bromodichloromethane	ND	0.7
1,2-Dichloropropane	ND	0.5
cis-1,3-Dichloropropene	ND	0.5
Trichloroethene	ND	0.4
Dibromochloromethane	ND	0.5
1,1,2-Trichloroethane	ND	0.7
Benzene	2.0	0.5
trans-1,3-Dichloropropene	ND	0.4
Bromoform	ND	0.7
4-Methyl-2-Pentanone	ND	1.1
2-Hexanone	ND	1.9
Tetrachloroethene	1.4	0.6
1,1,2,2-Tetrachloroethane	ND	0.6
Toluene	9.6	0.3
Chlorobenzene	19	0.4
Ethylbenzene	310	0.7
Styrene	ND	0.6
Xylene (Total)	40	0.4

Client ID: **MW-3**
Site: HWD Farmingdale

Lab Sample No: **424026**
Lab Job No: I092

Date Sampled: 04/22/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47650.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 2.0

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. Unknown	3.10	31	
2. Chlorotrifluoroethene isomer	3.28	45	
3. Ethylmethylbenzene isomer	14.37	8.1	
4. Benzene, propyl-	14.81	29	
5. Ethylmethylbenzene isomer	14.93	11	
6. Ethylmethylbenzene isomer	15.21	28	
7. Trimethylbenzene isomer	15.37	110	
8. Trimethylbenzene isomer	15.83	43	
9. Unknown Aromatic	16.07	50	
10. Benzene, 1,2-dichloro-/Unknown Aromati	16.22	7.5	
11. Methylpropylbenzene isomer	16.30	10	
12. Ethyldimethylbenzene isomer	16.37	10	
13. Methyl-methylethylbenzene isomer	16.47	12	
14. 2,3-dihydro-methyl-1H-Indene isomer/C1	16.65	10	
15. Tetramethylbenzene isomer	16.91	11	
16.			
17.			
18.			
19.			
20.			
21.			
22.			
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30.			

TOTAL ESTIMATED CONCENTRATION 416

Client ID: **BD042203** (MW-3)
Site: HWD Farmingdale

Lab Sample No: **424028**
Lab Job No: I092

Date Sampled: 04/22/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47651.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 2.0

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	0.9
Bromomethane	ND	0.9
Vinyl Chloride	ND	1.1
Chloroethane	ND	0.9
Methylene Chloride	ND	1.6
Acetone	ND	1.9
Carbon Disulfide	ND	0.5
1,1-Dichloroethene	ND	0.9
1,1-Dichloroethane	ND	0.5
trans-1,2-Dichloroethene	ND	0.5
cis-1,2-Dichloroethene	1.9	0.5
Chloroform	ND	0.4
1,2-Dichloroethane	ND	0.5
2-Butanone	ND	4.9
1,1,1-Trichloroethane	ND	0.3
Carbon Tetrachloride	ND	0.4
Bromodichloromethane	ND	0.7
1,2-Dichloropropane	ND	0.5
cis-1,3-Dichloropropene	ND	0.5
Trichloroethene	ND	0.4
Dibromochloromethane	ND	0.5
1,1,2-Trichloroethane	ND	0.7
Benzene	1.8	0.5
trans-1,3-Dichloropropene	ND	0.4
Bromoform	ND	0.7
4-Methyl-2-Pentanone	ND	1.1
2-Hexanone	ND	1.9
Tetrachloroethene	1.2	0.6
1,1,2,2-Tetrachloroethane	ND	0.6
Toluene	8.2	0.3
Chlorobenzene	17	0.4
Ethylbenzene	270	0.7
Styrene	ND	0.6
Xylene (Total)	35	0.4

Client ID: **BD042203** (MW-3)
Site: HWD Farmingdale

Lab Sample No: **424028**
Lab Job No: I092

Date Sampled: 04/22/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47651.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 2.0

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. Unknown	3.10	23	
2. Chlorotrifluoroethene isomer	3.28	40	
3. Ethylmethylbenzene isomer	14.37	7.0	
4. Benzene, propyl-	14.82	24	
5. Ethylmethylbenzene isomer	14.92	9.9	
6. Ethylmethylbenzene isomer	15.21	24	
7. Trimethylbenzene isomer	15.37	99	
8. Coeluting Aromatics	15.56	6.8	
9. Trimethylbenzene isomer	15.83	38	
10. Unknown Aromatic	16.08	45	
11. Benzene, 1,2-dichloro-/Unknown Aromati	16.23	8.8	
12. Ethyldimethylbenzene isomer	16.38	8.9	
13. Methyl-methylethylbenzene isomer	16.47	10	
14. 2,3-dihydro-methyl-1H-Indene isomer	16.65	8.7	
15. Tetramethylbenzene isomer	16.90	9.2	
16.			
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30.			

TOTAL ESTIMATED CONCENTRATION 362

Client ID: **MW-6**
Site: HWD Farmingdale

Lab Sample No: **424025**
Lab Job No: I092

Date Sampled: 04/22/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47648.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	0.5
Bromomethane	ND	0.4
Vinyl Chloride	ND	0.5
Chloroethane	ND	0.5
Methylene Chloride	ND	0.8
Acetone	ND	1.0
Carbon Disulfide	ND	0.2
1,1-Dichloroethene	ND	0.4
1,1-Dichloroethane	ND	0.2
trans-1,2-Dichloroethene	ND	0.2
cis-1,2-Dichloroethene	ND	0.2
Chloroform	ND	0.2
1,2-Dichloroethane	ND	0.3
2-Butanone	ND	2.5
1,1,1-Trichloroethane	0.3	0.2
Carbon Tetrachloride	ND	0.2
Bromodichloromethane	ND	0.4
1,2-Dichloropropane	ND	0.2
cis-1,3-Dichloropropene	ND	0.2
Trichloroethene	1.1	0.2
Dibromochloromethane	ND	0.2
1,1,2-Trichloroethane	ND	0.3
Benzene	ND	0.3
trans-1,3-Dichloropropene	ND	0.2
Bromoform	ND	0.3
4-Methyl-2-Pentanone	ND	0.6
2-Hexanone	ND	1.0
Tetrachloroethene	120	0.3
1,1,2,2-Tetrachloroethane	ND	0.3
Toluene	ND	0.2
Chlorobenzene	ND	0.2
Ethylbenzene	ND	0.4
Styrene	ND	0.3
Xylene (Total)	ND	0.2

Client ID: **MW-6**
Site: HWD Farmingdale

Lab Sample No: **424025**
Lab Job No: I092

Date Sampled: 04/22/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47648.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. NO VOLATILE ORGANIC COMPOUNDS FOUND			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
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10.			
11.			
12.			
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30.			

TOTAL ESTIMATED CONCENTRATION 0.0

Client ID: **MW-7**
Site: HWD Farmingdale

Lab Sample No: **424024**
Lab Job No: I092

Date Sampled: 04/22/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47654.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 25.0

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	12
Bromomethane	ND	11
Vinyl Chloride	ND	13
Chloroethane	ND	12
Methylene Chloride	ND	20
Acetone	ND	24
Carbon Disulfide	ND	6.0
1,1-Dichloroethene	ND	11
1,1-Dichloroethane	ND	6.0
trans-1,2-Dichloroethene	ND	6.2
cis-1,2-Dichloroethene	38	6.0
Chloroform	ND	4.8
1,2-Dichloroethane	ND	6.5
2-Butanone	ND	62
1,1,1-Trichloroethane	ND	4.0
Carbon Tetrachloride	ND	4.8
Bromodichloromethane	ND	9.0
1,2-Dichloropropane	ND	5.8
cis-1,3-Dichloropropene	ND	6.0
Trichloroethene	48	4.5
Dibromochloromethane	ND	6.2
1,1,2-Trichloroethane	ND	8.5
Benzene	ND	6.5
trans-1,3-Dichloropropene	ND	5.2
Bromoform	ND	8.5
4-Methyl-2-Pentanone	ND	14
2-Hexanone	ND	24
Tetrachloroethene	2600	7.8
1,1,2,2-Tetrachloroethane	ND	7.0
Toluene	ND	3.8
Chlorobenzene	ND	4.5
Ethylbenzene	ND	9.2
Styrene	ND	7.0
Xylene (Total)	ND	4.5

Client ID: **MW-7**
Site: HWD Farmingdale

Lab Sample No: **424024**
Lab Job No: I092

Date Sampled: 04/22/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47654.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 25.0

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. NO VOLATILE ORGANIC COMPOUNDS FOUND			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
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27.			
28.			
29.			
30.			

TOTAL ESTIMATED CONCENTRATION 0.0

Client ID: **MW-8**
Site: HWD Farmingdale

Lab Sample No: **424027**
Lab Job No: I092

Date Sampled: 04/22/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47652.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 10.0

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	4.6
Bromomethane	ND	4.4
Vinyl Chloride	ND	5.3
Chloroethane	ND	4.6
Methylene Chloride	ND	8.1
Acetone	ND	9.7
Carbon Disulfide	ND	2.4
1,1-Dichloroethene	ND	4.3
1,1-Dichloroethane	ND	2.4
trans-1,2-Dichloroethene	ND	2.5
cis-1,2-Dichloroethene	27	2.4
Chloroform	ND	1.9
1,2-Dichloroethane	ND	2.6
2-Butanone	ND	25
1,1,1-Trichloroethane	ND	1.6
Carbon Tetrachloride	ND	1.9
Bromodichloromethane	ND	3.6
1,2-Dichloropropane	ND	2.3
cis-1,3-Dichloropropene	ND	2.4
Trichloroethene	25	1.8
Dibromochloromethane	ND	2.5
1,1,2-Trichloroethane	ND	3.4
Benzene	ND	2.6
trans-1,3-Dichloropropene	ND	2.1
Bromoform	ND	3.4
4-Methyl-2-Pentanone	ND	5.5
2-Hexanone	ND	9.7
Tetrachloroethene	970	3.1
1,1,2,2-Tetrachloroethane	ND	2.8
Toluene	ND	1.5
Chlorobenzene	ND	1.8
Ethylbenzene	ND	3.7
Styrene	ND	2.8
Xylene (Total)	ND	1.8

Client ID: **MW-8**
Site: HWD Farmingdale

Lab Sample No: **424027**
Lab Job No: I092

Date Sampled: 04/22/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47652.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 10.0

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. NO VOLATILE ORGANIC COMPOUNDS FOUND			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
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18.			
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20.			
21.			
22.			
23.			
24.			
25.			
26.			
27.			
28.			
29.			
30.			

TOTAL ESTIMATED CONCENTRATION 0.0

Client ID: **TB042303**
Site: HWD Farmingdale

Lab Sample No: **424032**
Lab Job No: I092

Date Sampled: 04/14/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47646.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	0.5
Bromomethane	ND	0.4
Vinyl Chloride	ND	0.5
Chloroethane	ND	0.5
Methylene Chloride	ND	0.8
Acetone	ND	1.0
Carbon Disulfide	ND	0.2
1,1-Dichloroethene	ND	0.4
1,1-Dichloroethane	ND	0.2
trans-1,2-Dichloroethene	ND	0.2
cis-1,2-Dichloroethene	ND	0.2
Chloroform	ND	0.2
1,2-Dichloroethane	ND	0.3
2-Butanone	ND	2.5
1,1,1-Trichloroethane	ND	0.2
Carbon Tetrachloride	ND	0.2
Bromodichloromethane	ND	0.4
1,2-Dichloropropane	ND	0.2
cis-1,3-Dichloropropene	ND	0.2
Trichloroethene	ND	0.2
Dibromochloromethane	ND	0.2
1,1,2-Trichloroethane	ND	0.3
Benzene	ND	0.3
trans-1,3-Dichloropropene	ND	0.2
Bromoform	ND	0.3
4-Methyl-2-Pentanone	ND	0.6
2-Hexanone	ND	1.0
Tetrachloroethene	ND	0.3
1,1,2,2-Tetrachloroethane	ND	0.3
Toluene	ND	0.2
Chlorobenzene	ND	0.2
Ethylbenzene	ND	0.4
Styrene	ND	0.3
Xylene (Total)	ND	0.2

Client ID: **TB042303**
Site: HWD Farmingdale

Lab Sample No: **424032**
Lab Job No: I092

Date Sampled: 04/14/03
Date Received: 04/24/03
Date Analyzed: 04/28/03
GC Column: DB624
Instrument ID: VOAMS6.i
Lab File ID: f47646.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. NO VOLATILE ORGANIC COMPOUNDS FOUND			
2.			
3.			
4.			
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27.			
28.			
29.			
30.			

TOTAL ESTIMATED CONCENTRATION 0.0

ST EDISON
w Durham Road
Edison, New Jersey 08817
Phone: (732) 549-3900 Fax: (732) 549-3679

CHAIN OF CUSTODY / ANALYSIS REQUEST

PAGE 1 OF 1

Name (for report and invoice): John Brussel
Company: BBL
Address:
City: Syracuse State: NY
Phone: 315-446-2570 Fax:

Samplers Name (Printed): Glenn Palmer
P.O. #:

Site/Project Identification: HWD Farmingdale
State (Location of site): NJ: ☐ NY: ☒ Other:
Regulatory Program:

Analysis Turnaround Time
Standard ☒
Rush Charges Authorized For:
2 Week ☐
1 Week ☐
Other ☐

ANALYSIS REQUESTED (ENTER "X" BELOW TO INDICATE REQUEST)

LAB USE ONLY
Project No:
Job No: I092

Sample Identification	Date	Time	Matrix	No. of Cont.	voc 624	ms/msD 624	Sample Numbers
Mw-7	4/22/03	1405	GW	9	✓	✓	424024
mw-6	↓	1459	↓	3	✓		424025
mw-3		1104		3	✓		424026
mw-8		1025		3	✓		424027
BD042203	↓		↓	3	✓		424028
mw-2	4/23/05	0725	↓	3	✓		424029
mw-1	↓	0935		3	✓		424030
mw-1D	↓	1110	↓	3	✓		424031
TB042303	Km 4/24/03	X	W	2	✓		424032

Preservation Used: 1 = ICE, 2 = HCl, 3 = H_2SO_4, 4 = HNO_3, 5 = NaOH
6 = Other ________, 7 = Other ________

	voc 624	ms/msD 624
Soil:	2	2
Water:	2	2

Special Instructions

Water Metals Filtered (Yes/No)?

Relinquished by	Company	Date / Time	Received by	Company
1) Glenn Palmer	BBL	4/24/03 / 10:30 Am	1) K. CHALOKA	STL
2) K CHALOKA	STL Edison Ken Chaloka	4/24/03 / 12:00 Pm	2) Gm	STL
3)		|	3)	
4)		|	4)	

Laboratory Certifications: New Jersey (12028), New York (11452), Pennsylvania (68-522), Connecticut (PH-0200), Rhode Island (132).

STL-6003

Microseeps, Inc.

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

MICROSEEPS

Client Name: Blasland Bouck & Lee
Contact: John Brussel
Address: 6723 Towpath Road
Box 66
Syracuse, NY 13214-0066

Page 1 of 2
Order #: P0304416
Report Date: 05/12/03
Client Proj Name: Farmingdale NY
Client Proj #: Farmingdale NY

Laboratory Results

Lab Sample #	Client Sample ID
P0304416-01	MW-1D

Approved By: ____________________

NOTES:

Order #: P0304416
Report Date: 05/12/03
Client Proj Name: Farmingdale NY
Client Proj #: Farmingdale NY

Lab Sample #: P0304416-01

Client Name: Blasland Bouck & Lee
Contact: John Brussel
Address: 6723 Towpath Road
Box 66
Syracuse, NY 13214-0066

Sample Description	Matrix	Sampled Date/Time	Received
MW-1D	Water	23 Apr. 03 11:10	24 Apr. 03

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date	
WetChem							
Water							
Alkalinity as CaCO3	71	4.0	mg/L	310.1	js	4/25/03	
Ammonia as N	<2.0	2.0	mg/L	350.2	js	5/2/03	
Chloride	36	1.0	mg/L	9056	md	4/25/03	04:39
Nitrate	<0.50	0.50	mg/L	9056	md	4/25/03	04:39
Nitrite	<0.50	0.50	mg/L	9056	md	4/25/03	04:39
Phosphate	<0.10	0.10	mg/L	9056	md	4/25/03	04:39
SolubleOrganic Carbon	<5	5	mg/L	9060	md	5/6/03	
Sulfate	18	1.0	mg/L	9056	md	4/25/03	04:39
Sulfide	< 2.0	2.0	mg/L	376.1	am	4/28/03	
Metals							
ter							
on-dissolved	<0.050	0.050	mg/L	6010B	ak	4/30/03	
RiskAnalysis							
Water							
Carbon dioxide	76	0.60	mg/L	AM20GAX	mm	5/9/03	
Ethane	29	5.0	ng/L	AM18	mm	5/9/03	
Ethene	32	5.0	ng/L	AM18	mm	5/9/03	
Methane	14	0.015	ug/L	AM20GAX	mm	5/9/03	

P0304416

CHAIN - OF - CUSTODY RECORD

Phone: (412) 826-5245 **Microseeps, Inc. - 220 William Pitt Way - Pittsburgh, PA 15238** Fax No. : (412) 826-3433

Company : BBL
Co. Address : Tow Path Rd
Proj. Manager: John Brussel
Proj. Location: Farmingdale NY
Proj. Number:
Phone # : 315-446-2570 Fax # :

Sampler's signature :

Results to :

Invoice to :

Cooler ID	Cooler Temp.

01

Sample ID	Sample Description	Date	Time	Comp.	Grab	# Cont.	Alkalinity	Ammonia	Sulfide	Dissolved Organic Carbon	chloride, nitrate, nitrite, sulfate, phosphate	methane, ethane, ethene, CO2	Dissolved Iron		Remarks
mw-1D		4/23/03	1110		X	15	X	X	X	X	X	X	X		

Relinquished by :	Company :	Date :	Time :	Received by: CWashlash	Company : Microseeps	Date : 4/24/03	Time : 1401
Relinquished by :	Company :	Date :	Time :	Received by :	Company :	Date :	Time :
Relinquished by :	Company :	Date :	Time :	Received by :	Company :	Date :	Time :

WHITE COPY : Accompany Samples YELLOW COPY : Laboratory File PINK COPY : Submitter

MICROSEEPS

Client Name: Blasland Bouck & Lee
Contact: John Brussel
Address: 6723 Towpath Road
Box 66
Syracuse, NY 13214-0066

Order #: P0304415
Report Date: 05/09/03
Client Proj Name: Farmingdale NY
Client Proj #: Farmingdale NY

Laboratory Results

Lab Sample #	Client Sample ID
P0304415-01	MW-2
P0304415-02	MW-1

Approved By:

NOTES:

Order #: P0304415
Report Date: 05/09/03
Client Proj Name: Farmingdale NY
Client Proj #: Farmingdale NY

Lab Sample #: P0304415-01

Client Name: Blasland Bouck & Lee
Contact: John Brussel
Address: 6723 Towpath Road
Box 66
Syracuse, NY 13214-0066

Sample Description	Matrix	Sampled Date/Time	Received
MW-2	Water	23 Apr. 03 9:25	24 Apr. 03

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date	
WetChem							
Water							
Alkalinity as CaCO3	61	4.0	mg/L	310.1	js	4/25/03	
Ammonia as N	<2.0	2.0	mg/L	350.2	js	5/2/03	
Chloride	35	1.0	mg/L	9056	md	4/24/03	18:51
Nitrate	15	0.50	mg/L	9056	md	4/24/03	18:51
Nitrite	<0.50	0.50	mg/L	9056	md	4/24/03	18:51
Phosphate	<0.10	0.10	mg/L	9056	md	4/24/03	18:51
SolubleOrganic Carbon	<5.0	5.0	mg/L	9060		5/7/03	
Sulfate	19	1.0	mg/L	9056	md	4/24/03	18:51
Sulfide	<2.0	2.0	mg/L	376.1	am	4/28/03	
Metals							
[illegible]ter							
[illegible]on-dissolved	<0.050	0.050	mg/L	6010B	ak	4/30/03	
RiskAnalysis							
Water							
Carbon dioxide	26	0.60	mg/L	AM20GAX	mm	5/8/03	
Ethane	84	5.0	ng/L	AM18	mm	5/8/03	
Ethene	25	5.0	ng/L	AM18	mm	5/8/03	
Methane	0.73	0.015	ug/L	AM20GAX	mm	5/8/03	

Order #: P0304415
Report Date: 05/09/03
Client Proj Name: Farmingdale NY
Client Proj #: Farmingdale NY

Client Name: Blasland Bouck & Lee
Contact: John Brussel
Address: 6723 Towpath Road
Box 66
Syracuse, NY 13214-0066

Lab Sample #: P0304415-02

Sample Description	Matrix	Sampled Date/Time	Received
MW-1	Water	23 Apr. 03 9:35	24 Apr. 03

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
WetChem						
Water						
Alkalinity as CaCO3	32	4.0	mg/L	310.1	js	4/25/03
Ammonia as N	<2.0	2.0	mg/L	350.2	js	5/2/03
Chloride	20	1.0	mg/L	9056	md	4/24/03 19:16
Nitrate	17	0.50	mg/L	9056	md	4/24/03 19:16
Nitrite	<0.50	0.50	mg/L	9056	md	4/24/03 19:16
Phosphate	<0.10	0.10	mg/L	9056	md	4/24/03 19:16
SolubleOrganic Carbon	<5.0	5.0	mg/L	9060		5/7/03
Sulfate	20	1.0	mg/L	9056	md	4/24/03 19:16
Sulfide	<2.0	2.0	mg/L	376.1	am	4/28/03
Metals						
ter						
on-dissolved	<0.050	0.050	mg/L	6010B	ak	4/30/03
RiskAnalysis						
Water						
Carbon dioxide	34	0.60	mg/L	AM20GAX	mm	5/8/03
Ethane	82	5.0	ng/L	AM18	mm	5/8/03
Ethene	23	5.0	ng/L	AM18	mm	5/8/03
Methane	0.71	0.015	ug/L	AM20GAX	mm	5/8/03

PO 304415

CHAIN - OF - CUSTODY RECORD

Phone: (412) 826-5245 Microseeps, Inc. - 220 William Pitt Way - Pittsburgh, PA 15238 Fax No. : (412) 826-3433

Company : BBL
Co. Address : Tow Path Rd
Proj. Manager: John Brussel
Proj. Location: Farmingdale NY
Proj. Number:
Phone # : 315-446-2570 **Fax # :**

Sampler's signature :

Results to : John Brussel
Syracuse

Invoice to : John Brussel
Syracuse

Cooler ID	Cooler Temp.

Parameters Requested

Sample ID	Sample Description	Date	Time	Comp.	Grab	# Cont.	Alkalinity	Ammonia	Sulfide	Dissolved Organic Carb	Chloride, Nitrate, Nitrite, Sulfate, Phosphate	Methane, Ethane, Ethene, CO2	Dissolved Iron		Remarks
01 mw-2		4/23/03	0925		x	15	X	X	X	X	X	X	X		
02 mw-1		|	0935		x	15	X	X	X	X	X	X	X		
~~mw-1B~~															

Relinquished by :	Company :	Date :	Time :	Received by :	Company :	Date :	Time :
	BBL	4/23/03	1300	[illegible]	Microseeps	4/24/03	12:45

WHITE COPY : Accompany Samples YELLOW COPY : Laboratory File PINK COPY : Submitter

MICROSEEPS

Client Name: Blasland Bouck & Lee
Contact: John Brussel
Address: 6723 Towpath Road
Box 66
Syracuse, NY 13214-0066

Order #: P0304389
Report Date: 05/08/03
Client Proj Name: HWD 02
Client Proj #: 6040524

Laboratory Results

Lab Sample #	Client Sample ID
P0304389-01	MW-7
P0304389-02	MW-6
P0304389-03	MW-3
P0304389-04	MW-8

Approved By:

NOTES:

Order #: P0304389
Report Date: 05/08/03
Client Proj Name: HWD 02
Client Proj #: 6040524

Lab Sample #: P0304389-01

Client Name: Blasland Bouck & Lee
Contact: John Brussel
Address: 6723 Towpath Road
Box 66
Syracuse, NY 13214-0066

Sample Description	Matrix	Sampled Date/Time	Received
MW-7	Water	22 Apr. 03 14:05	23 Apr. 03

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
WetChem						
Water						
Alkalinity as CaCO3	52	4.0	mg/L	310.1	js	4/25/03
Ammonia as N	5.2	2.0	mg/L	350.2	am	4/29/03
Chloride	22	1.0	mg/L	9056	md	4/23/03 20:14
Nitrate	14	0.50	mg/L	9056	md	4/23/03 20:14
Nitrite	<0.50	0.50	mg/L	9056	md	4/23/03 20:14
Phosphate	<0.10	0.10	mg/L	9056	md	4/23/03 20:14
SolubleOrganic Carbon	<5.0	5.0	mg/L	9060	md	4/29/03
Sulfate	30	1.0	mg/L	9056	md	4/23/03 20:14
Sulfide	<2.0	2.0	mg/L	376.1	am	4/25/03
Metals						
ater						
on-dissolved	<0.050	0.050	mg/L	6010B	ak	4/30/03
RiskAnalysis						
Water						
Carbon dioxide	28	0.60	mg/L	AM20GAX	mm	5/7/03
Ethane	5.8	5.0	ng/L	AM18	mm	5/7/03
Ethene	8.4	5.0	ng/L	AM18	mm	5/7/03
Methane	0.13	0.015	ug/L	AM20GAX	mm	5/7/03

Order #: P0304389
Report Date: 05/08/03
Client Proj Name: HWD 02
Client Proj #: 6040524

Lab Sample #: P0304389-02

Client Name: Blasland Bouck & Lee
Contact: John Brussel
Address: 6723 Towpath Road
Box 66
Syracuse, NY 13214-0066

Sample Description	Matrix	Sampled Date/Time	Received
MW-6	Water	22 Apr. 03 14:59	23 Apr. 03

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
WetChem						
Water						
Alkalinity as CaCO3	29	4.0	mg/L	310.1	js	4/25/03
Ammonia as N	2.2	2.0	mg/L	350.2	am	4/29/03
Chloride	14	1.0	mg/L	9056	md	4/23/03 20:39
Nitrate	10	0.50	mg/L	9056	md	4/23/03 20:39
Nitrite	<0.50	0.50	mg/L	9056	md	4/23/03 20:39
Phosphate	<0.10	0.10	mg/L	9056	md	4/23/03 20:39
SolubleOrganic Carbon	< 5.0	5.0	mg/L	9060	md	4/29/03
Sulfate	24	1.0	mg/L	9056	md	4/23/03 20:39
Sulfide	<2.0	2.0	mg/L	376.1	am	4/25/03
Metals						
ater						
on-dissolved	<0.050	0.050	mg/L	6010B	ak	4/30/03
RiskAnalysis						
Water						
Carbon dioxide	26	0.60	mg/L	AM20GAX	mm	5/7/03
Ethane	<5.0	5.0	ng/L	AM18	mm	5/7/03
Ethene	11	5.0	ng/L	AM18	mm	5/7/03
Methane	0.080	0.015	ug/L	AM20GAX	mm	5/7/03

Order #: P0304389
Report Date: 05/08/03
Client Proj Name: HWD 02
Client Proj #: 6040524

Client Name: Blasland Bouck & Lee
Contact: John Brussel
Address: 6723 Towpath Road
Box 66
Syracuse, NY 13214-0066

Lab Sample #: P0304389-03

Sample Description	Matrix	Sampled Date/Time	Received
MW-3	Water	22 Apr. 03 11:04	23 Apr. 03

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
WetChem						
Water						
Alkalinity as CaCO3	200	4.0	mg/L	310.1	js	4/25/03
Ammonia as N	3.7	2.0	mg/L	350.2	am	4/29/03
Chloride	9.4	1.0	mg/L	9056	md	4/23/03 21:03
Nitrate	<0.50	0.50	mg/L	9056	md	4/23/03 21:03
Nitrite	<0.50	0.50	mg/L	9056	md	4/23/03 21:03
Phosphate	<0.10	0.10	mg/L	9056	md	4/23/03 21:03
SolubleOrganic Carbon	<5.0	5.0	mg/L	9060	md	4/29/03
Sulfate	5.2	1.0	mg/L	9056	md	4/23/03 21:03
Sulfide	<2.0	2.0	mg/L	376.1	am	4/25/03
Metals						
Water						
Iron-dissolved	21	0.050	mg/L	6010B	ak	4/30/03
RiskAnalysis						
Water						
Carbon dioxide	71	0.60	mg/L	AM20GAX	mm	5/7/03
Ethane	410	5.0	ng/L	AM18	mm	5/7/03
Ethene	340	5.0	ng/L	AM18	mm	5/7/03
Methane	780	0.015	ug/L	AM20GAX	mm	5/7/03

Order #: P0304389
Report Date: 05/08/03
Client Proj Name: HWD 02
Client Proj #: 6040524

Client Name: Blasland Bouck & Lee
Contact: John Brussel
Address: 6723 Towpath Road
Box 66
Syracuse, NY 13214-0066

Lab Sample #: P0304389-04

Sample Description	Matrix	Sampled Date/Time	Received
MW-8	Water	22 Apr. 03 10:25	23 Apr. 03

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
WetChem						
Water						
Alkalinity as CaCO3	92	4.0	mg/L	310.1	js	4/25/03
Ammonia as N	< 2.0	2.0	mg/L	350.2	am	4/29/03
Chloride	15	1.0	mg/L	9056	md	4/23/03 21:28
Nitrate	8.6	0.50	mg/L	9056	md	4/23/03 21:28
Nitrite	<0.50	0.50	mg/L	9056	md	4/23/03 21:28
Phosphate	<0.10	0.10	mg/L	9056	md	4/23/03 21:28
SolubleOrganic Carbon	<5.0	5.0	mg/L	9060	md	4/29/03
Sulfate	27	1.0	mg/L	9056	md	4/23/03 21:28
Sulfide	<2.0	2.0	mg/L	376.1	am	4/25/03
Metals						
ater						
on-dissolved	0.73	0.050	mg/L	6010B	ak	4/30/03
RiskAnalysis						
Water						
Carbon dioxide	38	0.60	mg/L	AM20GAX	mm	5/7/03
Ethane	8000	5.0	ng/L	AM18	mm	5/7/03
Ethene	180	5.0	ng/L	AM18	mm	5/7/03
Methane	160	0.015	ug/L	AM20GAX	mm	5/7/03

P0304389

CHAIN - OF - CUSTODY RECORD

Phone: (412) 826-5245 **Microseeps, Inc. - 220 William Pitt Way - Pittsburgh, PA 15238** Fax No. : (412) 826-3433

Company : BBL
Co. Address : TowPath Rd Syracuse NY
Proj. Manager: John Brussel
Proj. Location: HWD
Proj. Number:
Phone # : 315-4[illegible]-2570 Fax # :

Sampler's signature :

Results to : John Brussel

Invoice to : John Brussel

Cooler ID	Cooler Temp.

Parameters Requested

	Sample ID	Sample Description	Date	Time	Comp.	Grab	# Cont.	Alkalinity	Ammonia	Sulfide	Dissolved Organic Carb	chloride, nitrate, nitrite su phosphate	methane, ethane, ethene, CO2	Dissolved Iron		Remarks
01	mw-7	GW	4/22/05	1405		x	15	✓	✓	✓	✓	✓	✓	✓		
02	mw-6		↓	1459		↓	15	↓	↓	↓	↓	↓	↓	↓		
03	mw-3		↓	1104		↓	15	↓	↓	↓	↓	↓	↓	↓		
04	mw-8		↓	1025		↓	15	↓	↓	↓	↓	↓	↓	↓		

Relinquished by :	Company : BBL	Date : 4/22/05	Time : 1600	Received by : R. Welch	Company : Microseeps	Date : 4/23/05	Time : 1100
Relinquished by :	Company :	Date :	Time :	Received by :	Company :	Date :	Time :
-d by :	Company :	Date :	Time :	Received by :	Company :	Date :	Time :

WHITE COPY : Accompany Samples YELLOW COPY : Laboratory File PINK COPY : Submitter

Microbial Insights, Inc.

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

microbial insights

2340 Stock Creek Blvd.
Rockford TN 37853-3044
Phone (865) 573-8188
Fax: (865) 573-8133
Email: microbe@microbe.com

Microbial Analysis Report

Client: John Brussel
BBL
Tow Path Rd.
Syracuse, NY

Phone: 315.446.2570

Fax:

MI Identifier: 84bbl **Date Rec.:** 4/24/03 **Report Date:** 5/20/03

Analysis Requested: PLFA

Project: HWD

Comments:

All samples within this data package were analyzed under U.S. EPA Good Laboratory Practice Standards: Toxic Substances Control Act (40 CFR part 790). All samples were processed according to standard operating procedures. Test results submitted in this data package meet the quality assurance requirements established by Microbial Insights, Inc.

Reported by:

Susan Reynolds

Reviewed by:

Yvette M.

microbial insights

2340 Stock Creek Blvd.
Rockford TN 37853-3044
Phone (865) 573-8188
Fax: (865) 573-8133
Email: microbe@microbe.com

Microbial Analysis Report

Executive Summary

The microbial communities from seven groundwater samples were analyzed and characterized according to their phospholipid fatty acid composition (PLFA analysis). Results from this study revealed the following key observations:

- Biomass estimates, as determined by the total concentration of PLFA, were shown to be highest in sample MW-1D. Overall, biomass concentrations varied between ~10^3 to ~10^6 cells/mL water among sampling locations.

- PLFA profiles revealed that the complexity and composition of the community structure varied among sampling locations. Samples MW-1 and MW-2 were shown to contain simple community structures in comparison to the other samples submitted for analysis. High proportions of terminally branched saturated PLFA (indicative of anaerobes) were found in samples MW-3 and MW-1D. Samples MW-6 and MW-1D were shown to contain high proportions of polyenoic PLFA (characteristic of eukaryotic organisms). The biomarker 18:2ω6, indicative of fungi, was the most prevalent in the polyenoic group.

- Physiological status biomarkers indicated that the Gram negative bacteria in all samples other than MW-1 and MW-6 were stressed and at least borderline starved. MW-2 and MW-1D were shown to be the most starved.

Overview of Approach:

Phospholipid Fatty Acid Analysis

Determination of the phospholipid fatty acids (PLFA) in environmental samples is an effective tool for monitoring microbial responses to their environment. They are essential components of the membranes of all cells (except for the Archea, a minor component of most environments), so their sum includes all important actors of most microbial communities. There are four different types of information in PLFA profiles – biomass, community structure, diversity, and physiological status.

Biomass: PLFA analysis is the most reliable and accurate method available for the determination of viable microbial biomass. Since phospholipids break down rapidly upon cell death (21, 23), the PLFA biomass does not contain 'fossil' lipids of dead cells. The sum of the PLFA, expressed as picomoles (1 picomole = 1×10^{-12} mole), is proportional to the number of cells. The proportion used in this report, 20,000 cells/pmole, is taken from cells grown in laboratory media, and varies somewhat with type of organism and environmental conditions. Starving bacterial cells have the lowest cells/pmol, and healthy eukaryote cells have the highest.

Community Structure:. The PLFA in an environmental sample is the sum of the microbial community's PLFA, and reflects the proportions of different organisms in the sample. PLFA profiles are routinely used to classify bacteria and fungi (19) and are one of the characteristics used to describe new bacterial species (25). Broad phylogenic groups of microbes have different fatty acid profiles, making it possible to distinguish between them (4, 5, 22, 24). Table 1 describes the six major structural groups employed in this report.

Table 1. Description of PLFA structural groups.

PLFA Structural Group	General classification
Monoenoic (Monos)	Abundant in Proteobacteria (Gram negative bacteria), typically fast growing, utilize many carbon sources, and adapt quickly to a variety of environments.
Terminally Branched Saturated (TerBrSats)	Characteristic of Firmicutes (Low G+C Gram-positive bacteria), and also found in Bacteriodes, and some Gram-negative bacteria.
Branched Monoenoic (BrMonos)	Found in the cell membranes of micro-aerophiles and anaerobes, such as sulfate- or iron-reducing bacteria
Mid-Chain Branched Saturated (MidBrSats)	Common in Actinobacteria (High G+C Gram-positive bacteria), and some sulfate-reducing bacteria.
Normal Saturated (Nsats)	Found in all organisms.
Polyenoic	Found in Eukaryotes such as fungi, protozoa, algae, higher plants, and animals.

Diversity: The diversity of a microbial community is a measure of the number of different organisms and the evenness of their distribution. Natural communities in an undisturbed environment tend to have high diversity. Contamination with toxic compounds will reduce the diversity by killing all but the resistant organisms. The addition of a large amount of a food source will initially reduce the diversity as the opportunists (usually Proteobacteria) over-grow organisms less able to reproduce rapidly. The formulas used to calculate microbial community diversity from PLFA profiles have been adapted from those applied to communities of macro-organisms (8).

Physiological status: The membrane of a microbe must adapt to the changing conditions of it's environment, and these changes are reflected in the PLFA. Toxic compounds or environmental conditions that disrupt the membrane cause some bacteria to make trans fatty acids from the usual cis fatty acids (7). Many Proteobacteria and others respond to starvation or highly toxic conditions by making cyclopropyl (7) or mid-chain branched fatty acids (20). The physiological status biomarkers for Toxic Stress and Starvation/Toxicity are formed by dividing the amount of the stress-induced fatty acid by the amount of it's biosynthetic precursor.

PLFA were analyzed by extraction of the total lipid (21) and then separation of the polar lipids by column chromatography (6). The polar lipid fatty acids were derivatized to fatty acid methyl esters, which were quantified using gas chromatography (15). Fatty acid structures were verified by chromatography/mass spectrometry and equivalent chain length analysis.

Results and Discussion

Phospholipid Fatty Acid Analysis

Biomass estimates, as determined by the total concentration of PLFA, were shown to be highest in sample MW-1D. Biomass concentrations varied between ~10^3 to ~10^6 cells/mL water.

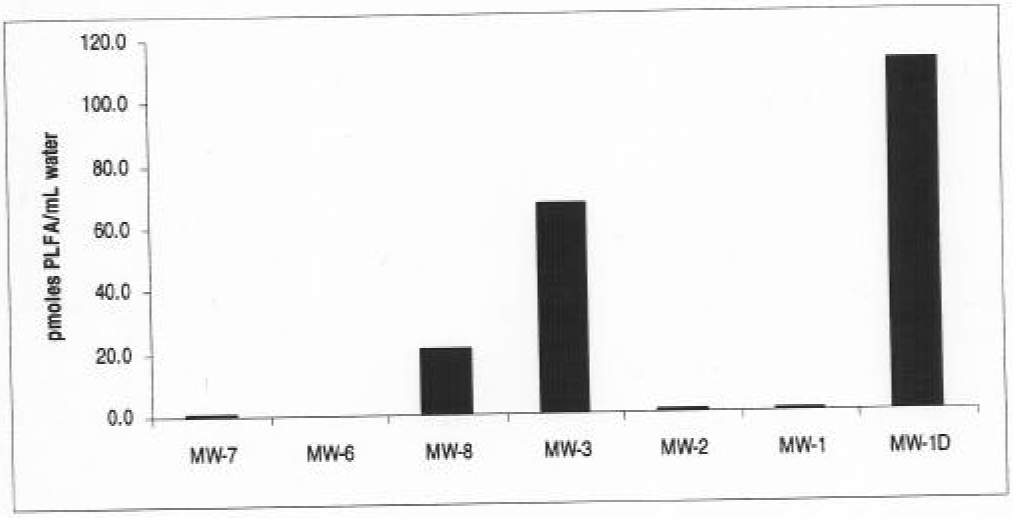

Figure 1. Biomass content is presented as the total amount of phospholipid fatty acids (PLFA) extracted from a given sample. Total biomass is calculated based upon PLFA attributed to both bacterial and eukaryotic biomass (characteristic of higher organisms).

PLFA profiles revealed that the complexity and composition of community structure varied with sampling location. Samples MW-2 and MW-1 contained simple community structures (few PLFA groups were detectable, Figure 2). MW-2 was composed primarily of monoenoic PLFA (characteristic of Proteobacteria), while MW-1 contained mostly normally saturated PLFA. Proteobacteria are of particular interest in contaminated sites in that they have the ability to utilize a wide range of carbon sources and adapt quickly to environmental changes. Normally saturated PLFA are common to both prokaryotic and eukaryotic organisms and therefore do not give much insight into the structure of the community. High proportions are usually indicative of a simple community structure.

The other samples submitted for analysis exhibited a fairly diverse community structure. Samples MW-8 and MW-3 had the most similar community structures. In comparison to the other samples, MW-3 and MW-1D contained high proportions of terminally branched saturated PLFA, which are primarily attributed to Firmicutes (*Clostridia*-like anaerobes). An increase can indicate the presence of anaerobes. Samples MW-6 and MW-1D contained high proportions of polyenoic PLFA, compared to the other samples, (characteristic of eukaryotic organisms). The biomarker 18:2ω6, indicative of fungi, was the most prevalent fatty acid in the polyenoic group.

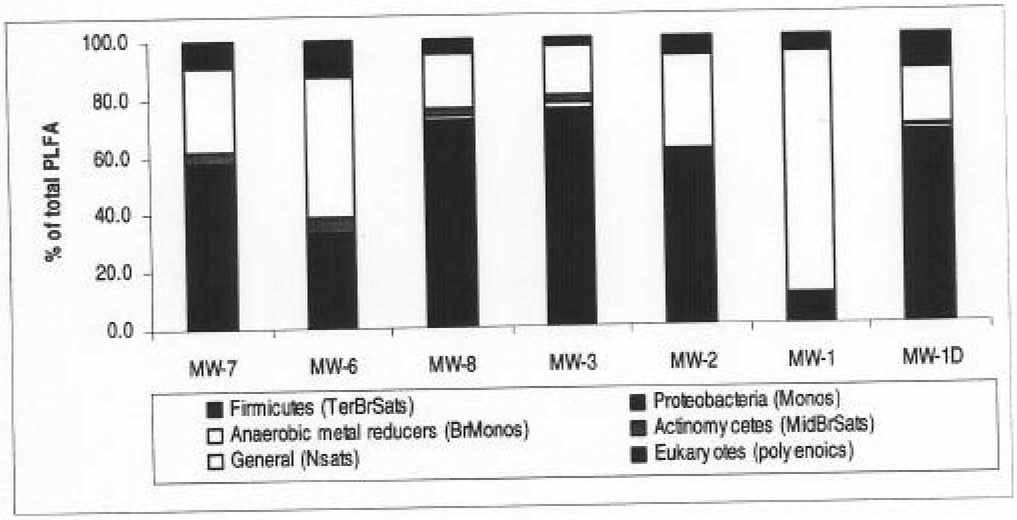

Figure 2. Relative percentages of total PLFA structural groups in the samples analyzed. Structural groups are assigned according to PLFA chemical structure, which is related to fatty acid biosynthesis. See Table 1 for detailed descriptions of structural groups. An "X" indicates samples with insufficient biomass for community structure to be determined.

Physiological status biomarkers indicated that only samples MW-6 and MW-1 were not starved or stressed. MW-2 and MW-1D were the most starved.

In the other samples showing signs of stress, the Group A bacteria contributed, almost exclusively, to the stress biomarker ratio. This indicated that the Group B bacteria were responding more favorably than the Group A bacteria to the specific environmental conditions at this site.

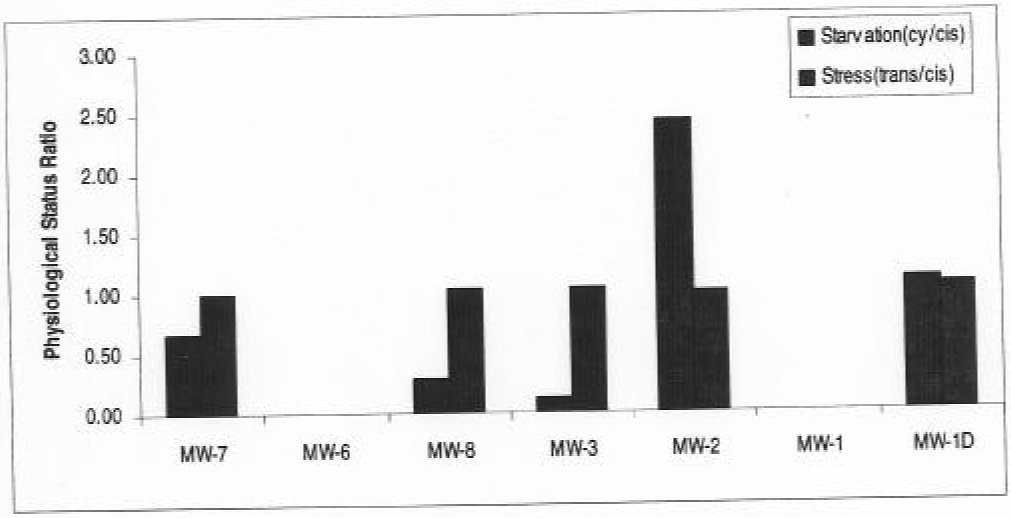

Figure 3. Microbial physiological stress markers. Starvation biomarker for the Gram-negative community is assessed by the ratio cyclopropyl fatty acids to their metabolic precursor. Adaptation of the Gram-negative community to toxic stress is determined by the ratio of ω7t/ω7c fatty

acids. Gram-negative bacteria generate *trans* fatty acids to minimize the permeability of their cellular membranes as an adaptation to a less favorable environment. Ratios (16:1ω7t/16:1ω7c and 18:1ω7t/18:1ω7c) greater than 0.1 have been shown to indicate an adaptation to a toxic or stressful environment, resulting in decreased membrane permeability. An "X" indicates samples with insufficient biomass for metabolic status markers to be determined.

Table 2. Values below are: viable microbial biomass expressed as picomoles of PLFA per mL of sample and as cells per mL of sample, fatty acid structural groups as percent of total PLFA, and physiological status biomarkers as mole ratio. "-" indicates data not available.

Samples		**Biomass**		**Community Structure (% of total PLFA)**						**Physiological Status**	
Sample Name	Sample Date	pmol/mL	cells/mL	Firmicutes (TerBrSats)	Proteobacteria (Monos)	Anaerobic metal reducers (BrMonos)	Actinomycetes/ SRB (MidBrSats)	General (Nsats)	Eukaryotes (polyenoics)	Starved cy/cis	Membrane Stress, trans/cis
MW-7	4/22/2003	0.4	8.81E+03	0.0	57.8	0.0	3.9	29.5	8.8	0.67	1.00
MW-6	4/22/2003	0.2	4.11E+03	0.0	33.0	0.0	5.9	48.5	12.6	0.00	0.00
MW-8	4/22/2003	21	4.23E+05	5.2	67.1	1.4	3.0	18.3	5.2	0.28	1.03
MW-3	4/22/2003	67	1.34E+06	10.6	64.9	2.1	3.2	16.5	2.7	0.12	1.03
MW-2	4/23/2003	0.3	6.46E+03	0.0	61.1	0.0	0.0	32.8	6.2	2.43	1.00
MW-1	4/23/2003	1	1.12E+04	0.0	10.1	0.0	0.0	84.3	5.6	0.00	0.00
MW-1D	4/23/2003	112	2.23E+06	13.6	53.3	1.3	0.7	19.3	11.8	1.10	1.06

References

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www.siremlab.com
130 Research Lane, Suite 2
Guelph, Ontario N1G 5G3
Phone: (519) 822-2265
Fax: (519) 822-3151

16 May 2003

SiREM Ref: TL0035

John Brussel
BBL Inc.
6723 Towpath Road
PO Box 66
Syracuse NY 13214-0066

Reference: Gene-Trac *Dehalococcoides* Assays - DT-0075
Invoice #813197

Dear Mr. Brussel:

This letter transmits the final test results for 7 samples submitted for *Dehalococcoides* testing. Invoice # 813197 in the amount of $2359.57 has been applied against your PO # BBL-PS-14099 for this work.

If you have any questions or concerns regarding the attached results or invoice, please contact me toll free by telephone at 1-866-251-1747 ext. 238, or by email at pdennis@siremlab.com.

We appreciate your business and look forward to serving you again in the future.

Sincerely,
SiREM Laboratory

Phil Dennis, M.A.Sc.
Director

/att.

SiREM
Site Recovery & Management

www.siremlab.com

130 Research Lane, Suite 2
Guelph, Ontario N1G 5G3
Phone: (519) 822-2265
Fax: (519) 822-3151

Test Results for Gene-Trac *Dehalococcoides* Assay

Client Name: BBL Inc.	**Test Reference Number:** DT-0075
Contact: John Brussel	**Report Issued:** 07-May-03
Site Location: HWD Farmingdale, NY	**Site Sampling:** 22-Apr-03, 23-Apr-03 **Sample(s) Received:** 28-Apr-03 **DNA Extraction:** 29-Apr-03
Telephone: (315) 446-9120	**Gel Image Number :** AG-0099a&b /DHC-UP-0038
E-mail: jcb@bbl-inc.com	**Positive Control (+ve control):** Assay with Cloned *Dehalococcoides* 16S rRNA gene
Fax:	**Negative Control (-ve control):** Assay with DNA extraction blank

Test Results:

Client Sample ID	SiREM ID	Non-*Dehalococcoides* Bacterial DNA	*Dehalococcoides* Test, Intensity (% of Positive Control)	Intensity Score	Test Result: *Dehalococcoides* DNA
MW-7	DHC-0404	Detected	0%	-	Not Detected
MW-6	DHC-0405	Detected	0%	-	Not Detected
MW-3	DHC-0406	*Not Tested	100%	+++	Detected (3 of 3 primer sets)
MW-8	DHC-0407	*Not Tested	52%	++	Detected (3 of 3 primer sets)
MW-2	DHC-0408	Detected	0%	-	Not Detected
MW-1	DHC-0409	Not Detected	0%	-	Not Detected
MW-1D	DHC-0410	Detected	0%	-	Not Detected
Not applicable	+ve control	Not applicable	100%	+++	Detected (3 of 3 primer sets)
Not applicable	-ve control	Not applicable	0%	-	Not Detected

* Universal bacterial primer test not performed where *Dehalococcoides* test is positive

The above results refer only to that portion of the sample tested with the Gene-Trac assay. The test is based on a polymerase chain reaction (PCR) test with three primer sets specific to DNA sequences in the 16S rRNA gene of *Dehalococcoides* organisms. A positive (+ to ++++) result indicates that genetic material (DNA) from a member of the *Dehalococcoides* group was detected. *Dehalococcoides* organisms are the only microorganisms proven to possess the necessary enzymes for the complete dechlorination of tetrachloroethene or trichloroethene to ethene. The presence of *Dehalococcoides* genetic material has been positively correlated to complete dechlorination of chlorinated ethenes at contaminated sites.

"Dehalococcoides Test Intensity" = quantitative assessment of electrophoresis band intensity of PCR product as a percentage of the corresponding positive control reaction. This value provides a semi-quantitative assessment of the amount of *Dehalococcoides* genetic material present in the sample. While band intensity might reflect actual concentration of the target organism, Gene-Trac is a semi-quantitative method and is only recommended to determine the presence or absence of *Dehalococcoides* genetic material in the sample.

"Intensity Score", categorizes PCR product quantity based on the "intensity (% of positive control)": ++++ = Very high band intensity (greater than 100% of positive control), +++ = high band intensity (67-100%), ++ moderate band intensity (34-66%) + = low band intensity (4-33%), -/+ = inconclusive (1-3%), - = no detectable band (0%)

Analyst: J. Mariani **Authorized by:** **Date:** May 15/03

Jaimee Mariani
Laboratory Technologist

Philip Dennis, M.A.Sc.,
Director, SiREM

Gene-Trac *Dehalococcoides* Case Narrative, Test DT-0075

Sample Condition:

SiREM received 7 – 2*1000 ml ground water samples from HWD Farmingdale, NY, on April 28, 2003. The samples arrived in a cooler with a measured temperature of 16°C and were stored at 4°C upon arrival in the laboratory. Each sample was vacuum filtered for the preparation of the genomic DNA.

Test Particulars:

Client Designation	SiREM Designation	*"Debris Description"	**Volume of Groundwater Utilized
MW-7	DHC-0404	No debris	900 mL
MW-6	DHC-0405	Light Brown Debris	900 mL
MW-3	DHC-0406	Red/Brown Debris	800 mL
MW-8	DHC-0407	Yellow/Brown Debris	900 mL
MW-2	DHC-0408	Yellow	900 mL
MW-1	DHC-0409	No debris	900 mL
MW-1D	DHC-0410	Brown Debris w/ Black Flecks	900 mL

Notes:

*"Debris" refers to solid material (including biomass) remaining after vacuum filtration of groundwater through a 0.45 μM filter

** Varying amounts of groundwater are utilized depending on the volume of debris collected, or the capacity of the filter prior to clogging, maximum is 1L.

Genomic DNA extraction was performed on the above noted samples on April 29, 2003. A PCR reaction using a universal bacterial primer was performed on all sample(s) not testing positive for *Dehalococcoides* DNA.

This test is used to determine if the samples contained PCR amplifiable bacterial DNA (other than that belonging to *Dehalococcoides* organisms) and is reported on the Test Certificate under "non-*Dehalococcoides* Bacterial DNA". This test confirmed that the DNA extraction from every sample except MW-1 was successful, which increases confidence that negative *Dehalococcoides* results are true negatives and not due to sampling biases. The negative result of sample MW-1 suggests that we were unable to extract PCR amplifiable bacterial DNA from this sample, most likely due to a lack of biomass.

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Site Recovery & Management

Chain-of-Custody Form

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www.siremlab.com

No. 0001

Page 1 of 1

Lab # S-0003

Project Name HWD Farmingdale
Project #
Project Manager John Brussel
Company BBL
Address Tow Path Rd
Syracuse NY
Phone # 315-446-2570
Fax # 315-446-2570
Sampler's Signature
Sampler's Printed Name Glenn Palmer

Analysis

Preservative 0

Preservative Key
0. None
1. HCL
2. Other
3. Other
4. Other
5. Other
6. Other

Client Sample ID	Lab ID	Sampling Date	Sampling Time	Matrix	# of Containers	Dehalococcoides Ethenogenes	Other Information
mw-7		4/22/03	1405	GW	2	X	
mw-6		↓	1459	↓	↓	↓	
mw-3		↓	1104	↓	↓	↓	
mw-8		↓	1025	↓	↓	↓	
mw-2		4/23/03	925	GW	2	X	
mw-1		↓	935	↓	↓	↓	
MW-1D		↓	1110	↓	↓	↓	

Sample Receipt
Cooler Condition:
Cooler Temperature:
Custody Seals: Yes ☐ No ☐

Invoice Information
P.O. #
Bill To:

For Lab Use Only
3 sample bottles broken in transit.

Relinquished By:	Received By:	Relinquished By:	Received By:	Relinquished By:	Received By:
Signature	Signature Rita Schofield	Signature	Signature	Signature	Signature
Printed Name	Printed Name Rita Schofield	Printed Name	Printed Name	Printed Name	Printed Name
Firm BBL	Firm Sirem Lab	Firm	Firm	Firm	Firm
Date/Time 4/22/03 1600	Date/Time April 28/03	Date/Time	Date/Time	Date/Time	Date/Time

Distribution: White - Return to Originator; Yellow - Lab Copy; Pink - Retained by Client

In the absence of an executed agreement, submission of samples to SiREM implies consent for performance of analyses specified on this Chain-of-Custody form and agreement with the terms and conditions of the SiREM Laboratory Services Agreement. The entity submitting samples shall be responsible for payment in full for said analyses.

Appendix E

Evaluation of Natural Attenuation

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Appendix E

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Feasibility Study Report
Evaluation of Natural Attenuation

1.0 Introduction

This appendix presents an evaluation of monitored natural attenuation (MNA) of chemicals of concern (COCs) in groundwater at the site. The purpose of this evaluation is to determine the feasibility of using MNA for site remediation, and to help assess what role MNA may play in groundwater remedial activities. Methods used to evaluate MNA in this section are consistent with appropriate United States Environmental Protection Agency (USEPA) technical guidance (USEPA, 1998) and USEPA's Office of Solid Waste and Emergency Response (OSWER) Directive 9200.4-17P (USEPA, 1999). The Directive states that MNA implementation depends on "…a variety of physical, chemical or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These in situ processes include biodegradation; dispersion; dilution; sorption; volatilization; radioactive decay; and chemical or biological stabilization, transformation or destruction of contaminants."

This evaluation is based on COC groundwater analytical results and certain MNA indicator parameters measured during a groundwater sampling event performed in April 2003. As discussed in detail below, these data support the general conclusion that dissolved COCs in groundwater are being naturally attenuated at some sampling locations due to a variety of processes including dispersion, dilution, hydrophobic sorption, and in-situ biodegradation. Based on this conclusion, MNA is feasible as a component of the site groundwater remedy and could be used to treat some portions of the residual dissolved-phase COC plume.

2.0 Technical Basis for MNA

This section discusses the technical basis for monitored natural attenuation (MNA) in groundwater at the site, and provides a general framework for evaluating site-specific data. This is important because chemical migration and attenuation in groundwater can be complicated due to the presence of heterogeneous flowpaths, non-aqueous phase liquids (NAPLs), and transient groundwater flow conditions. After the theoretical context in this section has been developed, site-specific data are reviewed in Section 3 in an effort to elucidate predominant transport mechanisms.

2.1 Groundwater Flow and Chemical Transport

The key transport and attenuation mechanisms for groundwater and chemical migration in saturated soils at the site include advection, hydrophobic sorption, hydrodynamic dispersion, dilution, and naturally occurring in-situ biodegradation (ISBIO). Hydrophobic sorption of COCs onto solid organic matter present in saturated soils may retard the migration rate of chemicals relative to the average linear groundwater velocity. Hydrodynamic dispersion and dilution may cause decreasing chemical concentrations in groundwater during transport. ISBIO is a biologically-mediated destructive process that decreases the total mass of chemicals in groundwater. Each of these transport and attenuation mechanisms is described in greater detail in the following sections.

2.2 Advection

Advective transport of chemicals in groundwater, or advection, refers to the transport of chemicals by the bulk movement of groundwater. In granular soils such as those found at the site, advection can be the most important process resulting in the downgradient migration of dissolved chemicals. Groundwater advection in saturated soils can be approximated by Darcy's Law as follows (Freeze and Cherry, 1979):

$$v = K\,I\,/\,n_e$$

where v is the average linear groundwater velocity, K is the horizontal hydraulic conductivity of the soil, I is the hydraulic gradient, and n_e is the effective porosity of the soil. Using this formula, an average hydraulic conductivity of 272 feet per day (ft/d), a hydraulic gradient of 0.004, and an assumed effective porosity of 0.3, the average linear groundwater velocity in saturated soils at the site is approximately 3.5 ft/d. Although this value seems high, it is characteristic of the glacial outwash sand and gravel deposits present beneath the site.

2.3 Hydrodynamic Dispersion and Dilution

Hydrodynamic dispersion is a combination of mechanical mixing and diffusion, and results in chemical plumes spreading laterally outward from the main direction of groundwater flow along a flowpath. Because groundwater flow in some porous media may exhibit a high degree of heterogeneity due to the natural variability of soil texture and structure, groundwater flowpaths can be tortuous resulting in mechanical mixing of COC-laden groundwater with unimpacted groundwater. Mechanical mixing during advective groundwater flow thus leads to lowering of COC concentrations with time and distance along a given flowpath. Chemical diffusion is considered negligible during advective transport in granular soils such as those present at the site. With time, chemical plumes in saturated soils will disperse longitudinally and laterally as different portions of the chemical mass are transported at different velocities.

Dilution of chemicals in groundwater can occur at the site due to the addition of water through recharge of infiltrating precipitation. Recharge from infiltrating precipitation is the result of a complex series of processes in the unsaturated zone that results in the downward transport of water, chemicals, and perhaps naturally occurring organic matter (NOM) to the water table. NOM in recharging groundwater may be very important for supporting natural ISBIO of site COCs, which is described in Section 2.5. Although much of the area near the site is relatively impermeable due to the presence of asphalt, concrete, and buildings, some infiltration of precipitation and resulting dilution of chemical plumes is likely to occur. Furthermore, the recharge basin located approximately 80 feet north-northeast of the site is a likely source of groundwater recharge in the area and probably results in some dilution of chemical plumes in groundwater near the site.

2.4 Hydrophobic Sorption and COC Retardation

Hydrophobic sorption refers to the chemical transport process whereby nonpolar, hydrophobic chemicals such as chlorinated solvents dissolved in groundwater partition preferentially to solid organic matter present within soils. The quantity of chemicals that can partition to solid organic matter is directly proportional to the amount of solid organic matter. The result of this process is that some quantity of the chemical mass is removed from groundwater during transport, and the rate of COC migration in groundwater can be less than the average linear groundwater velocity. Hydrophobic sorption is therefore an attenuation process which results in the COC plume velocity being retarded relative to the average linear groundwater velocity.

To more accurately evaluate the role that hydrophobic sorption may play in retarding the COC plume migration rate relative to the average linear groundwater velocity in site soils, COC-specific retardation factors were estimated based on the following equation (Freeze and Cherry, 1979):

$$R_c = \rho_b \, x \, K_{oc} \, x \, f_{oc} \, / \, n$$

where R_c is the hydrophobic-based retardation factor for a specific chemical (c), ρ_b is the bulk density of the soil, K_{oc} is the chemical-specific organic carbon partition coefficient, f_{oc} is the fraction of solid organic carbon in the soil, and n is the soil porosity. The following table calculates site-specific retardation factors for the site COCs and their intermediate byproducts based on this equation:

Site COC	K_{oc}	R_c
Tetrachloroethene	363	4.3
Trichloroethene	104	1.9
Cis-1,2-Dichloroethene	50	1.5
Vinyl chloride	29.5	1.3
1,1,1-Trichloroethane	179	2.6
1,1-Dichloroethane	40	1.4
1,1-Dichloroethene	343	4.1

Note: Calculations based on a soil bulk density of 99 pounds per cubic foot (assumed) and fraction of organic carbon of 0.0017 (average of site measurements for soils sampled between 4 and 14 feet below the ground; n=18). K_{oc} values are Syracuse Research Corporation (SRC) recommended values based on their Chemfate database, which may be found at http://esc.syrres.com/efdb/Chemfate.htm. R_c values calculated according to above equation.

As shown, site-specific COC retardation factors ranged from about 1.3 for vinyl chloride (little retardation) to 4.3 for PCE (moderate retardation). This information indicates that hydrophobic-based retardation of COCs in saturated site soils may account for some of the observed COC plume attenuation.

2.5 In-Situ Biodegradation

In-situ biodegradation (ISBIO) is a naturally occurring, biologically mediated destructive process that decreases chemical mass in groundwater with time and distance. To carry out their life functions, naturally occurring microorganisms require electron donors (organic carbon), electron acceptors, water, mineral nutrients, and appropriate environmental conditions (e.g., pressure, temperature, pH). Natural ISBIO is the process by which organic chemicals are degraded or transformed by naturally occurring microorganisms through the use of an organic chemical as a carbon source or electron acceptor. By evaluating the biogeochemistry of groundwater at contaminated sites, it is possible to demonstrate that biodegradation is occurring and to determine which biogeochemical reactions are predominant.

Organic chemicals can be biodegraded in-situ in groundwater by means of naturally occurring aerobic and anaerobic microorganisms that oxidize organic compounds. Aerobic oxidation of organic chemicals requires the presence of molecular oxygen (O_2) as an electron acceptor, as well as appropriate microorganisms, nutrients (e.g., phosphorus, potassium, and nitrogen), and environmental conditions (e.g., circumneutral pH conditions and adequate temperature). Anaerobic oxidation of organic chemicals can occur via oxidation-reduction (redox) processes including nitrate reduction, iron reduction, sulfate reduction, and methanogenesis, and requires the presence of an alternate electron acceptor such as nitrate, ferric iron, sulfate, and/or carbon dioxide, as well as the presence of appropriate microorganisms, nutrients, and environmental conditions. These processes are described in greater detail below.

Most of the site COCs can be naturally biodegraded in groundwater by means of sequential decay reactions in which secondary COCs are produced as intermediate byproducts. These intermediate byproducts can undergo further biodegradation reactions until final byproducts are produced. A classic example of a sequential decay reaction that is well documented at hazardous waste sites is *reductive dechlorination* of chlorinated ethenes (Vogel et al., 1987):

$$\mathrm{PCE} \rightarrow \mathrm{TCE} \rightarrow \mathrm{DCE} \rightarrow \mathrm{VC} \rightarrow \mathrm{Ethene} + CO_2 + Cl^-$$

In reductive dechlorination of PCE, certain microorganisms utilize chloride ions as electron acceptors, and strip them from ethene molecules in a stepwise process resulting in the formation of lesser-chlorinated molecules as intermediate byproducts until finally only ethene molecules and chloride ions are remaining. This reaction requires appropriate microorganisms to be present, reducing geochemical conditions, and a sufficient supply of organic carbon and nutrients. In addition, the intermediate byproducts DCE, VC, and ethene can be further degraded by oxidative processes (requiring oxygen) resulting in the formation of carbon dioxide and chloride ions as final byproducts:

$$\mathrm{DCE} + O_2 \rightarrow CO_2 + Cl^-$$

$$\mathrm{VC} + O_2 \rightarrow CO_2 + Cl^-$$

$$\mathrm{Ethene} + O_2 \rightarrow CO_2 + Cl^-$$

These chemical equations are presented here for illustrative purposes and to provide a framework for evaluating the site natural attenuation data which included analysis of many of the reactants, intermediates, and final byproducts of these and other reactions.

The general approach to evaluating groundwater data for ISBIO assessments typically involves comparing analytical results for COCs and select biogeochemical indicator parameters from groundwater samples collected within the COC plume with background groundwater samples collected hydraulically upgradient from the source area. This is known as the "background comparison approach." Changes in concentrations of COCs and biogeochemical parameters between background groundwater and plume groundwater can provide insights into the predominant biogeochemical processes that are occurring in the vicinity of the sampling points. Biogeochemical indicator parameters include electron acceptors such as nitrate, sulfate, solid forms of iron; electron donors such as total and dissolved carbon; nutrients such as nitrogen and phosphorus; and degradation byproducts such as carbon dioxide, ethene, ethane, and methane. Parameter selection is typically based on the biologic principle that microorganisms consume electron acceptors, organic carbon, and nutrients, and generate byproducts while metabolizing organic pollutants (Chappelle, 1993). ISBIO indicator parameters are discussed in greater detail in the following subsections.

Environmental Conditions

Environmental conditions of groundwater that affect microbial growth and ISBIO include groundwater pH, temperature, alkalinity, and oxidation reduction potential (ORP). Circumneutral pH values (i.e., $6 < \mathrm{pH} < 8$) indicate favorable pH conditions for microbiologic growth and biodegradation. Alkalinity can buffer organic acids that may be generated during some biogeochemical reactions, and well-buffered groundwater is therefore favorable for microbial growth and biodegradation. An optimal groundwater temperature range for microbial growth is generally between about 10°C and 30°C. ORP values provide a gross measure of whether groundwater conditions are generally oxidizing or reducing. Reducing geochemical conditions are favorable for anaerobic oxidation and reductive dechlorination of site-specific COCs.

Electron Acceptors

Microorganisms require the presence of electron acceptors during metabolic reactions involving ISBIO of site-related COCs. Naturally occurring electron acceptors typically monitored in groundwater include dissolved oxygen (DO), nitrate, nitrite, ferric iron, sulfate, and carbon dioxide. Each of these electron acceptors is associated with a different oxidation reduction (redox) process known to degrade organic pollutants, as follows.

- Aerobic degradation is a biologically mediated redox reaction in which aerobic microorganisms use oxygen as an electron acceptor, oxidize organic compounds, and produce carbon dioxide and other inorganic compounds as byproducts.
- Denitrification is an anaerobic redox reaction in which denitrifying microorganisms use nitrate and nitrite as electron acceptors, oxidize organic carbon compounds, and produce carbon dioxide, ammonia, and other inorganic compounds as byproducts.
- Iron reduction is an anaerobic redox reaction in which iron reducing microorganisms use ferric iron (Fe^{3+}) as an electron acceptor, oxidize organic carbon compounds, and produce carbon dioxide, ferrous iron (Fe^{2+}), and other inorganic compounds as byproducts.
- Sulfate reduction is an anaerobic redox reaction in which sulfate reducing microorganisms use sulfate as an electron acceptor, oxidize organic carbon compounds, and produce carbon dioxide, sulfides, and other inorganic compounds as byproducts.
- Methanogenesis is an anaerobic redox reaction in which methanogenic bacteria use carbon dioxide as an electron acceptor, ferment organic compounds, and produce carbon dioxide, methane, and other inorganic compounds as byproducts.

Each of these redox reactions requires certain electron acceptors. Electron acceptor availability and usage can be evaluated by comparing on-site concentrations with background groundwater conditions.

Electron Donors

Organic carbon is required for microbiologic growth and ISBIO of site COCs. For reductive dechlorination of chlorinated solvents to occur, alternative carbon sources such as NOM or anthropegenically-introduced organic carbon (e.g., petroleum chemicals) are required. Sources of organic carbon in site groundwater can be indicated by detectable concentrations of Soluble Organic Carbon (SOC) and other organic chemicals. SOC concentrations of 20 mg/L or greater are considered optimal for dechlorination processes (Wiedemeier, 1998). In addition to these geochemical indicators, some intermediate breakdown products such as ethane and ethene can also serve as alternative organic carbon sources for reductive dechlorination reactions.

Nutrients

Nitrogen and phosphorus are macronutrients required by microorganisms for cell growth and maintenance. The availability of these nutrients can be evaluated along with naturally occurring carbon sources to determine whether sufficient quantities of macronutrients are available to support ISBIO of site COCs. Deficiencies of these macronutrients can limit microbiological growth and ISBIO.

2.6 Summary

There are several naturally occurring fate and transport processes that potentially contribute to naturally attenuating peak concentrations of COCs in site groundwater, including hydrophobic sorption, hydrodynamic dispersion, dilution, and natural ISBIO. These fate and transport processes provide a general framework against which site-specific data may be compared in an effort to assess the relative importance of each process.

3.0 Evaluation of In-Situ Biodegradation

This section evaluates the nature and extent of naturally occurring ISBIO of COCs in groundwater beneath the site, and what roles natural ISBIO may play in the overall groundwater remedy for the site. It includes descriptions of the types of data used to evaluate ISBIO, VOC concentration trends with time and distance, site geochemical conditions, and site microbiological conditions.

3.1 Data Types and Quantities

Groundwater samples were collected at select site monitoring wells and analyzed for Target Compound List (TCL) VOCs and ISBIO indicator parameters during the April 2003 sampling event. Groundwater monitoring wells sampled in support of this evaluation include MW-1, MW-1D, MW-2, MW-3, MW-6, MW-7, and MW-8. VOCs identified during this sampling event are listed in Table 1. ISBIO indicator parameters analyzed for during this sampling event are listed in Table 2, and generally include indicators of environmental conditions (e.g., pH, temperature, oxidation-reduction potential [ORP]) and concentrations of key electron acceptors, electron donors, and metabolic byproducts of biologically-mediated redox reactions associated with in-situ reductive dehclorination reactions. These data constitute the primary data set utilized to evaluate ISBIO conditions at the site.

To facilitate evaluation of the ISBIO data, a conceptual groundwater flowpath was identified for the shallow groundwater zone. This flowpath originates in an area hydraulically upgradient from the site, extends through the probable source location, and terminates in an area hydraulically downgradient from the probable source location. Use of this conceptual flowpath can show changes in VOC and ISBIO indicator parameter concentrations with distance along the flowpath. The premise of this method is that biogeochemical changes in groundwater associated with ISBIO will manifest themselves as measurable changes in the indicator parameters along a flowpath. This is commonly called the "background comparison approach." Although groundwater flow can be complex and heterogeneous, the background comparison approach can be appropriate in such settings. The shallow groundwater flowpath consists of the following groundwater monitoring wells:

- MW-1 (background);
- MW-2 (probable source area);
- MW-7 (probable source area); and
- MW-8 (downgradient location).

3.2 VOC Concentration Trends

Concentration trends of VOCs in groundwater samples collected at site monitoring wells with time and distance were evaluated for evidence of ISBIO and other natural attenuation processes (e.g., dilution). COC concentration trends with time and distance can also be used to evaluate plume stability, which is a suggested component of natural attenuation evaluations based on regulatory guidance documents (USEPA, 1998).

3.2.1 VOC Concentration Trends with Time

Figure 1 shows current and historical groundwater VOC concentrations measured at site monitoring wells in February 1990, January 2000, February 2001, and April 2003. As shown, since 1990 PCE concentrations have increased with time in groundwater sampled at monitoring wells MW-1, MW-2, MW-6, and MW-7, and decreased with time in groundwater sampled at monitoring well MW-3. Also as shown on Figure 1, since 1990 TCE concentrations have decreased with time in groundwater sampled at monitoring wells MW-1, MW-2, and MW-3, and increased with time at monitoring well MW-7. The data also show that since 1990 1,2-DCE concentrations have decreased with time in groundwater sampled at monitoring wells MW-2 and MW-3, and increased with time at monitoring well MW-7.

The presence of 1,2-DCE, which is an intermediate byproduct of ISBIO of PCE and TCE, can be considered evidence that ISBIO is naturally occurring in groundwater at some locations of the site. However, the VOC concentration trends with time are inconclusive regarding the stability of the VOC groundwater plume.

3.2.2 VOC Concentration Trends with Distance

Figure 1 shows the distribution of VOCs detected in groundwater with distance at the site, and Figure 2 illustrates concentrations of select VOCs measured at monitoring wells along the shallow groundwater flowpath described above during the April 2003 sampling event. As shown, detectable concentrations of PCE and TCE were present in recent and historic background groundwater samples collected at hydraulically upgradient monitoring well MW-1. The highest VOC concentrations generally have been detected in groundwater sampled at monitoring well MW-7. VOC concentrations in groundwater appears to decrease between monitoring wells MW-7 and MW-2. It is notable that the relative concentrations of VOCs do not appear to change significantly with distance, indicating that dispersion and dilution are contributing to the attenuation of peak VOC concentrations with distance.

3.3 Geochemical Conditions

The April 2003 groundwater monitoring data were used to evaluate geochemical conditions at the site (Table 2). General geochemical conditions are discussed first, followed by the implications of site geochemistry on naturally occurring ISBIO.

3.3.1 General

Generic indicators of geochemical conditions in site groundwater include groundwater pH, temperature, and oxidation-reduction potential (ORP). As shown in Table 2, groundwater pH ranged from about 6.0 to 7.8 standard units at all wells sampled during the April 2003 sampling event. This pH range is considered to be optimal for ISBIO reactions to occur. Furthermore, site groundwater appeared to be moderately to well buffered in April 2003, as indicated by alkalinity measurements that ranged from about 29 to 200 mg/L (Table 2). Groundwater temperatures ranged from about 11°C to 15°C during the April 2003 sampling event (Table 2), indicating that the groundwater temperature at the site was adequate for ISBIO at the time of sampling.

Groundwater ORP ranged from -121 to 157 millivolts (mV) at wells sampled during the April 2003 sampling event (Table 2). As shown, the lowest ORP measurements (indicated by negative values) were recorded at monitoring wells MW-3 and MW-8, which indicates that groundwater near these sampling conditions was under strongly reducing conditions at the time of sampling. This observation is supported in part by the dissolved oxygen (DO) measurement recorded at monitoring well MW-3 which was less than 1.0 mg/L (Table 2). The elevated DO measurement recorded at monitoring well MW-8 (3.5 mg/L) may be a false positive result due to the ample opportunities for atmospheric oxygen to be introduced into the sample during field sampling and analytical procedures. At best, the DO measurement recorded at MW-8 in April 2003 is inconclusive regarding geochemical conditions in groundwater at this location. Based on this information, there appears to be at least one and possibly two geochemically reducing zones in shallow groundwater near the site, located near monitoring well MW-3 and possibly MW-8, that were conducive to reductive dechlorination ISBIO reactions at the time of sampling.

3.3.2 Implications for Natural ISBIO

The groundwater monitoring data were also used to evaluate the implications of site geochemical conditions for naturally occurring ISBIO of site COCs. This was accomplished by reviewing the site data for indicator parameters of electron acceptor availability, electron donor availability, nutrient availability, and the presence of metabolic byproducts.

Electron Acceptor Availability

Naturally occurring microorganisms known to participate in reductive dechlorination and ISBIO reactions require an adequate supply of electron acceptors such as nitrate, sulfate, and carbon dioxide to carry out their life functions. Electron acceptor availability was evaluated at the site by plotting measured indicator parameters with distance along the shallow groundwater flowpath discussed above (Figures 3 through 5). The basic premise of this approach is that naturally occurring ISBIO reactions consume electron acceptors while COCs are being degraded, and that these reactions result in measurable and observable patterns along groundwater flowpaths.

For example, nitrate is the electron acceptor associated with denitrification, which is an important redox process that destroys organic matter in groundwater and causes reducing geochemical conditions. Therefore, concentrations of nitrate measured in site samples can be used to indicate the presence and magnitude of denitrification. Nitrate concentrations measured along the shallow groundwater flowpath in April 2003 are shown on Figure 3. As shown, nitrate concentrations ranged from 8.6 to 17 mg/l. The highest nitrate concentration observed along the flowpath was detected in groundwater sampled at background monitoring well MW-1 and the lowest nitrate concentration was detected at downgradient monitoring well MW-8. These data suggest that nitrate was available as an electron acceptor in groundwater hydraulically upgradient from the site, and that nitrate was being consumed at some locations along the shallow groundwater flowpath at the time of sampling. This information indicates that denitrification likely was occurring in groundwater near monitoring wells MW-2 and MW-7. The non-detect nitrate concentration measured in groundwater sampled at monitoring well MW-3 (Table 2) indicates that nitrate was almost fully depleted at this sampling location.

Nitrite concentrations can also be used to indicate the presence, absence, and magnitude of dentrification in groundwater at some sites. However, nitrite concentrations were non-detect at all sampling locations in April 2003 and, therefore, the data are inconclusive.

Sulfate is the electron acceptor associated with sulfate reduction, which is an important redox process that may be associated with reductive dechlorination and ISBIO of chlorinated solvents in groundwater. Concentrations of sulfate measured in site samples can therefore be used to indicate the presence and magnitude of sulfate reduction. Sulfate concentrations measured along the shallow groundwater flowpath in April 2003 are shown on Figure 4. As shown, sulfate concentrations ranged from about 19 mg/l to 30 mg/l along this flowpath. The lowest sulfate concentration observed along the flowpath was detected at monitoring well MW-2 and the highest sulfate concentration was detected at monitoring well MW-7. These data suggest that sulfate was available as an electron acceptor in groundwater hydraulically upgradient from the site, and that sulfate was being consumed at some locations along the shallow groundwater flowpath at the time of sampling. This information indicates that sulfate reduction likely was occurring in groundwater near monitoring well MW-2. The low sulfate concentration measured in groundwater sampled at monitoring well MW-3 (5.2 mg/L; Table 2) indicates that sulfate was depleted (compared with background) at this sampling location.

Carbon dioxide is the electron acceptor associated with methanogenesis, which is an important redox process associated with reductive dechlorination and ISBIO of chlorinated solvents in groundwater. Concentrations of carbon dioxide measured in site samples can therefore be used to indicate the presence and magnitude of methanogenesis. Carbon dioxide concentrations along flowpath A-A' are shown on Figure 5. As shown, carbon dioxide concentrations ranged from about 26 to 76 mg/L along this flowpath. The lowest carbon dioxide concentration observed along the flowpath was detected at monitoring well MW-2 and the highest carbon dioxide concentrations were detected at monitoring wells MW-1 (background) and MW-8 (hydraulically downgradient). This information suggests that carbon dioxide was available as an electron acceptor in groundwater hydraulically upgradient from the site at the time of sampling. The elevated carbon dioxide concentration detected in groundwater sampled at monitoring well MW-3 (71 mg/L; Table 2) is inconclusive with regard to the presence and magnitude of methanogenesis in groundwater at this sampling location, and is more thoroughly discussed below.

Electron Donor Availability

Naturally occurring microorganisms known to participate in reductive dechlorination and ISBIO reactions require an adequate supply of electron donors such as naturally-occurring organic matter (NOM) to carry out their life functions. Anthropogenically introduced sources of organic carbon, such as petroleum chemicals, can also serve as electron donors during reductive dechlorination and ISBIO of chlorinated solvents in groundwater. Electron donor availability was evaluated at the site by measuring concentrations of soluble organic carbon in site samples (Table 2). Similar to electron acceptors, the basic premise of this approach is that naturally occurring ISBIO reactions consume electron donors while COCs are being degraded, and this results in measurable and observable patterns along groundwater flowpaths.

As shown in Table 2, concentrations of soluble organic carbon measured in site groundwater samples during the April 2003 sampling event were non-detect at all locations sampled. This information indicates that a suitable supply of electron donors was not available in hydraulically upgradient groundwater at the time of sampling, and that a lack of biologically available organic carbon in site groundwater may be an ISBIO rate-limiting factor.

As mentioned above, in addition to NOM, petroleum chemicals can also serve as electron donors during reductive dechlorination reactions. The April 2003 analytical results plotted on Figure 1 suggest that low levels (i.e., less than 1 mg/L) of petroleum chemicals such as benzene, toluene, ethylbenzene, and xylene isomers were detected in groundwater sampled at monitoring well MW-3. This information suggests that a limited quantity of electron donors may have been available for reductive dechlorination and ISBIO of chlorinated solvents in groundwater near the MW-3 sampling location in April 2003.

Nutrient Availability

Naturally occurring microorganisms known to participate in reductive dechlorination and ISBIO reactions also require an adequate supply of macronutrients such as nitrogen and phosphorus to carry out their life functions. Anthropogenically introduced sources of nutrients, such as fertilizers, can also serve as macronutrients during reductive dechlorination and ISBIO of chlorinated solvents in groundwater. Nutrient availability was evaluated at the site by measuring concentrations of ammonia and nitrate to indicate the potential availability of nitrogen, and concentrations of phosphate to indicate the potential availability of phosphorus.

As shown in Table 2, concentrations of nitrate measured in site groundwater samples during the April 2003 sampling event ranged from non-detect to 17 mg/L. This data shows that a suitable supply of nitrogen was available at some sampling locations at the time of sampling. However, nitrogen was depleted at other sampling locations (i.e., MW-3). Furthermore, phosphate concentrations were everywhere non-detect above the method detection limit of 0.1 mg/L. This information suggests that a lack of biologically available macronutrients, particularly nitrogen and phosphorus, in site groundwater may be an ISBIO rate-limiting factor.

ISBIO Metabolic Byproducts

In addition to serving as an electron acceptor, carbon dioxide is also a metabolic byproduct of a variety of ISBIO reactions, including aerobic respiration, denitrification, iron reduction, sulfate reduction, and methanogenesis. Therefore, carbon dioxide concentrations can be a good generic indicator for the presence and magnitude of ISBIO reactions in groundwater. Carbon dioxide concentrations along flowpath A-A' are shown on Figure 5. As shown, the highest carbon dioxide concentration observed along the flowpath (38 mg/L) was detected at hydraulically downgradient monitoring well MW-8. This information confirms the presence of ISBIO in site groundwater near monitoring well MW-8 at the time of sampling. The elevated carbon dioxide concentration detected in groundwater sampled at monitoring well MW-3 (71 mg/L; Table 2) confirms the presence of ISBIO in site groundwater near monitoring well MW-3 at the time of sampling.

Ammonia is a metabolic byproduct associated with denitrification, which was discussed above. Concentrations of ammonia measured in site samples can therefore also be used to indicate the presence and magnitude of denitrification. As shown in Table 2, concentrations of ammonia measured in site groundwater samples during the April 2003 sampling event ranged from non-detect to 5.2 mg/L. The lowest ammonia concentrations observed in site groundwater samples were at monitoring wells MW-1, MW-2, and MW-8, and the highest ammonia concentration was detected at monitoring well MW-7. These data suggest that ammonia was being produced as a metabolic byproduct in site groundwater at the time of sampling. This information indicates that denitrification likely was occurring in groundwater near monitoring wells MW-3, MW-6, and MW-7 in April 2003.

Dissolved iron is a metabolic byproduct associated with iron reduction, which is an important redox process associated with reductive dechlorination and ISBIO of chlorinated solvents in groundwater. Concentrations of dissolved iron measured in site samples can therefore be used to indicate the presence and magnitude of iron reduction. Dissolved iron concentrations measured along the shallow groundwater flowpath in April 2003 are shown on Figure 6. As shown, dissolved iron concentrations ranged from non-detect to about 21 mg/l along this flowpath. The lowest dissolved iron concentrations observed along the flowpath were at monitoring wells MW-1, MW-2, and MW-7, and the highest dissolved iron concentration was detected at monitoring well MW-8. These data indicate that dissolved iron was being produced as a metabolic byproduct in groundwater hydraulically downgradient from the site at the time of sampling. This information indicates that iron reduction likely was occurring in groundwater near monitoring well MW-8 in April 2003. The elevated dissolved iron concentration measured in groundwater sampled at monitoring well MW-3 (21 mg/L; Table 2) indicates that iron reduction also was occurring at this sampling location.

Sulfide is a metabolic byproduct associated with sulfate reduction, which is an important redox process discussed above. Concentrations of sulfide measured in site samples can therefore be used to indicate the presence and magnitude of sulfate reduction in some cases. Sulfide concentrations were non-detect at all sampling locations (Table 2). Because sulfide can participate in a variety of geochemical reactions, the site data are inconclusive with regard to the presence, absence, and magnitude of sulfate reduction.

Methane is a metabolic byproduct associated with methanogenesis, which is an important redox process associated with reductive dechlorination and ISBIO of chlorinated solvents in groundwater as discussed above. Concentrations of methane measured in site samples can therefore be used to indicate the presence and magnitude of methanogenesis. Methane concentrations measured along the shallow groundwater flowpath in April 2003 are shown on Figure 7. As shown, methane concentrations ranged from about 0.001 to 0.16 mg/l along this flowpath. The lowest methane concentration observed along the flowpath was detected at monitoring well MW-7, and the highest methane concentration was detected at monitoring well MW-8. These data indicate that methane was being produced as a metabolic byproduct in groundwater hydraulically downgradient from the site at the time of sampling. This information indicates that methanogenesis likely was occurring in groundwater near monitoring well MW-8 in April 2003. The elevated methane concentration measured in groundwater sampled at monitoring well MW-3 (~0.8 mg/L; Table 2) indicates that methanogenesis also was occurring at this sampling location.

Ethane is one of the final byproducts of reductive dechlorination of some chlorinated solvents in groundwater, and therefore concentrations of ethane measured in site samples can be used to verify the presence of complete reductive dechlorination reactions. Ethane concentrations measured along the shallow groundwater flowpath in April 2003 are shown on Figure 8. As shown, ethane concentrations ranged from about 0.006 to 8 micrograms per liter (ug/L) along this flowpath. The lowest ethane concentration observed along the flowpath was detected at monitoring well MW-7, and the highest ethane concentration was detected at monitoring well MW-8. These data indicate that ethane was being produced as a metabolic byproduct in groundwater hydraulically downgradient from the site at the time of sampling. This information indicates that reductive dechlorination was occurring in groundwater near monitoring well MW-8 in April 2003. The elevated ethane concentration measured in groundwater sampled at monitoring well MW-3 (~0.4 ug/L; Table 2) indicates that reductive dechlorination also was occurring at this sampling location.

Ethene is also a final byproduct of reductive dechlorination of some chlorinated solvents in groundwater, and therefore concentrations of ethene measured in site samples can be used to verify the presence of complete reductive dechlorination reactions. As shown in Table 2, concentrations of ethene measured in site groundwater samples during the April 2003 sampling event ranged from about 0.008 to 0.34 ug/L. The lowest ethene concentrations observed in site groundwater samples were detected at monitoring wells MW-6 and MW-7, and the highest ethene concentrations were detected at monitoring wells MW-3 and MW-8. These data indicate that ethene was being produced as a metabolic byproduct in groundwater hydraulically downgradient from the site at the time of sampling. This information indicates that reductive dechlorination was occurring in groundwater near monitoring wells MW-3 and MW-8 in April 2003.

Chloride concentrations can be used to indicate the presence and magnitude of ISBIO of chlorinated solvents in groundwater because chloride is final byproduct of most naturally occurring and enhanced ISBIO reactions involving chlorinated solvents. In other words, chloride concentrations can be a good, generic indicator of the extent of ISBIO of chlorinated solvents at some sites. Chloride concentrations measured along the shallow groundwater flowpath in April 2003 are shown on Figure 9. As shown, chloride concentrations ranged from about 15 to 35 mg/L. The lowest chloride concentration observed along the flowpath was detected at monitoring well MW-8 and the highest chloride concentration was detected at monitoring well MW-2. These data indicate that chloride was being produced along the shallow groundwater flowpath at the time of sampling, and that ISBIO of chlorinated solvents likely was occurring in groundwater near monitoring well MW-2 at the time of sampling. Chloride concentrations measured in groundwater at other downgradient monitoring wells such as MW-3 and MW-8 are inconclusive due to the low resolution of the analytical method.

3.4 Microbiological Conditions

The presence, type, and metabolic status of indigenous microorganisms in the subsurface beneath the site were evaluated by analyzing groundwater samples collected at monitoring wells located upgradient, near the middle, and downgradient of the site for concentrations of phospholipid fatty acids (PLFAs) during the April 2003 sampling event. Phospholipids are part of intact cell membranes and, therefore, identification and quantification of PLFAs in groundwater samples can provide information regarding the in-situ biomass, community structure, and metabolic status of indigenous microbial populations.

The PLFA data indicate that the in-situ biomass of site groundwater samples ranged from about 10^3 to 10^6 cells per milliliter (cells/mL) during the April 2003 sampling event (Table 2). As shown, the maximum biomass concentrations were detected at monitoring wells MW-1D, MW-3, and MW-8. The PLFA data also indicate that groundwater samples collected at monitoring wells MW-1D, MW-3, and MW-8 contained relatively high proportions of terminally branched saturated PLFAs, which indicate the presence of anaerobic microorganisms, and branched monoenoic PLFAs which indicate the presence of metal-reducing microorganisms such as sulfate- and iron-reducing bacteria. These trends correlate well with the presence of increased concentrations of metabolic byproducts (i.e., carbon dioxide, methane, ethane, and ethene) at the MW-3 and MW-8 sampling locations, as well as the presence of petroleum chemicals in the sample collected at monitoring well MW-3. On balance, the PLFA and biogeochemical data suggest that indigenous groundwater microorganisms at some locations beneath the site have adapted to the presence of dissolved petroleum chemicals and chlorinated solvents and are able to incorporate these substances into their metabolic processes.

Groundwater samples were also analyzed for the presence of a specific microorganism known to reductively dechlorinate chlorinated solvents, namely *Dehalococcoides Ethenogenes*. *D. Ethenogenes* is the only microorganisms species isolated to date capable of complete reductive dechlorination of PCE, TCE, DCE isomers, and vinyl chloride, and therefore confirming its presence in groundwater can be used to verify that reductive dechlorination reactions are in fact causing the geochemical changes noted above. As shown in Table 2, detectable concentrations of *D. Ethenogenes* were measured in groundwater samples collected at monitoring wells MW-3 and MW-8, which confirms that appropriate types of microorganisms were present at these sampling locations to support complete ISBIO or enhanced ISBIO of COCs in groundwater. Although *D. Ethenogenes* was not detected above the method detection limit in samples collected at the remainder of the monitoring wells sampled, it is important to remember that non-detect microbiologic measurements do not indicate that microorganisms are not present in a sample, only that the microorganisms were not present above the method detection limit.

3.5 Summary

Based on the above discussion, there is ample evidence that ISBIO and complete reductive dechlorination of chlorinated solvents was occurring in shallow groundwater near the downgradient portion of the site-related COC plume during the April 2003 sampling event, specifically near the MW-3 and MW-8 sampling locations. This conclusion is supported by the groundwater analytical data, which demonstrate that a population of anaerobic microorganisms, including *D. Ethenogenes*, was present in the subsurface capable of complete reductive dechlorination of dissolved chlorinated solvents. The data indicate that a lack of organic carbon and macronutrients such as nitrogen and phosphorus may be limiting the rate of naturally occurring ISBIO reactions at some areas of the site.

4.0 Conclusions

This evaluation of natural attenuation has yielded the following conclusions:

- The key transport and attenuation mechanisms for COC migration in groundwater at the site include advection, hydrodynamic dispersion, dilution, hydrophobic sorption, and naturally occurring ISBIO.
- Dispersion and dilution are expected to result in attenuation of peak COC concentrations in site groundwater.
- The COC plume migration rate is likely retarded compared with the average linear groundwater velocity due to hydrophobic sorption onto solid aquifer materials. Sorption-based COC retardation factors ranging between about 1.3 and 4.3 have been estimated for the site.
- ISBIO and complete reductive dechlorination of site COCs through ethene and ethane appear to be occurring in at least two naturally occurring "bioreactive zones" located near the MW-3 and MW-8 sampling locations, which are situated near the downgradient portion of the COC plume.

6.0 References

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Tables

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Table 1

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Evaluation of Natural Attenuation
Groundwater Analytical Results for Detected Volatile Organic Compounds (ppb)

Detected Compound	NYSDEC Groundwater Standards	MW-1	MW-1D	MW-2	MW-3	BD042203 (MW-3)	MW-6	MW-7	MW-8
Benzene	1	< 0.3	< 0.3	< 2.6	**2.0**	**1.8**	< 0.3	< 6.5	< 2.6
Chlorobenzene	5	< 0.2	< 0.2	< 1.8	**19**	**17**	< 0.2	< 4.5	< 1.8
cis-1,2-Dichloroethene	5	< 0.2	< 0.2	**21**	2.3	1.9	< 0.2	**38**	**27**
1,1-Dichloroethane	5	< 0.2	1.8	< 2.4	< 0.5	< 0.5	< 0.2	< 6.0	< 2.4
1,1-Dichloroethene	5	< 0.4	1.3	< 4.3	< 0.9	< 0.9	< 0.4	< 11	< 4.3
Ethylbenzene	5	< 0.4	< 0.4	< 3.7	**310**	**270**	< 0.4	< 9.2	< 3.7
Tetrachloroethene	5	**50**	0.8	**1,200**	1.4	1.2	**120**	**2,600**	**970**
Trichloroethene	5	< 0.2	1.7	**34**	< 0.4	< 0.4	1.1	**48**	**25**
1,1,1-Trichloroethane	5	< 0.2	1.4	< 1.6	< 0.3	< 0.3	0.3	< 4.0	< 1.6
Toluene	5	< 0.2	< 0.2	< 1.5	**9.6**	**8.2**	< 0.2	< 3.8	< 1.5
Xylenes (Total)	5	< 0.2	< 0.2	< 1.8	**40**	**35**	< 0.2	< 4.5	< 1.8

Notes:

1. Samples collected by Blasland, Bouck & Lee, Inc. (BBL) on April 22-23, 2003.
2. Sample BD042203 is a blind duplicate of sample MW-3.
3. Samples analyzed by Severn Trent Laboratories, Inc. (STL) of Edison, New Jersey for Target Compound List (TCL) volatile organic compounds (VOCs) using United States Environmental Protection Agency (USEPA) Method 624.
4. Concentrations are reported in parts per billion (ppb), which are equivalent to micrograms per liter (µg/L).
5. Groundwater quality standards are from the New York State Department of Environmental Conservation (NYSDEC) Division of Water, Technical and Operational Guidance Series (TOGS 1.1.1) document entitled, "Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations," dated June 1998, revised April 2000.
6. < = Compound was not detected at a concentration exceeding the reported laboratory detection limit.
7. Shaded value indicates a VOC concentration exceeding the presented groundwater quality standard.

Table 2

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Evaluation of Natural Attenuation
Groundwater Field/Laboratory Analytical Results for Key Indicator Parameters of In-Situ Biodegradation

Field/Laboratory Parameters	MW-1	MW-1D	MW-2	MW-3	MW-6	MW-7	MW-8
Field Parameters							
pH	6.2	6.2	6.3	6.8	7.7	6.5	6.0
Temperature (^{o}C)	13.9	15.3	11.3	13.0	15.2	11.2	11.6
Specific Conductance (mS/cm)	0.20	0.27	0.28	0.39	0.17	0.24	0.25
Dissolved Oxygen (mg/L)	8.6	0.5	7.1	0.8	6.5	5.7	3.5
Turbidity (NTU)	0.0	10.1	0.0	17.5	0.0	8.3	2.2
Redox (mV)	135	116	156	-121	127	157	-40
Laboratory Analytical Parameters							
Geochemical Parameters							
Alkalinity as $CaCO_3$ (mg/L)	32	71	61	200	29	52	92
Ammonia as N (mg/L)	< 2.0	< 2.0	< 2.0	3.7	2.2	5.2	< 2.0
Chloride (mg/L)	20	36	35	9.4	14	22	15
Nitrate (mg/L)	17	< 0.50	15	< 0.50	10	14	8.6
Nitrite (mg/L)	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phosphate (mg/L)	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Soluble Organic Carbon (mg/L)	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Sulfate (mg/L)	20	18	19	5.2	24	30	27
Sulfide (mg/L)	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Iron-dissolved (mg/L)	< 0.050	< 0.050	< 0.050	21	< 0.050	< 0.050	0.73
Carbon dioxide (mg/L)	34	76	26	71	26	28	38
Ethane (ng/L)	82	29	84	410	< 5.0	5.8	8,000
Ethene (ng/L)	23	32	25	340	11	8.4	180
Methane (ug/L)	0.71	14	0.73	780	0.08	0.13	160
Microbiological Parameters							
Biomass via PLFA (Cell/mL)	1.12E+04	2.23E+06	6.46E+03	1.34E+06	4.11E+03	8.81E+03	4.23E+05
Anaerobes via PLFA (% of population)	0.0	13.6	0.0	10.6	0.0	0.0	5.2
Metal reducers via PLFA (% of population)	0.0	1.3	0.0	2.1	0.0	0.0	1.4
Dehalococcoides Ethenogenes	ND	ND	ND	Detected	ND	ND	Detected

Notes:

1. Samples collected by Blasland, Bouck & Lee, Inc. (BBL) on April 22-23, 2003.
2. Field measurements obtained by BBL using a Horiba U-22 flow-through cell/water quality meter.
3. Laboratory analyses for key indicator parameters of in-situ biodegradation were performed by three laboratories, as summarized below:
   - Geochemical parameter analysis was performed by Microseeps, Inc. (University of Pittsburgh Applied Research Center) of Pittsburgh, Pennsylvania;
   - Phospholipid fatty acids (PLFA) analysis was performed by Microbial Insights, Inc. of Rockford, Tennessee; and
   - *Dehalococcoides ethenogenes* analysis was performed by Sirem Site Recovery & Management, Inc. (Sirem) of Guelph, Ontario.
4. Analyses were performed using the following methods:
   - United States Environmental Protection Agency (USEPA) Method 9056 for chloride, nitrate, nitrite, phosphate, and sulfate;
   - USEPA Method 310.1 for alkalinity;
   - USEPA Method 350.2 for ammonia;
   - USEPA Method 376.1 for sulfide;
   - USEPA Method 6010B for dissolved iron;
   - USEPA Method 9060 for dissolved organic carbon;
   - Laboratory-specific gas chromatography (GC) methods for carbon dioxide/methane (AM20GAX) and ethane/ethene (AM18);
   - A laboratory-specific gas chromatography/mass spectrometry (GC/MS) method for PLFA; and
   - A laboratory-specific polymerase chain-reaction (PCR) method for *dehalococcoides ethenogenes* .
5. Concentrations reported in the units identified above.

6. S.U. = Standard units.
7. °C = Degrees Celcius.
8. mS/cm = milliSiemens per centimeter.
9. NTU = Nephelometric turbidity units.
10. mV = milliVolt.
11. mg/L = milligrams per liter, which is equivalent to parts per million (ppm).
12. ng/L = nanograms per liter.
13. < = Compound was not detected at a concentration exceeding the reported laboratory detection limit.
14. ND = not detected above the analytical method detection limit.

Figures

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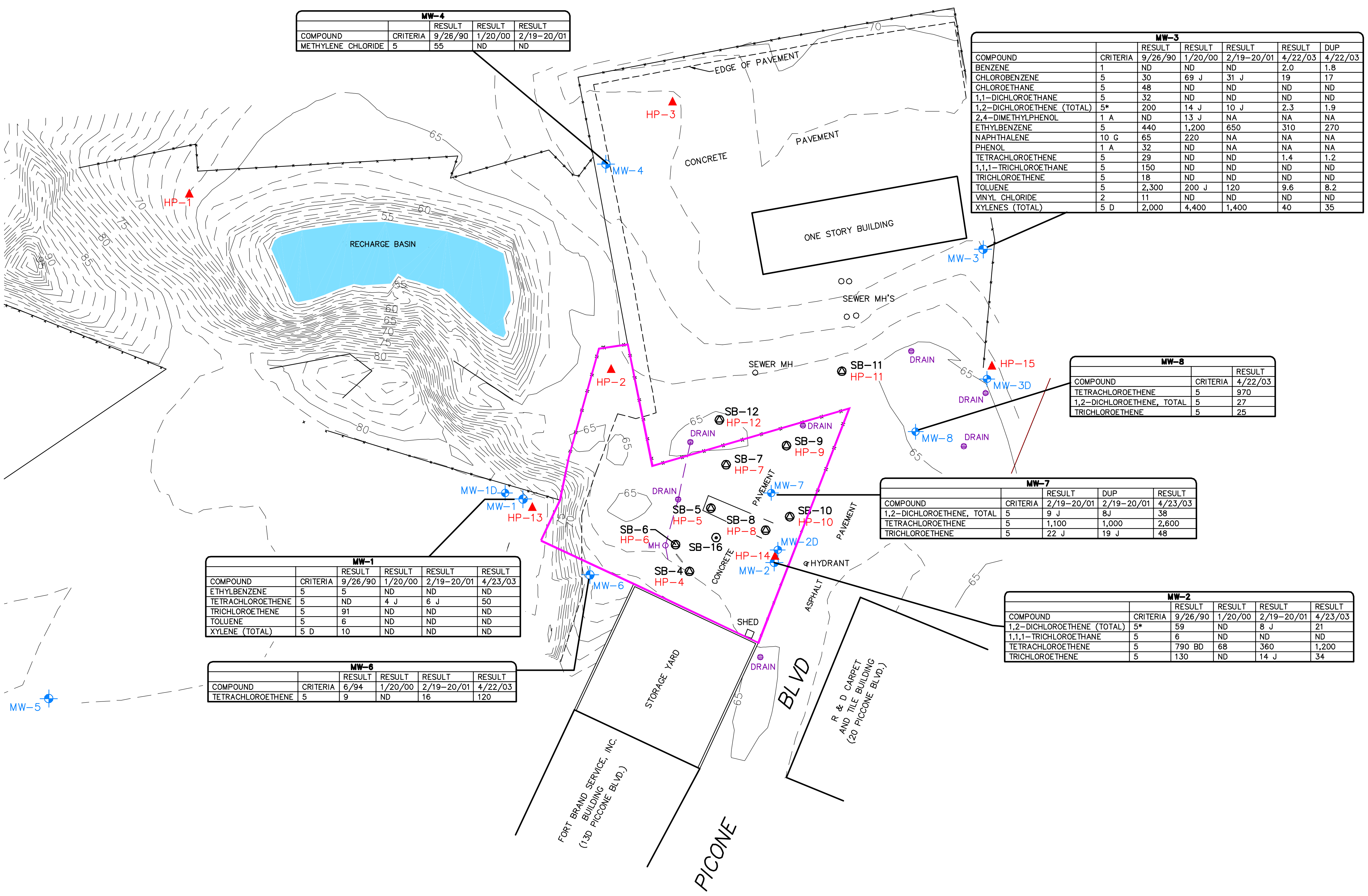


MW-4

		RESULT	RESULT	RESULT
COMPOUND	CRITERIA	9/26/90	1/20/00	2/19-20/01
METHYLENE CHLORIDE	5	55	ND	ND

MW-3

		RESULT	RESULT	RESULT	RESULT	DUP
COMPOUND	CRITERIA	9/26/90	1/20/00	2/19-20/01	4/22/03	4/22/03
BENZENE	1	ND	ND	ND	2.0	1.8
CHLOROBENZENE	5	30	69 J	31 J	19	17
CHLOROETHANE	5	48	ND	ND	ND	ND
1,1-DICHLOROETHANE	5	32	ND	ND	ND	ND
1,2-DICHLOROETHENE (TOTAL)	5*	200	14 J	10 J	2.3	1.9
2,4-DIMETHYLPHENOL	1 A	ND	13 J	NA	NA	NA
ETHYLBENZENE	5	440	1,200	650	310	270
NAPHTHALENE	10 G	65	220	NA	NA	NA
PHENOL	1 A	32	ND	NA	NA	NA
TETRACHLOROETHENE	5	29	ND	ND	1.4	1.2
1,1,1-TRICHLOROETHANE	5	150	ND	ND	ND	ND
TRICHLOROETHENE	5	18	ND	ND	ND	ND
TOLUENE	5	2,300	200 J	120	9.6	8.2
VINYL CHLORIDE	2	11	ND	ND	ND	ND
XYLENES (TOTAL)	5 D	2,000	4,400	1,400	40	35

MW-8

		RESULT
COMPOUND	CRITERIA	4/22/03
TETRACHLOROETHENE	5	970
1,2-DICHLOROETHENE, TOTAL	5	27
TRICHLOROETHENE	5	25

MW-7

		RESULT	DUP	RESULT
COMPOUND	CRITERIA	2/19-20/01	2/19-20/01	4/23/03
1,2-DICHLOROETHENE, TOTAL	5	9 J	8J	38
TETRACHLOROETHENE	5	1,100	1,000	2,600
TRICHLOROETHENE	5	22 J	19 J	48

MW-1

		RESULT	RESULT	RESULT	RESULT
COMPOUND	CRITERIA	9/26/90	1/20/00	2/19-20/01	4/23/03
ETHYLBENZENE	5	5	ND	ND	ND
TETRACHLOROETHENE	5	ND	4 J	6 J	50
TRICHLOROETHENE	5	91	ND	ND	ND
TOLUENE	5	6	ND	ND	ND
XYLENE (TOTAL)	5 D	10	ND	ND	ND

MW-6

		RESULT	RESULT	RESULT	RESULT
COMPOUND	CRITERIA	6/94	1/20/00	2/19-20/01	4/22/03
TETRACHLOROETHENE	5	9	ND	16	120

MW-2

		RESULT	RESULT	RESULT	RESULT
COMPOUND	CRITERIA	9/26/90	1/20/00	2/19-20/01	4/23/03
1,2-DICHLOROETHENE (TOTAL)	5*	59	ND	8 J	21
1,1,1-TRICHLOROETHANE	5	6	ND	ND	ND
TETRACHLOROETHENE	5	790 BD	68	360	1,200
TRICHLOROETHENE	5	130	ND	14 J	34

LEGEND

SITE BOUNDARY LOCATION
(11-A PICONE BOULEVARD)
FENCE LINE
MONITORING WELL LOCATION
SOIL BORING/HYDROPUNCH™ LOCATION
▲ HYDROPUNCH™ LOCATION ONLY
⊙ SOIL BORING LOCATION ONLY

Notes:

1. ALL CONCENTRATIONS ARE REPORTED IN MICROGRAMS PER LITER (ug/L) EQUIVALENT TO PARTS PER BILLION (ppb).
2. G = GUIDANCE VALUE
3. * = CRITERIA VALUE LISTED FOR 1,2-DICHLOROETHENE (Total) APPLIES TO THE Cis AND Trans- ISOMERS INDIVIDUALLY.
4. D = VALUE LISTED APPLIES TO EACH ISOMER INDIVIDUALLY.
5. A = VALUE LISTED APPLIES TO THE SUM OF THESE SUBSTANCES.
6. J = THE RESULT IS LESS THAN THE QUANTITATION LIMIT BUT GREATER THAN ZERO. CONCENTRATION GIVEN IS AN APPROXIMATE VALUE.
7. BD = CONTAMINANT ALSO DETECTED IN METHOD BLANK. DILUTED SAMPLE ANALYSIS.
8. ND = NOT DETECTED.
9. NA = NOT ANALYZED.
10. CRITERIA REFERENCE: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) DIVISION OF WATER TECHNICAL AND OPERATIONAL GUIDANCE SERIES (1.1.1), AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES, JUNE 1998.

40' 0 40' 80'
SCALE IN FEET

SOURCE:
ALL BASE MAP INFORMATION UNLESS OTHERWISE NOTED WAS TAKEN FROM A MAP ENTITLED "MONITORING WELL AND SOIL BORING LOCATION PLAN, HWD SITE-PICONE BOULEVARD, FARMINGDALE NEW YORK, PROJECT No. 604.05 #2". PREPARED BY ALBERT W. TAY. FILE No. 99390-3.DWG. SURVEYED 11/22/99 THROUGH 11/29/99. SURVEY REVISED 2/9/2000 AND 5/13/2003.

X: 60405X01.DWG
L: OFF=REF
P: STD PCP-DBL
5/23/03 CRA-54-IY, TLF, IY SYR-85-RCB
60405025\60405C01.DWG

HAZARDOUS WASTE DISPOSAL, INC. SITE
FARMINGDALE, NEW YORK
FEASIBILITY STUDY REPORT

HISTORIC DISTRIBUTION OF ORGANIC COMPOUNDS IN GROUNDWATER MONITORING WELLS ABOVE NYSDEC CRITERIA

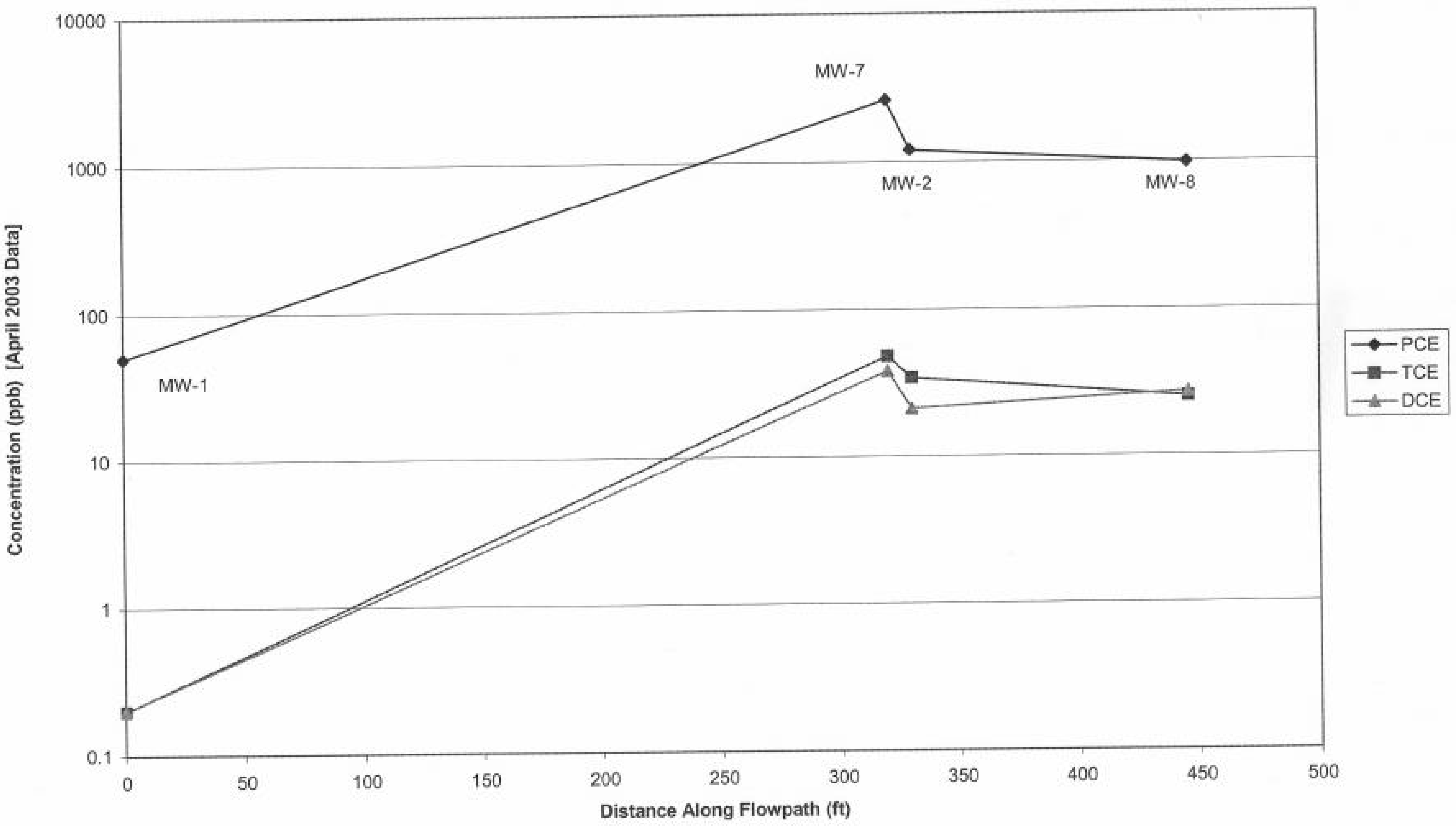
BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

FIGURE
1

Figure 2

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Evaluation of Natural Attenuation
VOC Concentration Trends Along Flowpath A-A'



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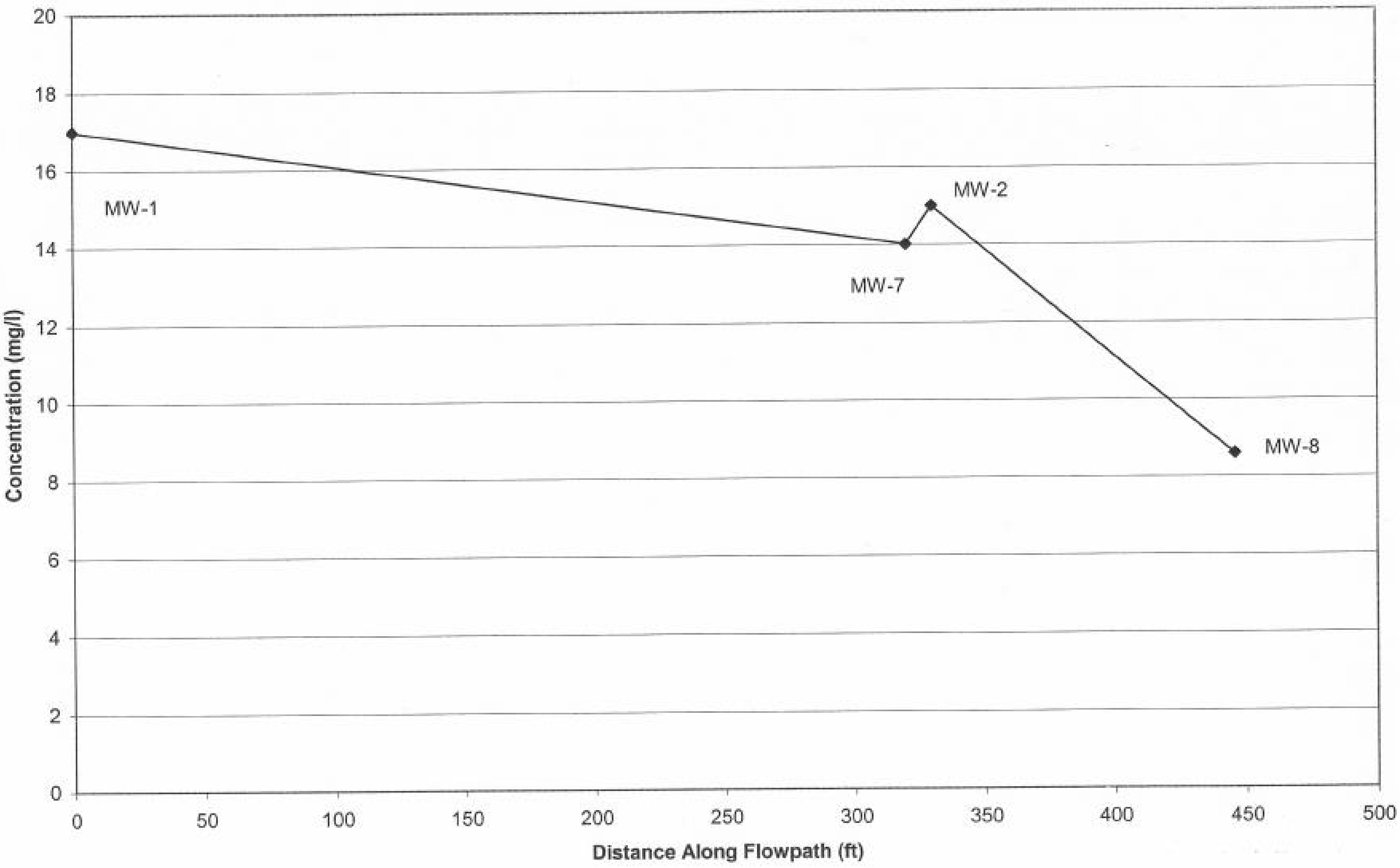
9/18/2003

Figure 3

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Evaluation of Natural Attenuation
Nitrate Concentration Trends Along Flowpath A-A'



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9/18/2003

Figure 4

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Evaluation of Natural Attenuation
Sulfate Concentration Trends Along Flowpath A-A′

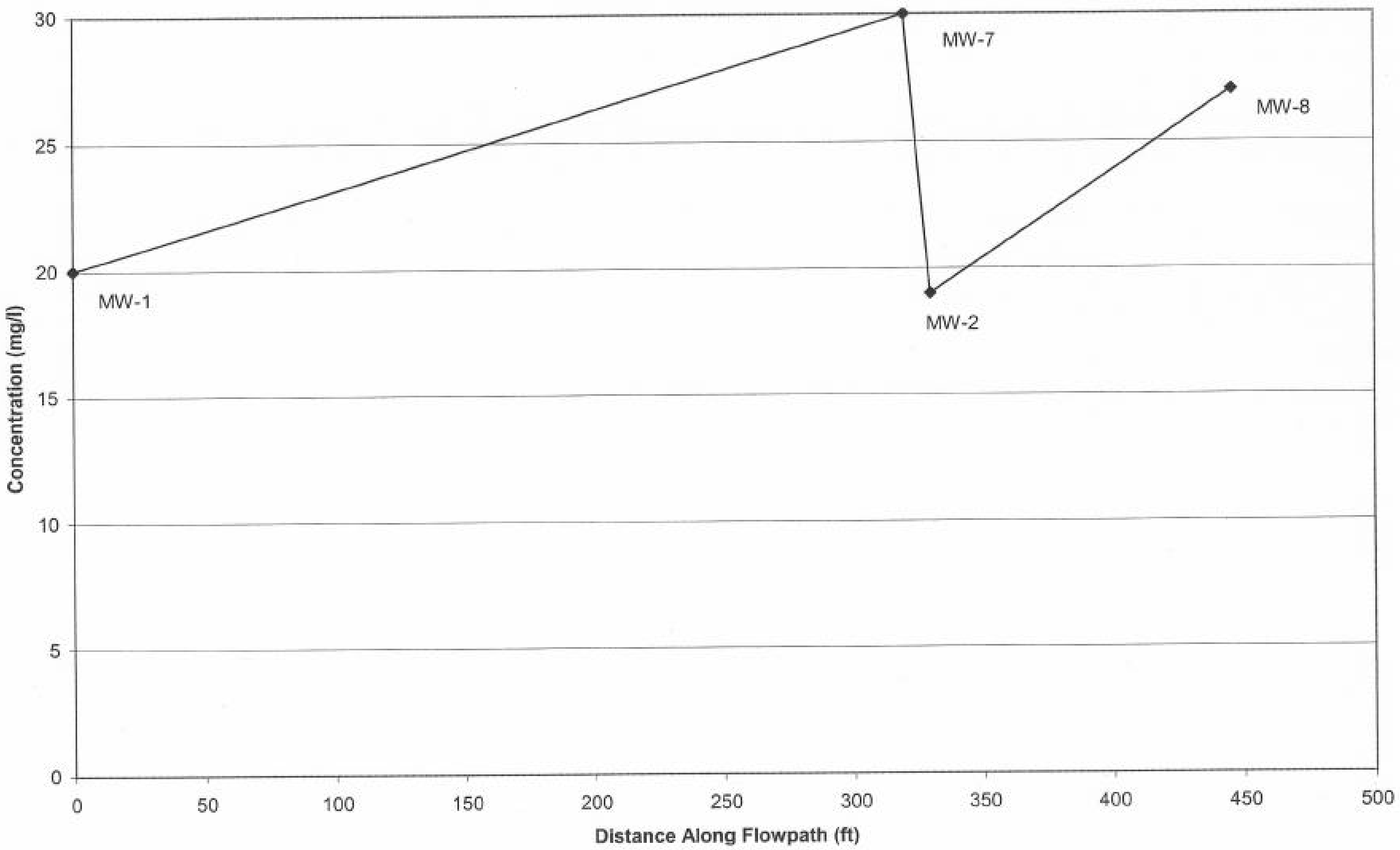

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Figure 5

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Evaluation of Natural Attenuation
__Carbon Dioxide Concentration Trends Along Flowpath A-A'__

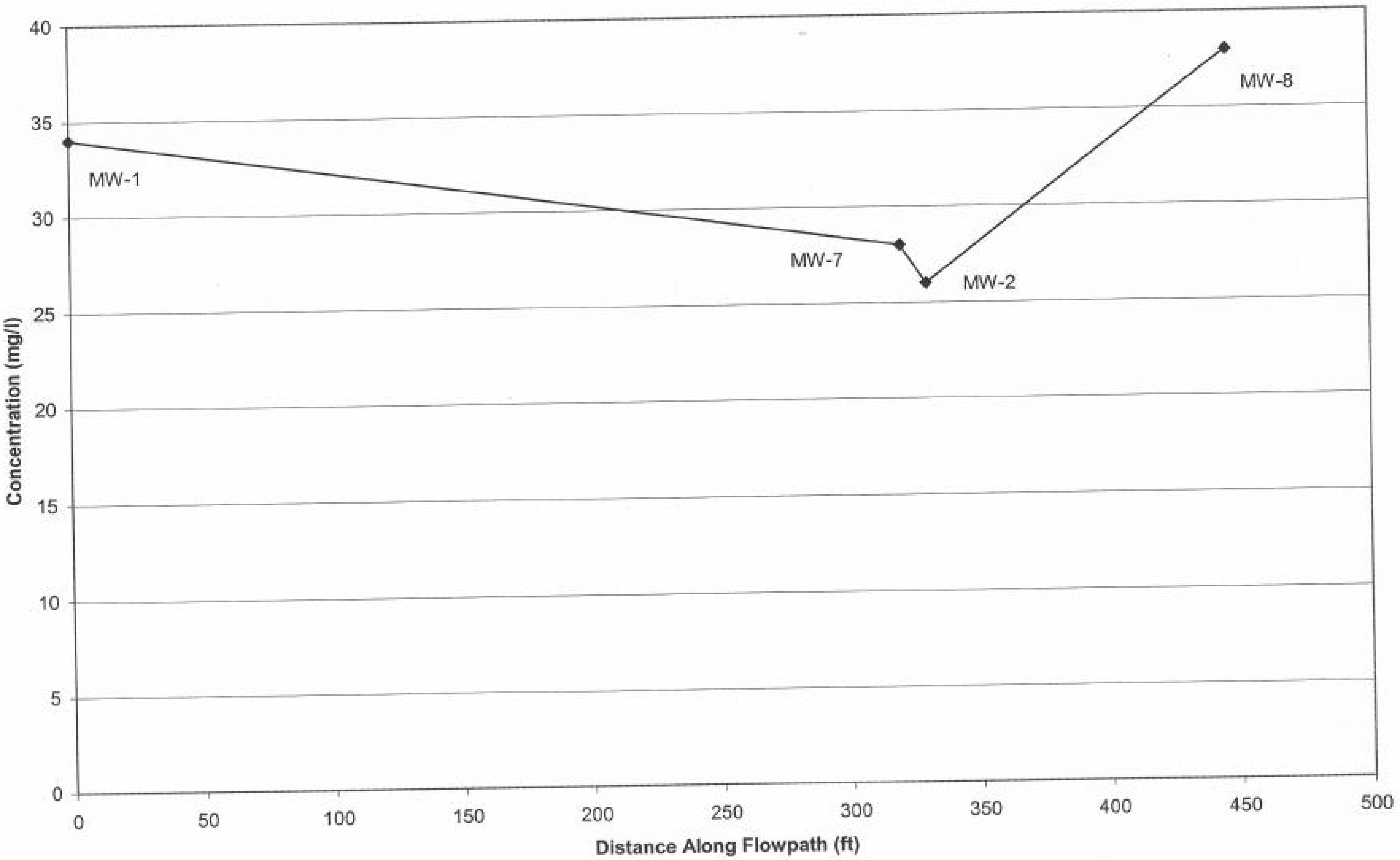

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Figure 6

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Evaluation of Natural Attenuation
Dissolved Iron Concentration Trends Along Flowpath A-A'

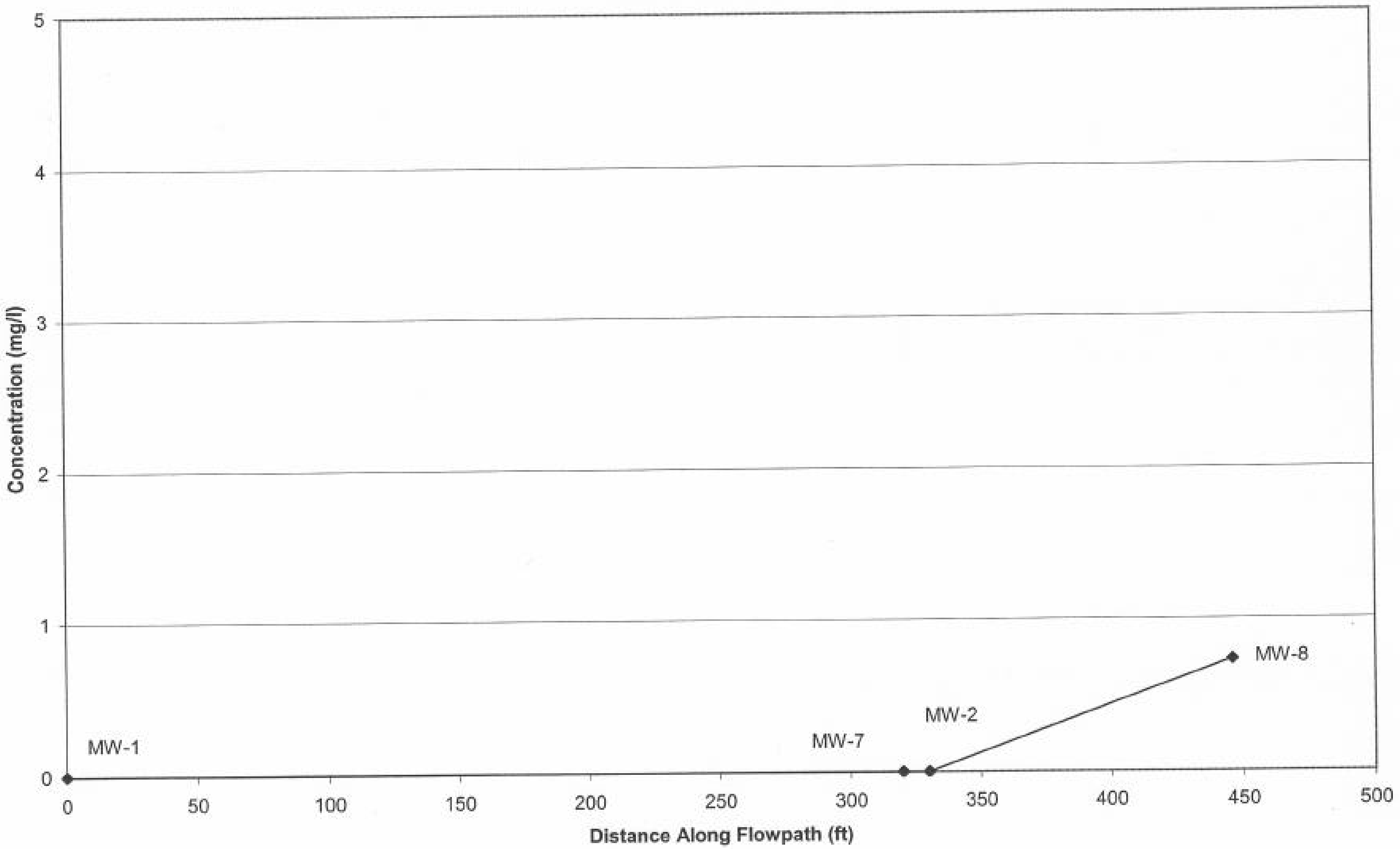

Figure 7

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Evaluation of Natural Attenuation
Methane Concentration Trends Along Flowpath A-A'

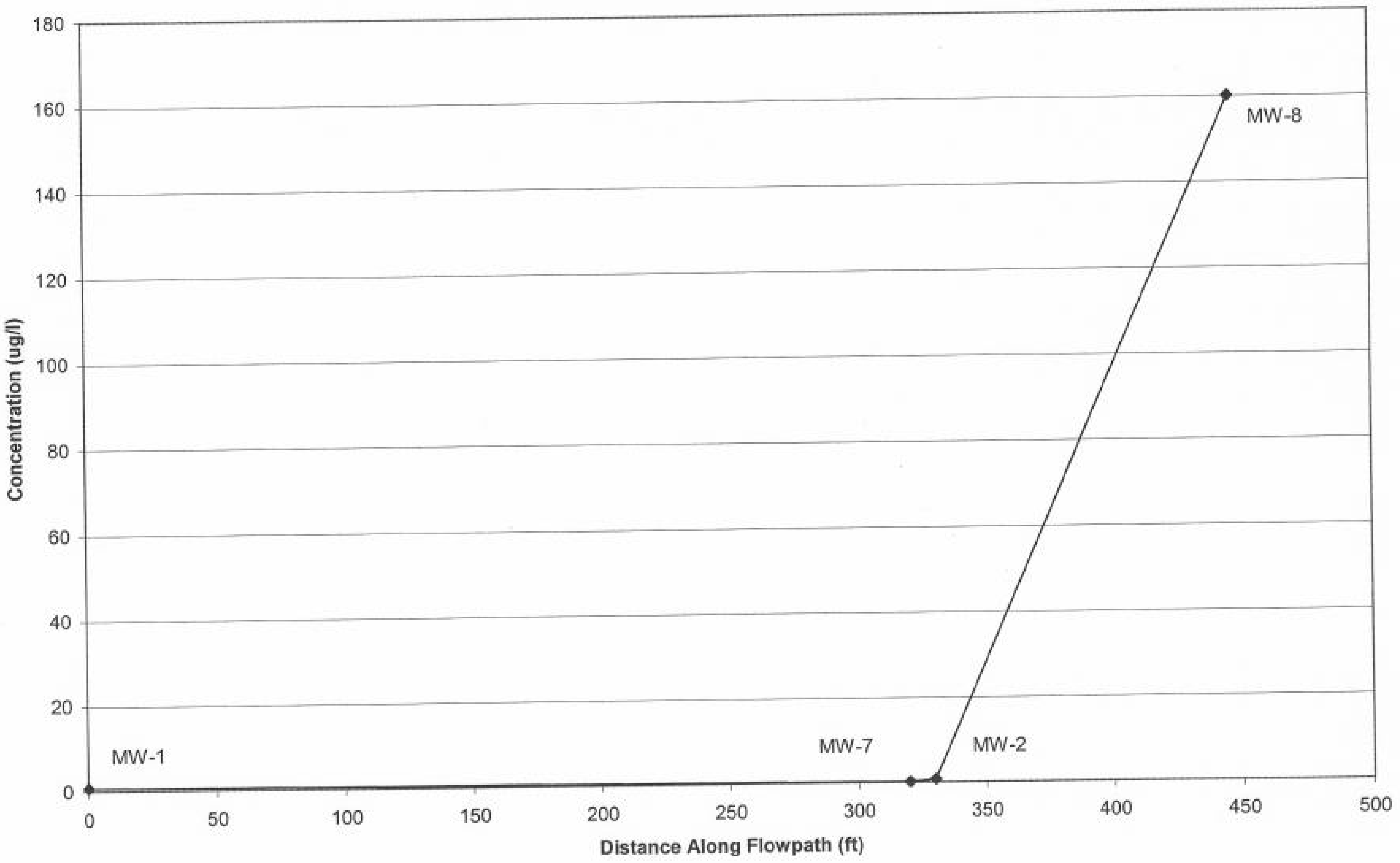

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Figure 8

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Evaluation of Natural Attenuation
Ethane Concentration Trends Along Flowpath A-A'

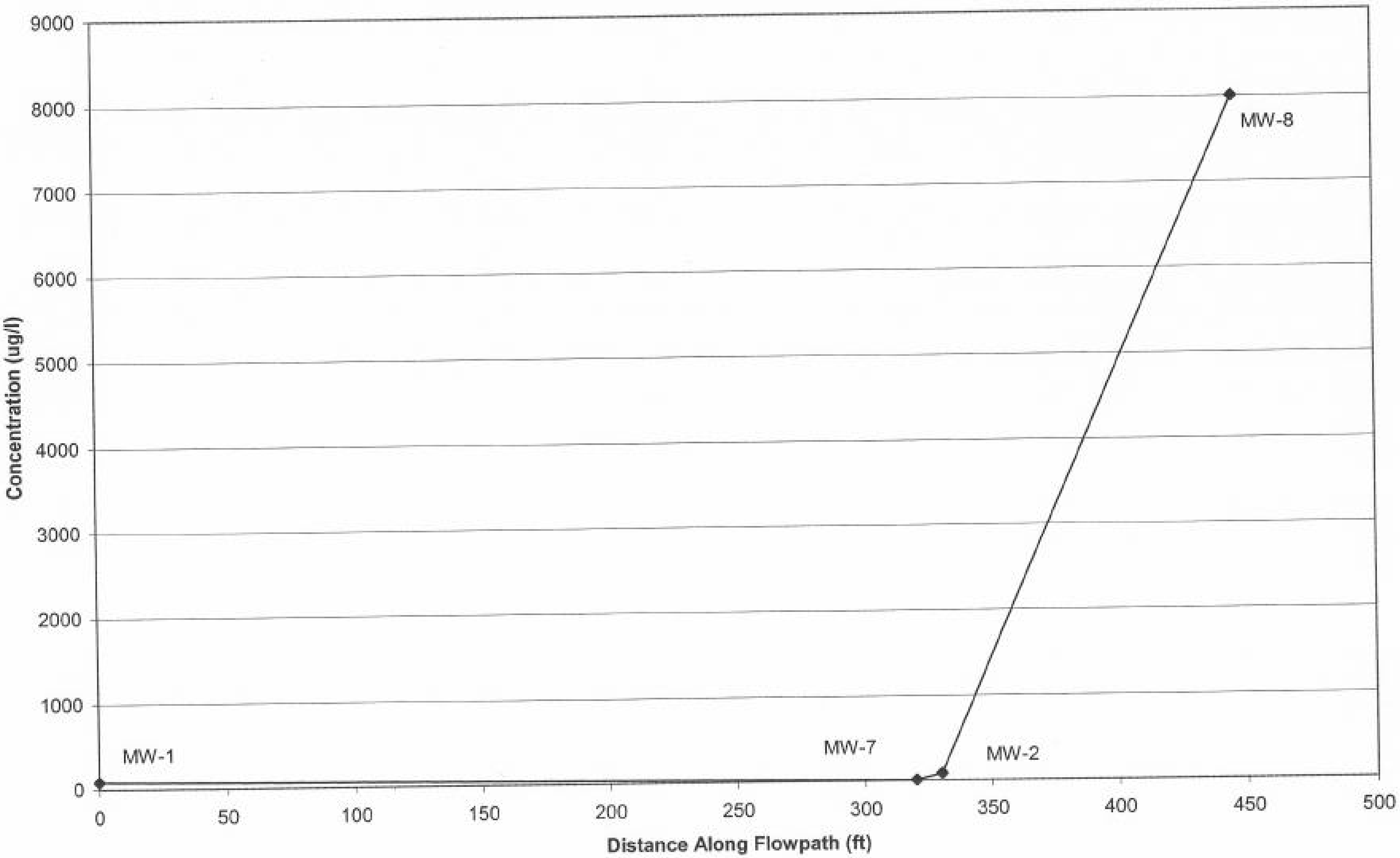

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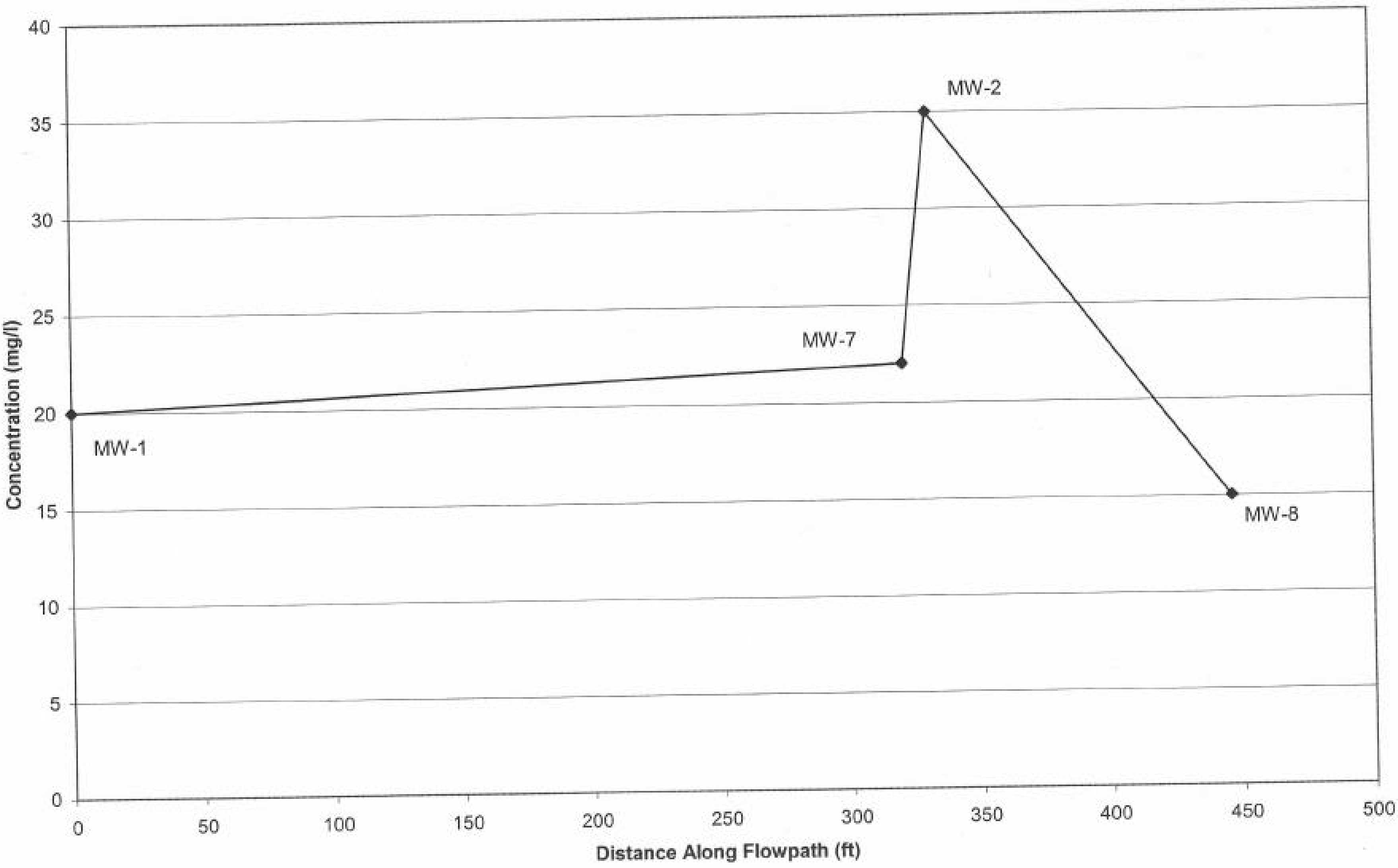
Figure 9

Hazardous Waste Disposal, Inc.
11A Picone Boulevard
Farmingdale, New York

Evaluation of Natural Attenuation
<u>Chloride Concentration Trends Along Flowpath A-A'</u>



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9/18/2003