Interim Remedial Measure Work Plan

For

The Interim Remedial Measure to Address Chlorinated Volatile Organic Compounds and Toluene in Specific Treatment Areas on Parcel A of the Former Pratt Oil Works Site, Long Island City, Queens, New York

Prepared for Waste Management of New York, LLC

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Certification Statement

I, Joseph J. Fiteni, Jr., certify that I am currently a New York State registered Professional Engineer and that this Interim Remedial Measures (IRM) Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

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In accordance with New York State Education Law, it is a violation for any person, unless he is acting under the direction of a licensed professional engineer, to alter the IRM Work Plan in any way.

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List of Acronyms

AS	air sparge
BM	best management practice
cDCE	cis-1,2-dichloroethene
CAMP	Community Air Monitoring Program
COC	certificate of completion
CVOC	chlorinated volatile organic compound
EDD	Electronic Data Deliverable
ECs	engineering controls
ESCP	Erosion and Sediment Control Plan
ft	feet
FPOW	Former Pratt Oil Works
GAC	granular activated carbon
GETS	groundwater extraction and treatment system
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
ICs	institutional controls
IRM	Interim Remedial Measures
ISCO	in situ chemical oxidation
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
NAPL	Non-aqueous phase liquid
NYCDOS	New York City Department of Sanitation
NYCRR	New York Codes, Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDEC DER	NYSDEC Division of Environmental Remediation
NYSDOH	New York State Department of Health
NYSPE	New York State Professional Engineer
PDF	Portable Document Format
PE	Professional Engineer
PID	photoionization detector
ppm	parts per million
PVC	polyvinyl chloride
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QCM	Quality Control Manager
scfm	Standard cubic feet per minute

SMP	Site Management Plan
SOCONY	Standard Oil Company of New York
SSCR	Supplemental Site Characterization Report (Kleinfelder, 2013)
SVE	soil vapor extraction
USDOT	United States Department of Transportation
VOCs	volatile organic compounds
WMNY	Waste Management of New York, LLC

Executive Summary

This Interim Remedial Measure (IRM) Work Plan ("Work Plan") pertains to reduction of chlorinated volatile organic compounds (CVOCs) and toluene in defined Specific Treatment Areas located on a portion of what is presently known as Lot 300, Block 312 at the Former Pratt Oil Works Site in Long Island City, Queens, New York (Property). The Property is currently owned by Waste Management of New York, LLC (WMNY), which operates a non-hazardous solid waste transfer station (Transfer Station) in accordance with a permit issued by the New York City Department of Sanitation (NYCDOS) and the New York State Department of Environmental Conservation (NYSDEC). Consistent with discussions at a July 19, 2016 meeting attended by WMNY, NYSDEC, and HydroGeoLogic (HGL), the Specific Treatment Areas are defined by CVOCs or toluene concentrations in soil above 500 milligrams per kilogram (mg/kg) or groundwater concentrations above 1,000 micrograms per liter (µg/L). The Specific Treatment Areas are depicted in Figure 1.2.

Characterization and interim remedial measures have been underway, at the Property and surrounding properties previously occupied by the Former Pratt Oil Works ("FPOW"), by ExxonMobil Corporation (ExxonMobil) in accordance with Consent Order Case No. D2-1002-12-07AM (ExxonMobil Consent Order) executed between ExxonMobil and the NYSDEC on July 15, 2008. Environmental characterization, including the sampling results used to define the Specific Treatment Areas, is documented in the 2013 *Supplemental Site Characterization Report* (SSCR)[1] submitted by Kleinfelder on behalf of ExxonMobil. Remediation measures at FPOW are or will be underway by ExxonMobil pursuant to a Consent Order dated April 12, 2016 ("2016 Consent Order").

The IRM described in this Work Plan pertains only to CVOC and toluene contamination in the Specific Treatment Areas, pursuant to an Order on Consent and Administrative Settlement of the Former Pratt Oil Works. The NYSDEC-approved work plan will be attached to the Consent Order. The objectives of the IRM are to reduce CVOC and toluene contamination in the Specific Treatment Areas.

This Work Plan evaluates the following four potential alternatives to achieve these objectives:

- Soil vapor extraction (SVE) and bioventing with vertical wells
- SVE and air sparging (AS) with vertical wells
- SVE and bioventing with horizontal wells
- SVE and AS with horizontal wells

In selecting the preferred alternative, Savin/HGL evaluated the effectiveness of protecting human health and the environment; compliance with standards, criteria and guidance; implementability; and cost. After considering these factors, and given the environmental conditions and site constraints, SVE and

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[1] WMNY's reference to documents submitted by ExxonMobil and/or Kleinfelder and for Roux Associates, Inc. should not be considered an admission to or agreement with the information, data, opinions, analysis, or conclusions contained in such documents, nor should such references be considered a representation by WMNY as to the accuracy or completeness of the information, data, opinions or conclusions contained in the documents submitted by ExxonMobil and/or Kleinfelder. WMNY expressly reserves any objections, rights, claims, defenses or challenges it may have with respect to anything contained in the documents submitted by ExxonMobil and/or Kleinfelder.

bioventing with vertical wells, with additional targeted remediation by AS based on data collected from SVE operation and access, is selected as the preferred IRM.

The IRM activities include the following steps:

- installation of SVE wells;
- installation of bioventing wells;
- installation of groundwater monitoring wells;
- installation of piping for the SVE and bioventing systems;
- pilot testing of the SVE wells and bioventing wells;
- installation of the blowers for the SVE and bioventing systems;
- operation and maintenance at design flow rates of the SVE system for 30,000 hours and the bioventing system for 3,000 hours over an approximate four-year period;
- performance monitoring; and
- implementation of AS (as appropriate based on on-going SVE monitoring data and access) during the 30,000-hour period of SVE operation but after the first 15,000 hours of SVE operation and first 1,500 hours of bioventing.

Measurement of mass removal, mass degradation, and decreasing contaminant concentrations in groundwater will be used and interpreted to evaluate IRM performance.

This IRM Work Plan provides other pertinent information to executing and managing the IRM, including project organization and oversight, security and work hours, Quality Assurance Project Plan (QAPP), Health and Safety Plan (HASP), community air monitoring plan (CAMP), soil/materials management plan, field preparation, and reporting.

1.0 Introduction

Waste Management of New York, LLC (WMNY) retained Savin Engineers and HydroGeoLogic (HGL) to prepare this Interim Remedial Measure (IRM) Work Plan (“Work Plan”) to address the chlorinated volatile organic compound (CVOC) and toluene concentrations in specific areas, located on a portion of what is currently known as Lot 300, Block 312 (Property), Long Island City, Queens, New York (see Figure 1.1). The Property is currently owned by WMNY, which operates a non-hazardous solid waste transfer station (Transfer Station) in accordance with a permit issued by the New York City Department of Sanitation and the New York State Department of Environmental Conservation (NYSDEC). The specific areas, referred to as Specific Treatment Areas A and B are depicted in Figure 1.2 and are consistent with the outcome of a working meeting attended by WMNY, NYSDEC, and HGL on July 19, 2016.

Characterization and interim remedial measures have been underway, at the Property and surrounding properties previously occupied by the Former Pratt Oil Works, by ExxonMobil Corporation (ExxonMobil) in accordance with Consent Order Case No. D2-1002-12-07AM (ExxonMobil Consent Order) executed between ExxonMobil and the NYSDEC on July 15, 2008. Environmental characterization, including initial characterization of the Acid Condition, is documented in the 2013 *Supplemental Site Characterization Report* (SSCR)[2] submitted by Kleinfelder on behalf of ExxonMobil. Remediation measures at FPOW are or will be underway by ExxonMobil pursuant to a Consent Order dated April 12, 2016 (“2016 Consent Order”).

The IRM described in this Work Plan pertains only to the CVOC and toluene soil and groundwater contamination in the Specific Treatment Areas, pursuant to an Order on Consent and Administrative Settlement addressing this IRM of Parcel A of the Former Pratt Oil Works. The NYSDEC-approved work plan will be attached to the Consent Order.

This IRM Work Plan:

- summarizes past investigations of the CVOC and toluene soil and groundwater concentrations;
- evaluates various potential remedial measures for the CVOC and toluene soil and groundwater concentrations;
- selects an appropriate remedial measure for the CVOC and toluene soil and groundwater concentrations; and
- presents a plan for implementing the IRM.

CVOC and toluene concentrations in the May 2013 *Supplemental Site Characterization Report (SSCR)*, information from the May through July 2016 *Site Status Update Report,* and logs from historical soil borings were reviewed and used in preparation of this IRM Work Plan.

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[2] WMNY’s reference to documents submitted by ExxonMobil, Kleinfelder and Roux Associates, Inc. should not be considered an admission to or agreement with the information, data, opinions, analysis, or conclusions contained in such documents, nor should such references be considered a representation by WMNY as to the accuracy or completeness of the information, data, opinions or conclusions contained in the documents submitted by ExxonMobil and/or Kleinfelder. WMNY expressly reserves any objections, rights, claims, defenses or challenges it may have with respect to anything contained in the documents submitted by ExxonMobil and/or Kleinfelder.

1.1 Location and Description

The location of the Property is depicted on Figure 1.1. The 20,000 square-foot one-story building in the southeastern portion of the Property is the result of building expansion conducted in 2014. A new rail spur is located in the northern portion of the Property. Truck scales are present in the western portion of the Property. The remaining portions of the Property are covered by concrete or asphalt pavement. The Property is served by public utilities including subsurface water, gas, electric, and telecommunication lines. The Property includes 16 monitoring wells that are part of ExxonMobil's groundwater monitoring network in accordance with the ExxonMobil Consent Order. Samples from five of these wells are analyzed for volatile organic compounds (VOCs), including CVOCs and toluene. The other 11 wells in the monitoring network are not analyzed due to the presence of non-aqueous phase liquid (NAPL) in the well.

1.2 History

The SSCR summarizes the Property history in part, as follows: The North American Kerosene Gas Lamp Company developed the Property in the early 1850s. Around 1876, Charles Pratt & Company acquired the Property (and surrounding properties) under the name Pratt Long Island Refinery. Standard Oil Company of New York (SOCONY) acquired the Former Pratt Oil Works (FPOW) in 1892 and operated the Property until 1949. From 1949 through 1998 the Property was owned by various industrial parties. WMNY purchased the Property in 1998 for use as a permitted solid waste transfer station.

1.3 Description of Surrounding Area

Additional industrial properties are located to the east and west of the Property. Tracks owned by the Long Island Railroad are located to the north of the Property.

2.0 Summary of Relevant Remedial Investigations

Remedial investigation by ExxonMobil at the Property to date is documented in the 2013 SSCR. The reader is referred to the 2013 SSCR for additional information about characterization of the Property.

2.1 Summary of Areas of Concern

There are two Specific Treatment Areas with CVOC and toluene soil and groundwater concentrations (Figure 1.2). One Specific Treatment Area (hereafter referred to as "Area A") is located approximately 100 feet (ft) southeast of the truck scales and 100 ft west-northwest of the truck entrance of the building. The truck path from the scales to the entrance of the building passes over the majority of Area A. Soil sampling results from LIF-23, MW-34, and LIF-25 presented in the 2013 SSCR assisted in defining this area. Toluene concentrations greater than 500 milligrams per kilogram (mg/kg) were detected at all three locations. Area A, which is approximately 7,500 square ft, is defined as a 25-ft buffer zone around the lines connecting these three sample locations.

The second Specific Treatment Area (hereafter referred to as "Area B") is located approximately 120 ft east of the truck scales and extends east-southeast for 350 ft under an 18-inch concrete slab between the railroad tracks and the building. The transfer of sealed containers from the building to the rail line takes place over the eastern portion of Area B. Soil and groundwater concentrations measured at MW-5S, MW-39, MW-40S, MW-41S, MW-43, MW-44, and TP-5 assisted in defining the extent of high CVOC and toluene concentrations (Figure 2.1). Toluene soil concentrations in three locations was greater than 500 mg/kg. In groundwater, both toluene and CVOCs concentrations were detected at concentrations greater than 1,000 micrograms per liter (µg/L). Area B encompasses approximately 25,000 square ft and is defined as a 25-foot buffer around the lines connecting the sample locations. The area between MW-40S and MW-41S is not included because LIF-19 did not have the same level of contamination as the other wells within the Specific Treatment Areas.

2.2 Summary of Investigation Work Conducted to Date and Findings

Review of the boring logs for MW-34 and LIF-23 (Appendix A) shows the majority of the contaminant mass is located above the water table and that contamination appears to be co-located with NAPL and/or coal ash with a high carbon content. The maximum detected toluene soil concentration in Area A was 36,400 mg/kg at a depth of 2.5 ft below ground surface (above the water table) at LIF-25. The maximum detected CVOC soil concentration in Area A (355 mg/kg) was at the same location and depth. A toluene soil concentration of 797 mg/kg and a CVOC soil concentration of 92.7 mg/kg was detected at approximately 8.5 ft below ground surface (near the water table) at LIF-23. The maximum toluene soil concentration at MW-34 was 520 mg/kg at 13 to 15 ft below ground surface (below the water table). The CVOC concentration at this location and depth was 1.3 mg/kg.

Review of the boring logs for the Area B locations (Appendix A) shows that the majority of the mass of toluene and CVOC within Area B is at or above the water table and co-located with NAPL or high carbon coal ash. All sampled locations are shown in Figure 2.1. Within Area B, only three locations (TP-5, MW-44, and MW-43/SB-19) had toluene soil concentrations greater than 500 mg/kg. Toluene at these three locations ranged from 919 mg/kg at TP-5 to 5,600 mg/kg at MW-44. The high toluene soil contamination is detected at soil samples from 1.5 ft to 7.5 ft below ground surface and decreases with depth. Groundwater samples collected from MW-5S, MW-39, MW-41S, MW-43, MW-44, and SB-19 had toluene concentrations greater than 1,000 µg/L, ranging from 1,600 µg/L at MW-5S to 140,000 µg/L at MW-43. These toluene groundwater concentrations were detected at the same depth interval of 3 to 15 ft below ground surface. The maximum CVOC soil concentration in Area B is 36 mg/kg at MW40S, but MW-39, MW-43 (collocated with SB-19), and MW-40S all have CVOC groundwater concentrations greater than 1,000 µg/L.

2.3 Qualitative Human Health Exposure Assessment

This qualitative human health exposure assessment was conducted in accordance with Appendix 3B of DER-10: *New York State Department of Health* (*NYSDOH) Qualitative Human Health Exposure Assessment* to evaluate potential existing and future exposure pathways to the toluene and CVOCs soil and groundwater concentrations.

Sources of Contamination

Several decades of industrial and petroleum-related operations have led to areas within the Property with elevated toluene and CVOC soil and groundwater concentrations. The Specific Treatment Areas are defined by sample locations with toluene soil concentrations greater than 500 mg/kg and toluene and/or CVOCs groundwater concentrations greater than 1,000 µg/L.

Environmental Media, Transport Mechanisms, and Points of Exposure

Groundwater is present at varying depths below ground surface ranging from approximately 5 ft below ground surface to approximately 11 ft below ground surface. The unsaturated zone above the Specific Treatment Areas is historic fill, asphalt sub-base, and asphalt or concrete. Clay and silt are present at 20 ft below ground surface beneath Area A and at varying depths beneath Area B. Groundwater flow is to the southwest toward surface water, which is within 25 ft of the known southern extent of Area A.

Routes of Exposure

Various potential routes of exposure are evaluated in the following table:

Potential Route of Exposure	Exposure Assessment
Ingestion of surface water	The nearby surface water is not used for human consumption. This exposure pathway is incomplete.
Inhalation of vapor in indoor ambient air	No buildings overlay the Specific Treatment Areas. Vapor intrusion of CVOCs in the adjacent building or truck scales is not assessed. However, the commercial operations may impair air quality. This exposure route cannot be assessed at this time.
Inhalation of vapor from outdoor ambient air	Organic vapors have not been thoroughly assessed in the subsurface or outdoor air. However, site paving and dilution of ambient air would minimize any exposure in the breathing zone.
Groundwater ingestion	Groundwater is not used in the vicinity of the Property for consumption or other purposes. This pathway is considered incomplete.
Dust inhalation	Inhalation of dust by commercial, industrial, or construction work could occur during intrusive activities. This exposure pathway is considered complete unless controls and planning are put in place to provide for appropriate safety precautions.
Direct contact and incidental ingestion of soil	Direct contact and incidental ingestion of contaminated soil by commercial, industrial, or construction work could occur during intrusive activities. This exposure pathway is considered complete unless controls and planning are put in place to provide for appropriate safety precautions.
Direct contact with groundwater	Direct contact with contaminated groundwater by commercial, industrial, or construction work could occur during intrusive activities that reach the water table. This exposure pathway is considered complete unless controls and planning are put in place to provide for appropriate safety precautions.

Potential Receptor Population

Based on the above routes of exposure, construction workers could become exposed to CVOCs and toluene in soil and groundwater if intrusive work is conducted within the Specific Treatment Areas without implementing appropriate health and safety precautions. Current facility conditions, including new concrete slabs and ventilation would mitigate potential for vapor intrusion into buildings from the subsurface. However, under potential different conditions in the future, commercial or industrial workers could potentially be exposed to CVOCs and toluene if working in enclosed areas near the Specific Treatment Areas where there is limited ventilation and there are cracks, gaps, or other penetrations through the floor that could potentially allow for vapor intrusion from the subsurface.

3.0 IRM Objective

NYSDEC classifies the groundwater immediately underneath the Property as a potential source of potable water even though the groundwater is perched in historical fill above lower permeability soils and is only present as a result of historical urban and industrial fill placed on top of a marsh. Due to this classification, final groundwater and soil cleanup goals are consistent with those associated with potable water.

The Specific Treatment Areas have been identified as areas in need of active remediation for CVOCs and toluene. However, CVOCs, toluene, and other contaminants are also in soil and groundwater outside of the Specific Treatment Areas. In addition, NAPL that is co-located with the contamination is expected to provide ongoing contributions of various contaminants site wide until it is removed. As such, the IRM objective is to reduce the toluene and CVOC soil and groundwater contamination within the Specific Treatment Areas to contaminant levels that are generally comparable with the rest of the site.

The final cleanup objectives will eventually be met upon completion of the final site remedy outlined in ExxonMobil 2016 Consent Order.

4.0 Alternatives Analysis and IRM Selection

This section identifies and screens remedial technologies applicable to remediation of the elevated CVOC and toluene soil and groundwater concentrations in Specific Treatment Areas A and B. The presence of NAPL and high carbon coal ash is accounted for in the screening process of remedial technologies because the high carbon content of the NAPL and coal ash store these contaminants via adsorption and will provide an ongoing source of these contaminants over time. The ongoing Transfer Station operations are also considered. Those technologies considered the most effective and implementable to achieve the IRM objective are retained for consideration in assembling remedial alternatives. The details of each alternative are also discussed in this section.

4.1 Identification and Screening of Technologies

A detailed search of available remediation technologies was carried out based on the nature and extent of the soil and groundwater contamination targeted for treatment. The potentially applicable technologies were evaluated in two steps. The first step evaluated the effectiveness of the technology to treat CVOC and toluene in the contaminated media. Only technologies considered to be effective to meet the IRM objective specified in Section 3 were retained for the next step of the screening process. The second screening step assessed the ability to implement each technology at the Property, considering the ongoing permitted waste transfer activities and other access constraints. Remedial technologies capable of treating the contamination within Area A and B are discussed in detail in the following sections and are summarized in Table 4.1.

Institutional Controls (ICs)

ICs are legal, administrative, and physical constraints (also called engineering controls (ECs)) that only reduce the potential for human exposure and can protect existing and future remedial measures. All proposed remedial alternatives include a form of ICs in combination with other treatment methods. Even though ICs are not effective in treating the Specific Treatment Areas, existing property controls can effectively control access during planning and implementation of any remedial technology. Furthermore, any additional ICs can be easily established until the proposed IRM objective is achieved. Therefore, ICs are retained for further analysis.

Groundwater Extraction and Treatment

A typical groundwater and extraction treatment system (GETS) extracts contaminated groundwater from the saturated zone and treats it using processes such as precipitation/coagulation/flocculation, filtration; green sand filtration, aerobic or anaerobic biological treatment, carbon adsorption, air stripping, or other treatment processes depending on the contaminants of concern and water quality. These systems are used to control plume migration and remove contaminant mass for aquifer restoration.

A GETS pumps groundwater from the ground using submersible pumps placed in extraction wells and then routes the extracted water to a treatment system typically located at the site. After the groundwater passes through the treatment train, it is discharged to a nearby surface water body or injected back into the ground. Permits are likely to be required for surface water discharge or re-injection of the treated water. In some cases, the extracted water is routed to a sewer for treatment in a local publicly owned treatment works. Groundwater monitoring and treatment system sampling are also required to monitor the success of a GETS.

Effectiveness: The effectiveness of a GETS at this site would be based primarily on the ability of the system to extract contaminated groundwater to remove contaminant mass removal. Groundwater extraction could remove and treat CVOCs and toluene in groundwater over a very long period of time. However, this technology would not address contamination present above the water table, where much of the contaminant mass is present. In addition, the presence of NAPL and coal ash that act as an ongoing source will diminish the performance of the remedy. Together, these factors would prevent a GETS from attaining the IRM objective. Therefore, this technology is eliminated from further screening and is not be considered in the development of the remedial alternatives.

Air Sparge/Soil Vapor Extraction (AS/SVE)

SVE involves the application of vacuum to contaminated soils to extract VOCs in a gaseous form. SVE can be combined with AS to address groundwater contamination. In AS, air or oxygen is injected into wells or through trenches installed below the groundwater table to transfer VOCs from water to air for extraction by the SVE system. The extracted gas is typically treated using a condenser, a vapor phase granular activated carbon (GAC), a thermal oxidizer, or a catalytic oxidizer before being released into the atmosphere. Any media used for the vapor treatment would have to be regenerated or appropriately disposed of off-site. Any condensate from the vapor treatment system would be disposed of at an appropriate facility. A permit for air emissions will most likely be required if this technology is implemented.

Effectiveness: The type of soil in the Specific Treatment Areas is well-suited to treatment with AS/SVE and the technology is proven to be highly effective in treating CVOCs and toluene. Typically, AS/SVE systems have short treatment times and can be effective at removing VOC mass above and below the water table. The transfer of oxygen from entrained air from SVE or from AS would promote aerobic degradation of toluene and many of the CVOCs (see bioremediation below). Under aerobic conditions, organic contaminants are rapidly degraded to carbon dioxide, water, chlorides, and microbial cell mass by microorganisms that use oxygen as the electron acceptor.

Implementability: AS/SVE is a well-established technology that has been used at many sites with similar conditions (geology, depth, and extent of contamination) to treat many of the contaminants present within Areas A and B. Due to the ongoing industrial activities, contamination within the Areas A and B could be treated with multiple vertical or horizontal wells. These wells would need to be installed and the piping run in accessible areas without interrupting permitted Transfer Station activities or compromising Transfer Station infrastructure.

In Situ Chemical Oxidation (ISCO)

ISCO typically involves the introduction of an oxidant into contaminated water via injection to oxidize contaminants. Oxidation reactions can chemically convert hazardous contaminants to nonhazardous or less toxic compounds and elements through the transfer of electrons from the contaminant to the oxidant. When using ISCO, oxidants are injected into the subsurface as a solution, mixed into the ground as a solid, or, in the case of ozone, injected as a gas. Oxidants commonly used include hydrogen peroxide, potassium/sodium permanganate, sodium persulfate, or ozone. In some cases, co-amendments (such as iron in Fenton's reagent reactions) are added to catalyze the reaction. Multiple rounds of injections and follow-on groundwater monitoring are typically needed to provide effective remediation.

Effectiveness: The most important factor to evaluate the effectiveness of this technology is the ability to distribute the oxidizing agent in the estimated area at the required concentration. Due to the heterogeneous subsurface, oxidant delivery problems are anticipated and the radius of influence can vary significantly between injection points or injection rounds. ISCO of unsaturated soils is challenging because the radius of influence is substantially reduced by reagents moving downward under the influence of gravity. In addition, the high carbon coal ash and NAPL would consume much of the oxidant intended for the toluene and CVOCs. ISCO can be applied to both soil and groundwater contamination but would be significantly less effective in the presence of NAPL and coal ash due to the extensive oxidant demand. For this reason, ISCO was not retained for further evaluation.

Bioremediation

Bioremediation is a process in which microorganisms degrade or transform contaminants found in soil and/or groundwater, converting them to less toxic or innocuous end products. Organic contaminants serve two purposes for the microorganisms: they provide a source of carbon, which is one of the basic building blocks of new cell constituents, and they provide electrons, which the organisms can extract to obtain energy. Chlorinated contaminants can also play the role of terminal electron acceptor when oxygen, nitrate, ferric iron, and sulfate have been consumed.

Natural bioremediation relies on indigenous microorganisms under existing site conditions and is likely to occur to some extent regardless of what remedial technology is employed. Enhanced bioremediation is a process in which site conditions are modified to stimulate and enhance the desired microbial activity by adding microorganisms (bioaugmentation); nutrients, organic substrates, and other amendments (biostimulation). Toluene can be an effective source of carbon and electrons for microorganisms, and toluene degradation through oxidative processes can be stimulated by adding electron acceptors such as oxygen, nitrate, and sulfate. The lightly chlorinated CVOCs identified in Areas A and B, such as cis-1,2-dichloroethene (cDCE) and vinyl chloride, could serve as a source of carbon and electrons for some microorganisms, and they could serve as a terminal electron acceptors for other microorganisms. The addition of oxygen could stimulate oxidative degradation of many CVOCs (such as cDCE and vinyl chloride), and the addition of other carbon-based nutrients and appropriate microbes could stimulate degradation of CVOCs by reductive dichlorination.

The remedial timeframe for this technology depends on the microbial community, the target contaminants and their concentrations, and the presence/absence of a continuing source term, such as NAPL and coal ash in this case.

Effectiveness: Most of the compounds observed in Areas A and B (including toluene, cDCE, and vinyl chloride) are amenable to oxidative biodegradation through the addition of oxygen. The success of an oxidative bioremediation application depends on the ability to distribute oxygen in the subsurface. AS/SVE, described above, is one approach to effectively deliver oxygen above and below the water table by entraining oxygen rich air from adjacent areas or the atmosphere. The oxygenation of the soil vapor can help degrade contamination in the unsaturated soil. Oxygen can also partition into groundwater and degrade contamination dissolved in groundwater.

The CVOCs are also amenable to reductive dechlorination if the right microorganisms are in place and the right amendments are added. The cDCE and vinyl chloride that are present may be the result other more chlorinated compounds degrading through reductive dechlorination. Toluene, however, is not amenable to reductive dechlorination, and degradation of toluene may be adversely affected if reductive dechlorination is encouraged through amendment addition. For this reason, enhanced oxidative bioremediation is considered effective and is retained for further evaluation. Reductive dechlorination, to the degree that it is happening naturally is retained, but because it does not address toluene or may interfere with toluene degradation, is not retained for further evaluation.

Implementability: The oxygen required to enhance aerobic bioremediation can be delivered via several methods, depending on the site hydrogeology and access. As noted above, SVE is effective at bringing oxygen into the treatment area. Because SVE wells typically have a large radius of influence, SVE would be expected to be effective at delivering oxygen throughout the treatment areas and would be implementable if wells and associated piping can avoid critical areas for the permitted waste transfer activities. Bioventing wells can also be added to enhance air and oxygen delivery above the water table and would also be implementable due to a fairly large radius of influence. AS and other forms of oxygen injection, such as hydrogen peroxide injection, would be somewhat less implementable because a smaller radius of influence requires more drilling.

In situ Chemical Reduction

This technology involves injecting zero valent iron through direct-push points or soil mixing and is often combined with in situ bioremediation to achieve reductive dechlorinating of CVOCs.

Effectiveness: This technology is effective for CVOCs but is ineffective for toluene and introduction of the reagents to treat the CVOCs could significantly interfere with the ability to treat toluene.

Excavation

Removal of contaminated material would entail excavation of the soil where the contamination is located. Excavated contaminated soils are transported to an appropriate off-site disposal facility based upon physical/chemical characterization of the excavated material. Health risks associated with soil removal and transportation activities must be considered as part of any alternative involving soil removal.

Effectiveness: Excavation of contaminated soil would be effective at removing contamination above the water table. For the contamination below the water table, dewatering would be required, which presents implementability challenges.

Implementability: Because of the locations of Areas A and B relative to infrastructure at the Property, the excavation, backfilling, and surface restoration associated with an excavation remedy would be highly disruptive to the Transfer Station activities. Area B is also adjacent to the newly-installed railroad tracks, the building, and buried utilities, further complicating the implementability of an excavation remedy. Including dewatering and shoring of the excavation further present implementability challenges because larger staging areas and increased time further interfere with Transfer Station operations. Therefore, due to these significant implementability challenges, this technology is eliminated from consideration.

Thermal Remediation

In situ thermal treatment is a process that uses electrical resistance, hot-air/steam injection, or conductive heating to heat soil and groundwater to temperatures above the boiling points of the contaminants. This would increase the volatilization rate of adsorbed VOCs and facilitate extraction through an SVE system. This combination of SVE and thermal treatment, sometimes referred to as thermally enhanced SVE, is a relatively well established technology that can achieve remediation of a wider range of organic contamination in a shorter time frame than SVE alone. Subsurface heating enhances SVE by increasing vapor pressure and diffusivity, increasing permeability, increasing volatility of the contaminants, increasing solubility, and decreasing viscosity (which subsequently increases mobility).

Effectiveness: As an aggressive treatment technology, thermal treatment would be highly effective in treating Areas A and B. This technology is well suited for treatment of contaminants in low permeability materials such as silts and clays which tend to be electrically conductive. However, the historic fill and rubble in Areas A and B is highly variable and in some cases permeable, reducing the electrical conductivity and reducing heating effectiveness. In situ thermal remediation is retained for further evaluation with respect to effectiveness.

Implementability: Thermal remediation would require over 40 electrodes or thermal wells within Areas A and B as well as piping and possibly electrical cables to connect these electrodes/wells to the other components of the thermal remedy. A typical thermal remedy would take over 6 months. Because of the locations of Areas A and B relative to the Transfer Station infrastructure, the drilling, trenching, and piping and operation associated with a thermal remedy would be highly disruptive to the Transfer Station activities for several months.

4.2 Description of Alternatives

Based on detailed screening, the retained technologies are combined with different delivery methods to develop four remedial alternatives. The four alternatives provide a range of cleanup actions for contaminated soil and groundwater within the Specific Treatment Areas. Each remedial alternative includes installation of five monitoring wells and four years of quarterly groundwater monitoring. The following alternatives are considered for evaluation.

Alternative 1 – SVE/bioventing with vertical wells

Alternative 1 consists of applying a vacuum to extract CVOC and toluene mass from the vadose zone within Areas A and B. A separate SVE system will be installed in each of the two Areas. With the applied vacuum, soil vapor will be drawn toward the extraction wells and the extracted vapors are then treated at the surface prior to discharge. An SVE pilot test is recommended to size the blower system and design the off-gas treatment system.

The SVE system for Area A will include a pre-fabricated system placed close to the southeast corner of the Property. The system will include a blower with sufficient power to accommodate extraction from three points based on the results of the SVE pilot test. It is assumed that pilot test results will confirm the need for extracted vapors to be treated with GAC to meet NYSDEC air emissions discharge criteria. Three extraction wells will be installed in Area A. Each extraction well will be constructed of 4-inch diameter Schedule 40 polyvinyl chloride (PVC) with flush-mount well cover. The vapors from each extraction well will be conveyed to the blower enclosure through its own pipe so that air flow for each well can be controlled with a valve at the blower enclosure rather than at the well head. The majority of the piping will be above-ground 3-inch diameter schedule 80 PVC pipe that is along the fence line. The two extraction wells closest to the fence line will be connected to the above-ground piping with a short stretch of below-ground piping. The third well is a contingency well and may not be needed. Due to the distance across the active driveway and disruptions to the permitted waste transfer activities, this third well will not be connected to the above-ground piping with below ground piping. Rather, temporary flexible piping will be used on an as-needed basis for this well if extraction from the other two wells is not adequate.

The SVE system for Area B will include a pre-fabricated blower system placed in the northeast corner of the Property. Based on the results of the SVE pilot test, a blower and a vapor GAC unit will be selected to accommodate the extraction of contaminated vapors from four extraction wells. Each extraction well will be constructed of 4-inch diameter Schedule 40 PVC with flush-mount well cover. The vapors from each extraction well will be conveyed to the blower enclosure through its own pipe so that air flow for each well can be controlled with a valve at the blower enclosure rather than at the well head. The piping will be 3-inch diameter Schedule 80 PVC and will be buried parallel to the railroad tracks from the well location to the blower enclosure. Additional permanently piped extraction wells are not included in Area B because trenching, cutting, or otherwise compromising the concrete slab in this area is not feasible due to the loading requirements of the slab from the heavy equipment.

Vapor extraction will inherently entrain oxygenated air from outside of the treatment area, and once the oxygenated air is within the treatment area, it will help degrade contamination. To accelerate this process and help flush contamination toward the Area B extraction wells, five 4-inch Schedule 40 PVC bioventing wells will be installed within Area B. Bioventing can occur passively or actively. Passive bioventing involves removing the well caps and allowing ambient air to enter the well under the influence of the extraction from the Area B extraction wells. Active bioventing involves injection of air from a bioventing blower, which will be located in a blower enclosure to the northwest of the Transfer Station building. Because of the location of the wells, they cannot be permanently connected to the bioventing blower. Each of the bioventing wells will be equipped with a male cam lock fitting for connection to the bioventing blower via a flexible hose. This setup would allow the operation of the injection wells when sufficient pauses in the waste transfer activities allow.

Figure 4.1 depicts the layout of a SVE/bioventing systems and blower enclosures for Alternative 1.

Alternative 2 – AS/SVE with vertical wells

Similar to Alternative 1, Alternative 2 includes an identical SVE system for each Specific Treatment Area. The same number of vertical SVE wells will be installed under this alternative and the same aboveground infrastructure would be required. Instead of a bioventing system, this alternative includes the installation of AS points to deliver ambient air below the water table to foster bioremediation in groundwater for both Areas. AS points, especially very shallow AS points such as those that would be used at this site, have a limited radius of influence. For full coverage of Areas A and B, AS points would need to be installed with approximately 15 ft between each AS point, resulting in over 100 AS points and associated piping. Given the constraints with installing below-ground piping due to the Transfer Station activities and the concrete slab, the large majority of the AS points would need to be connected with temporary flexible hose. AS would be done by zone on a rotating basis to reduce preferential flow and channeling of the air and increasing overall system efficiency. Figure 4.2 illustrates a potential remedy layout for Alternative 2.

Alternative 3 – SVE/bioventing with horizontal wells

The SVE/bioventing concept in this alternative is the same as that described for Alternative 1. The only difference is that horizontal rather than vertical vapor extraction and bioventing wells are assumed in this alternative. By installing horizontal wells, no disturbances to active areas will occur but the process is more complicated than drilling a conventional vertical well.

Figure 4.3 depicts the horizontal wells and the staging areas that would be used to drill them for Alternative 3. The vapor extraction and bioventing wells would be constructed a minimum of 1 ft above a reasonably expected high water table to reduce occluding the well with groundwater. The depth would likely be approximately 4 to 5 ft below ground surface for most of Areas A and B. Similar to Alternatives 1 and 2, a pilot study would be needed to determine the expected extraction rate, blower sizes, and the off-gas treatment system.

Alternative 4 – AS/SVE with horizontal wells

This alternative is similar to Alternative 3 except that AS wells are used instead of bioventing wells. The AS wells are installed at a depth of approximately 15 ft below ground surface to sparge air below the water table rather than above the water table. Because the zone of influence from the sparging wells is limited compared to the bioventing wells, there are more sparge wells in this alternative than there are bioventing wells for Alternative 3. Similar to Alternatives 1 and 2, a pilot study would be needed to determine the expected extraction rate, blower sizes, and the off-gas treatment system. Figure 4.4 depicts the horizontal wells and the staging areas that would be used to drill them for Alternative 4.

4.3 IRM Selection

The purpose of this section is to select the IRM alternative that will be implemented at the Property. Alternatives 1 through 4 all meet the IRM objective, but each alternative varies in effectiveness in protecting human health and the environment, implementability, and cost. A final evaluation of these three factors will assist in selecting one of the assembled alternatives.

Effectiveness at Protecting Human Health and the Environment

Alternatives 1 and 2 have the highest likelihood of uniformly addressing the high CVOC and toluene concentrations because the locations and rates of vapor extraction and bioventing or AS can be controlled. By contrast, extraction or air injection with horizontal wells will be controlled by the subsurface permeability, which is highly variable due to the nature of the historic fill. Soil vapor and air will move through the more permeable material, and not necessarily through the areas with the highest contamination.

Alternative 2 is likely to be more effective than Alternative 1 because the air from AS is injected below the water table, providing direct treatment of groundwater. By contrast, all air movement in Alternative 1 is above the water table, and treatment of groundwater is achieved indirectly by transfer of VOCs to soil vapor or by transfer of oxygen to groundwater and by natural fluctuations in the water table.

The Alternatives are therefore ranked as follows for effectiveness (most to least effective):

1. Alternative 2
2. Alternative 1
3. Alternative 4
4. Alternative 3

Implementability

The use of horizontal wells helps eliminate risk of interrupting site activities. However, the process of horizontal drilling is more complicated, especially given that drilling would be required through highly heterogenous urban historic fill that includes bricks, concrete, and other items that could cause refusal or loss of drilling fluids. Given the distances to cover through the fill and the need for one-way drilling (instead of surfacing at the far end of the horizontal well), the horizontal wells may fail to reach the target treatment areas. By contrast, multiple vertical wells can be installed in specific areas within an 8-hour period with one of several drilling techniques. If drilling encounters refusal, the well can be installed in a nearby location. Vertical wells have already been successfully installed at the site. For this reason, Alternatives 1 and 2 are more implementable than Alternatives 3 and 4.

Alternative 1 is more implementable than Alternative 2 because the installation, connection, and operation of approximately 100 AS points could be challenging, especially given that temporary flexible hose would be used to connect the AS points to the system piping. If AS is needed to treat targeted areas groundwater, it would be more implementable to conduct this targeted AS after the SVE and bioventing systems have been implemented, especially given that the majority of the contaminant mass is present above the water table.

The Alternatives are therefore ranked as follows for implementability (most to least implementable):

1. Alternative 1
2. Alternative 2
3. Alternative 3
4. Alternative 4

Cost

The costs of the systems are generally comparable because they all involve the extraction of soil vapor and the introduction of air. Alternative 2 would be more expensive than Alternative 1 and Alternative 4 would be more expensive than Alternative 3 because Alternatives 2 and 4 involve significantly more wells for AS.

The Alternatives are therefore ranked as follows for cost (lowest to highest cost):

1. Alternative 1
2. Alternative 2
3. Alternative 3
4. Alternative 4

Selection

Based on the above analysis, a modified version of Alternative 1 has been selected as the IRM. The modified version of Alternative 1 includes the use of targeted AS from vertical AS wells in areas where 1) data from SVE and bioventing operation indicate AS will accelerate mass removal and 2) AS can be reasonably implemented given ongoing Transfer Station activities. This modified version of Alternative 1, which includes components from Alternative 2, meets the IRM objective and therefore protects human health and the environment. It combines the technologies from the two most effective alternatives, is reasonable to implement given ongoing Transfer Station activities, and is cost-effective. Significant progress toward meeting the IRM objectives can be met in a short time frame without complication. In addition, the focus of extraction and bioventing can be controlled to maximize mass removal from specific areas. AS in target areas, where implementable and appropriate, will assist with treatment below the water table.

5.0 IRM

5.1 Implementation

The following scope of work will be performed in a chronological order:

Installation of SVE Wells

As briefly described in Section 4.2 and depicted in Figure 4.1, three SVE wells will be installed in Area A and four SVE wells will be installed in Area B. The SVE wells are placed to maximize treatment from accessible locations. The SVE wells will be constructed of 4-inch diameter Schedule 40 PVC with a flush-mount well cover and a 3-foot long, 4-inch diameter, 30-slot stainless steel wire wrapped well screen. The annulus around the well screen will be backfilled with sand to 2 ft above the screen and then with cement-bentonite grout to the surface. SVE well construction, including the depths of the well is provided in Figure 5.1.

Installation of Bioventing Wells

Five bioventing wells will be installed in the locations depicted in Figure 4.2. The bioventing wells will be constructed of 4-inch diameter Schedule 40 PVC with a flush-mount well cover and a 3-foot long, 4-inch diameter, 30-slot stainless steel wire wrapped well screen installed to the depth of water at the time of drilling. The typical completion depth will be approximately 7 to 10 ft below ground surface. The annulus around the well screen will be backfilled with sand to 2 ft above the screen and then with cement-bentonite grout to the surface. The wells will be fitted with a male cam-lock fitting and a cap that can be removed when the well is connected to the blower with a flexible hose. Bioventing well construction is illustrated in Figure 5.2.

Installation of Groundwater Monitoring Wells

Performance monitoring will include five monitoring wells that will be screened to monitor the CVOC and toluene concentrations in the shallow aquifer. The monitoring wells will be constructed of 2-inch diameter Schedule 40 PVC with a flush-mount well cover and a 10-foot long, 2-inch diameter, 10-slot PVC well screen installed to the target depth of 15 ft or the top of clay, whichever is shallower. The annulus around the well screen will be backfilled with sand to 2 ft above the screen and then with cement-bentonite grout to the surface. The location of the monitoring wells is shown in Figure 4.2. Monitoring well construction is illustrated in Figure 5.3.

Piping and Related Earthwork Activities

The piping and earthwork activities are related to the hard-piped wells of the SVE systems. The three extraction legs for Area A will be aboveground with a short below ground component for two of the wells. The third well will have a male cam-lock fitting for connection to temporary flexible pipe. The four extraction legs for Area B are below ground. The piping runs are illustrated and described on Figure 4.1. All header pipes will be constructed of 3-inch diameter Schedule 80 PVC.

All below ground piping will be installed in shallow trenches sufficient to cover the pipes to avoid tripping hazards or inadvertent damage. Deeper trenching is avoided to minimize short circuiting the vacuum created by the SVE wells. Piping will be placed and trenches will be backfilled in native fill if suitable. If native fill is not of sufficient uniformity and particle size, select fill will be used. Extraction legs will be installed with a minimum slope of 0.1 ft per 100 ft to drain condensate back to the extraction wells rather than toward the SVE blowers. Below ground pipe for the Area B wells will surface at the location of the blower enclosure that will be placed after the SVE pilot test.

SVE and Bioventing Pilot Test

The primary objectives of the SVE pilot test are as follows:

- develop full-scale SVE design parameters by determining the wellhead flow rates, vacuums/pressures, and blowers; and
- determine the appropriate off-gas treatment unit.

The SVE pilot test will be conducted after the installation of the SVE, bioventing, monitoring wells, and all of the extraction network piping and related earthwork activities. This will allow the pilot test to be conducted at the end of the extraction piping legs rather than at the well heads. The pilot testing will be conducted with a rented regenerative blower capable of extracting over 80 standard cubic ft per minute (scfm) at a vacuum of 20 inches of water, over 60 scfm at a vacuum of 30 inches of water, and a maximum vacuum of over 60 inches of water. A conceptual schematic of the pilot test system is illustrated on Figure 5.4.

Prior to testing a well, the water level will be measured in each well and compared to the depth of the extraction well screen. The distance between the measured water level and the middle of the well screen will be used to determine the maximum vacuum applied to the well during testing. For example, if the middle of the well screen is 3 ft above the water table, then the maximum vacuum applied to the well will be 36 inches of water. Air flow and vacuum from the well will be controlled by throttling flow with the valve and/or opening or closing the air inlet valve.

Each well will be tested for approximately six hours starting at one third of the maximum vacuum to be applied for that well. After two hours, the vacuum (and consequently the extraction rate) will be increased to two thirds of the maximum vacuum. After two hours at two thirds of the maximum vacuum, the extraction rate will be increased to the maximum vacuum to be applied to that well. After two hours of operating at the maximum vacuum (a total of six hours of extraction), a vapor sample will be collected for analysis using method TO-15 for VOCs and the test will be discontinued. During the test, vacuum, flow rate, VOCs (using a photoionization detector (PID)), oxygen and carbon dioxide (using a gas meter) will be measured at the end of the extraction pipe before the blower and ambient air inlet. Vacuum will also be measured at the ends of the other extraction well pipes in the Specific Treatment Area undergoing a test to evaluate the vacuum influence at nearby extraction wells. To the degree accessible during the testing, vacuums will also be measured at the other wells in the tested Specific Treatment Area using a hand-held vacuum gauge. Measurements will be attempted at 15-minute intervals during testing and at 15-minute intervals after extraction has been discontinued to measure recovery. Barometric pressure will also be measured throughout the testing to account for potential changes from barometric pressure. Only one extraction well be tested per day, requiring approximately 2 days for testing in Area A and 4 days of testing in Area B.

The Area B bioventing wells will also be tested to determine the flow rate and pressures that can be delivered to each of the wells. The testing will be conducted with the same size blower as the SVE testing. On a pre-arranged Sunday, when no Transfer Station activity is expected, each Area B bioventing well will be tested by injecting air. Flexible piping will be used to connect the blower to the bioventing well to be tested. For each well, air will be injected at a pressure of 20 inches of water for 1 hour and 40 inches of water for another hour. Pressure and injection flow rate will be measured for the test well, and pressure will be measured at each of the other wells in Area B at 15-minute intervals. The pressure will also be measured at each of the other wells in Area B at 15-minute intervals for 1 hour after injection has stopped to measure recovery. Testing for each well will take approximately 3 hours, allowing all four bioventing wells to be tested in one 12-hour shift on a Sunday.

The individual SVE and bioventing well testing will be used to select extraction rates and applied vacuums for each well for full system operation. On an additional pre-arranged Sunday, when no Transfer Station activity is expected, the Area A extraction system will be tested for 8-hours to confirm that the selected extraction rates for full system operation are achievable and appropriate. If necessary, a larger blower unit will be used. During the test, vacuum, flow rate, VOCs (using a PID), oxygen and carbon dioxide (using a gas meter) will be measured for each active extraction well. Vacuum will also be measured in the third Area A extraction well and in the two Area A groundwater monitoring wells at 15 minute intervals. After approximately 8 hours of extraction, a vapor sample will be collected for analysis using method TO-15. On a separate pre-arranged Sunday when no Transfer Station activity is expected, the Area B extraction system will undergo similar testing and monitoring. For the first eight hours, only the Area B extraction system will operate, and a vapor sample will be collected at the end of the eight hours. For the second eight hours, the Area B bioventing and extraction systems will operate, and a sample of extracted vapor will be collected at the end of the testing. During both eight-hour periods, vacuum, flow rate, VOCs (using a PID), oxygen and carbon dioxide (using a gas meter) will be measured for each active extraction well. Vacuum will be measured in the Area B groundwater monitoring wells before each test, at 15 minute intervals for the first two hours of each test, and once at the end of each test.

Installation of the SVE Blower Systems

Two pre-fabricated SVE blower systems with regenerative blowers will be installed on the Property as shown on Figure 4.1 to provide treatment for Areas A and B. Each SVE system will include a moisture separator, vacuum blower, storage tank for condensate, off-gas treatment (assumed to be GAC units), and the necessary controls/instrumentation system to monitor SVE system operation remotely and provide notification alarms. A process flow diagram for the two SVE systems is provided in Figure 5.6.

For each of the two systems a regenerative-type blower will be selected to support the design flow rates at the design vacuums. Blower sizes and configurations will be based on the results from the proposed SVE pilot studies. A system head loss curve will be developed. This curve is a function of flow rate and vacuum loss. Total system loss includes vacuum loss at the wells, vacuum loss in the piping, vacuum loss through the SVE unit, and pressure drop across the carbon. Final blower selection will be made based on the sum of flow rates, sum of system losses, and maintenance requirements. The blower will be equipped with a variable speed drive unit that will allow manual motor speed adjustments to be made in order to optimize soil vapor extraction rate and energy demand. The blower exhaust manifold will be constructed of carbon steel pipe and equipped with a thermometer and a thermostat to shut down blower on high temp condition caused by low air flow. A discharge silencer will also be included and the exhaust stack will be vented at least 15 ft above ground.

At present, no data are available to complete calculations using the NYSDEC's Division of Air Resources DAR-1 *Guidelines for the Control of Toxic Ambient Air Contaminants* and assess the need of off-gas treatment. During the SVE pilot test, samples will be collected and analyzed for VOCs. The preliminary remediation system design assumes that off-gas treatment is needed but sampling data will be submitted to DAR for permit consideration. The off-gas treatment will have a bypass in case it is not needed throughout the treatment duration. The proposed treatment unit is expected to be housed in the same enclosure with the blower and is anticipated to include two vapor GAC vessels. The GAC vessels will be operated in series and will be equipped with an outlet pressure gage, an outlet sample port, and a drain port.

Installation of Bioventing Blower System

A single bioventing system will be installed adjacent to the northwest corner of the waste transfer building (Figure 4.1) to provide oxygen to bioventing wells. The bioventing test will provide an approximate air injection rate and radius of influence based on the air permeability of the subsurface and a range of flow rates and injection pressures in order to determine the final size of the blower. In addition to the blower, the system will include inlet air filters, differential pressure indicators, and various control components. The total air design requirement for the bioventing process will be lower than extraction rate for Area B. The system will operate only during periods of extended Transfer Station inactivity (such as most Sundays or off hours during the week). The blower discharge will be routed through flexible hoses to the five bioventing wells. Due to the manual requirements for system start-up and shutdown, system controls will not include telemetry for remote monitoring and system control.

System Operation

The two SVE systems will operate continuously within the design vacuum and flow rate ranges determined from the pilot testing. The vacuums and flow rates for each extraction well will be monitored remotely twice a week, and the system will be inspected by trained personnel at least once per month. VOCs, oxygen, and carbon dioxide from each extraction well will be measured with a PID and gas meter monthly to provide a quantitative estimate of mass removal and mass degradation.

Off-gas vapor sampling will comply with the air permit, if required, and at a sufficient frequency to change out off-gas treatment media. Off-gas sampling will be no less frequent than once every six months at the sampling port before the off-gas treatment units to provide information for mass removal calculations. Collected condensate will be disposed of off-site at an appropriate facility. All system alarms will be responded to within 24 hours and addressed within 72 hours. If issues cannot be addressed within 72 hours, NYSDEC will be notified.

The SVE systems will operate for 30,000 hours within the design flow rate range, which is equivalent to four years of operation with over 85% up time. Every 7,500 hours of operation (annually), WMNY will meet with NYSDEC to discuss the conceptual site model, contaminant mass removal, system performance, and contaminant concentration trends in groundwater. WMNY and NYSDEC will discuss and agree upon potential operational changes to the existing system to improve mass removal. At the conclusion of the 30,000 hours of operation (or earlier as determined by WMNY and NYSDEC), the IRM will have been completed and the IRM report and site management plan will be submitted.

The bioventing system will be operated as Transfer Station operations allow. The bioventing system will operate for a minimum of 3,000 hours (or less as determined by WMNY or NYSDEC). WMNY will discuss the operating time of the bioventing system with NYSDEC during the annual meetings, and potential operational changes to the bioventing system will be discussed and agreed upon.

AS Implementation

The use of AS in place of bioventing will be considered after 15,000 hours of SVE operation and 1,500 hours of bioventing operation to allow SVE and bioventing to substantially treat the contamination and help identify target areas for AS.

5.2 IRM Performance Objectives and Performance Evaluation

The IRM performance objectives are to remove toluene and CVOC mass from Areas A and B through a defined period of SVE operation (30,000 hours) and bioventing operation (3,000 hours). Performance metrics will include the following:

- Mass removal for individual extraction rates as calculated by multiplying the extraction rate by the PID vapor concentrations and appropriate conversion factors.
- Mass degradation as calculated multiplying the extraction rate by the carbon dioxide concentrations and applying and converting the results to degraded toluene mass.
- Potential bioventing mass degradation as calculated by multiplying the oxygen concentration in ambient air by the bioventing injection rates and appropriate conversion factors.
- Compound-specific mass removal for each SVE system as calculated by multiplying the total system extraction rate by the CVOC and toluene concentrations detected in the TO-15 analysis from the extracted air.
- Contaminant concentrations and concentration trends in groundwater as determined by quarterly monitoring from the five IRM monitoring wells.

The IRM performance will be evaluated through the use of these metrics, which together provide a means of evaluating mass removed by the IRM over time and improving groundwater concentrations in the Specific Treatment Areas over time. These metrics will be quantified, reported, and discussed with NYSDEC on an annual basis, used to improve system performance over the next annual period of operation, and used to evaluate potential target areas for AS.

5.3 Soils/Materials Management Plan

This plan has been created to describe the procedures that will be employed during the handling of soil cuttings and development water from well installation and purge water from groundwater sampling.

Soil cuttings, development water, and purge water will be containerized in drums and stockpiled on site for off-site disposal at an approved facility. This stockpiled material will be tested to determine disposal requirements. Off-site material transport will be conducted in USDOT approved containers using licensed haulers, following all Federal, State, and local laws and regulations. All transport of material will be performed by licensed haulers in accordance with local, State, and Federal regulations, including 6 NYCRR Part 364. Haulers will be appropriately licensed and trucks properly placarded. An insignificant number of truck trips are anticipated relative to normal traffic for the area.

All soil cuttings, development water, and purge water removed from the Property as part of this IRM will be treated as contaminated and regulated material and will be transported and disposed in accordance with all local, State (including 6 NYCRR Part 360) and Federal regulations.

Appropriate disposal facilities will be chosen depending on the outcome of testing results. Soil and water will be transported to the designated disposal facilities while adhering to all Federal, State, and local rules and regulations. All required facility information will be reported to the NYSDEC Project

Manager before commencing disposal activities. This will include estimated quantities and a breakdown by class of disposal facility if appropriate (i.e., hazardous waste disposal facility, solid waste landfill, petroleum treatment facility, construction/demolition recycling facility). Actual disposal quantities and associated documentation will be reported to the NYSDEC in the IRM Report. This documentation will include waste profiles, test results, facility acceptance letters, manifests, bills of lading and facility receipts.

Soil cuttings taken off-site will be handled, at minimum, as a Municipal Solid Waste per 6 NYCRR Part 360-1.2. Material that does not meet Track 1 Unrestricted Use Soil Cleanup Objectives (SCOs) is prohibited from being taken to a New York State recycling facility (6 NYCRR Part 360-16 Registration Facility).

5.4 Engineering Controls (ECs)

Engineering controls will be used during drilling and pilot testing to control vapors and odors as needed. Mechanical ventilation may be used. Dust suppression with water will also be implemented as needed to prevent migration of particles from leaving the site. Upon completion of the remedy, the surface will be restored to the specifications of the Transfer Station solid waste permit. Engineering controls will be further developed in the Site Management Plan (SMP).

5.5 Institutional Controls (ICs)

The IRM Report will propose an Environmental Easement to be placed on the Property as part of the Site Management Plan. Upon NYSDEC approval of the IRM Report, this institutional control will be an appendix of the Site Management Plan and will be recorded by the Queens County Clerk’s office.

5.6 Site Management Plan

Site Management is the last phase of remediation and begins with the approval of the IRM Report and issuance of the Certificate of Completion (COC) for the IRM. The SMP is submitted as part of the IRM but will be written in a manner that allows its future incorporation into the Transfer Station’s solid waste permit. The property owner is responsible to ensure that all Site Management responsibilities defined in the SMP are performed.

The SMP is intended to provide a detailed description of the procedures required to manage the toluene and CVOC contamination remaining within the Specific Treatment Areas, including 1) implementation and management of all ECs and ICs; 2) media monitoring; 3) operation and maintenance of the SVE and bioventing systems; 4) performance of periodic inspections, certification of results, and submittal of Periodic Review Reports; and 5) defining criteria for termination of treatment system operations.

To address these needs, this SMP will include the following three plans:

- Engineering and Institutional Control Plan for implementation and management of EC/ICs;
- Monitoring Plan for implementation of Site Monitoring; and
- Operation and Maintenance Plan for operation of the SVE and bioventing systems if NYSDEC requires them to continue to operate after the IRM.

The SMP will be prepared in accordance with the requirements in NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation, dated 2010. The initial Periodic Review Report documenting site management activities, reporting, and EC/IC certification will be due 18 months after NYSDEC issues the Certificate of Completion and annually thereafter. Dependent on the date of the

Certificate of Completion, NYSDEC and WMNY will determine a mutually acceptable due date for the annual reporting. All handling of residual contaminated material will be subject to provisions contained in the SMP.

6.0 IRM Program

6.1 Project Organization and Oversight

The WMNY Project Manager will be Glen Schultz. The Remedial Engineer (RE) for this project is Joseph Fiteni (NYSPE) of Savin Engineers, P.C. The Quality Assurance Manager (QAM) will be a representative of the construction contractor. The Quality Control Manager (QCM) will be Douglas Sutton (Ph.D., New Jersey PE) of HGL. The field oversight scientist/engineer will report to the QCM and will provide daily summary reports to document that the IRM is implemented in accordance with this IRM Work Plan, Quality Assurance Project Plan (QAPP), and supporting documents. The field oversight scientist/engineer will promptly report any deviations from these documents to the RE, QAM, and QCM so that the issue can be rectified in a timely manner. The Project-Specific Safety Coordinator will be a qualified representative from the construction contractor. He will document that the IRM is implemented in accordance with the HASP and will report to Glen Schultz. An organization chart is included in Figure 6.1. Resumes of key personnel involved in the IRM are included in Appendix B.

6.2 Security and Work Hours

The Transfer Station is currently operated Monday through Saturday 24 hours per day as a permitted solid waste facility. Operation may also occur on Sundays but is infrequent. IRM construction work is anticipated to occur on Sundays when Transfer Station activities can be temporarily discontinued for eight hours or more, including evening/overnight hours. SVE operation will be continuous because it will not adversely affect Transfer Station operations. Bioventing operation will be conducted as time allows, including extensive operation on most Sundays. Security is maintained at the site 24 hours per day, 7 days per week.

6.3 Quality Assurance Project Plan

The QAPP describes the quality control components used to guide sampling and analytical procedures used to collect data to guide and evaluate the IRM. The QAPP is attached in Appendix C.

6.4 Health and Safety Plan

The HASP is included in Appendix D. The Project-Specific Safety Coordinator will be a qualified representative of the construction contractor. Work performed under this IRM will be in compliance with the HASP and applicable health and safety laws and regulations, including OSHA worker safety requirements and HAZWOPER requirements. Project-specific training will be provided to field personnel. Emergency telephone numbers will be posted at the site location before any IRM work begins. A safety meeting will be conducted before each shift begins. Topics to be discussed include task hazards and protective measures, emergency procedures, PPE levels, and other relevant safety topics. Meetings will be documented in a log book or specific form. An emergency contact sheet with names and phone numbers is included in the HASP.

6.5 Community Air Monitoring Plan

Air monitoring for VOCs at the perimeter of the exclusion zone or work area will be performed during drilling and during the handling of contaminated or potentially contaminated media. Dust generation from waste or contaminated soil is not expected because the soil will be moist. Exceedances of VOC action levels observed during performance of the Community Air Monitoring Plan (CAMP) will be reported to the NYSDEC Project Manager and included in the Daily Report.

VOCs will be monitored using a PID at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis during drilling. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work will be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment will be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If the ambient air concentration of total VOCs at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the levels readily decrease (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.
- If total VOCs at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that levels 200 ft downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less, but in no case less than 20 ft, is below 5 ppm over background for the 15-minute average.
- If the VOC level is above 25 ppm at the perimeter of the work area, activities will be shutdown.

All 15-minute readings must be recorded and be available for NYSDEC Division of Environmental Remediation (NYSDEC DER) personnel to review. Instantaneous readings, if any, used for decision purposes will also be recorded.

6.6 Permits and Approvals

All permits or government approvals required for IRM implementation have been or will be obtained prior to the start of implementation. Approval of this IRM by NYSDEC does not constitute satisfaction of these requirements and will not be a substitute for any required permit.

6.7 Field Operations and Preparation

Field Operations Plan

A field operations plan will document specific field procedures and decision logic for addressing upset or unexpected conditions. This field operations plans will be provided to NYSDEC for informational purposes.

Pre-construction Notification and Meeting

A pre-construction notification will be given to NYSDEC seven days prior to the start of drilling. NYSDEC will also be invited to the preparation meeting prior to the first day of pilot testing.

Mobilization

All remedial equipment will be delivered to the property via normal trucking routes, and will be stored on-site.

Stabilized Construction Entrances

The IRM does not necessitate construction entrances.

Utility Marker Layouts, Easement Layouts

The property owner and its contractors are solely responsible for the identification of utilities that might be affected by work conducted under this IRM Work Plan. The property owner and its contractors are solely responsible for safe execution of all invasive and other work performed under this IRM Work Plan.

Soil and Erosion Control Measures

An Erosion and Sediment Control Plan (ESCP) will be developed in conformance with requirements presented in the New York State Guidelines for Urban Erosion and Sediment Control. Best Management Practices (BMPs) for soil erosion will be selected to minimize erosion and sedimentation off-site from the start of the IRM to completion. The ESCP will include the following information:

- Descriptions of the selected BMPs that will be used to control erosion and sedimentation.
- Map showing the location of the proposed BMPs.
- Implementation schedule and maintenance requirements for the proposed BMPs.
- For active work zones, a perimeter BMP system will be installed and maintained to contain soil and sediment.

Accumulated sediment in the BMPs that is removed will be included with stockpiled material from drilling and excavation activities and will be managed in accordance with Section 5.3.

Equipment Staging

Equipment and reagent staging areas will be designated during the IRM to facilitate work and prevent in advertent releases of reagents.

Decontamination Area

A temporary decontamination area lined with polyethylene sheeting will be constructed for steam-cleaning or washing of equipment before equipment is taken off site. The location of the decontamination area will be coordinated with the facilities manager. At a minimum, the decontamination pad will have a 30 mil low-permeability liner, be bermed and sloped to a collection sump to contain and collect fluids, and have side walls to mitigate, to the extent practicable, errant overspray, especially when decontaminating large equipment. Wash waters will be collected and properly disposed of in accordance with regulations.

Demobilization

After IRM work is complete, all areas disturbed to accommodate support areas (e.g., staging areas, decontamination areas, storage areas), will be restored to conditions acceptable to the facilities manager. Temporary access areas (on-site and off-site) will be removed and disturbed access areas will be returned to conditions acceptable to the facilities manager. All sediment and erosion control measures will be removed and materials will be disposed in accordance with applicable rules and regulations.

6.8 Reporting and Recordkeeping

During construction, daily logs will be maintained, and throughout the IRM, monthly reports will be submitted. The Remedial Engineer will be responsible for certifying all reports and will be an individual licensed to practice engineering in the State of New York. All construction daily logs during a month will be included in that monthly report. The monthly reports throughout the IRM will be included in the IRM Report.

Daily logs for construction will include a brief description of activities conducted during the day, wells drilled, samples collected, waste generated, CAMP monitoring results, and any corrective actions taken.

Monthly reports will be submitted no later than two weeks following the end of the month in electronic format (PDF) only. All monthly reports will be submitted to the NYSDEC Project Manager and NYSDOH. These reports will include a description of the work done during the reporting period. During construction, this will include information such as wells drilled. During operation, this will include hours of operation, inspection findings, flow rate measurements, sampling results, and calculation of the metrics identified in Section 5.2 of this work plan. Any deviations from this IRM Work Plan will also be provided, including an explanation for the change. The planned activities for the next month, an updated schedule, and any anticipated problems will also be stated.

IRM construction activities will be photographed and submitted to the NYSDEC. They will clearly illustrate the identified locations of structures involved in the cleanup. A photo log will be created to include the photograph, date, and brief description of the photograph. The photo log will be submitted to the NYSDEC in their approved format, compact disc, or other acceptable media at an agreed upon frequency. All relevant photographs and other reports will be kept at the job location at all times for reference and inspection by NYSDEC staff. Information will be submitted in Electronic Data Deliverable (EDD) format pursuant to NYSDEC DER requirements. Data will be formatted to meet the guidelines specified by NYSDEC.

6.9 Complaint Management

All complaints filed by the public regarding any problems with the IRM will be kept on file and reviewed by the RE, QAM, and QCM. During IRM activities a sign will be prominently displayed indicating a cleanup is in progress. Also on this sign will be a complaint hotline phone number to be used if odors or any other hazards are detected by the public during the IRM.

6.10 Deviation from the IRM Work Plan

Any changes to the scope of work as stated in this plan will be noted in Monthly Progress Reports and the IRM Report. Any change will be accompanied by the reasons for the change, approval process for the change, and the effects that the change will have on the overall IRM.

6.11 Data Usability Summary Report

Dr. Sutton will prepare a Data Usability Summary Report. A copy of this report will be included in the IRM Report.

7.0 IRM Report

An IRM Report will be submitted to NYSDEC following implementation of the IRM defined in this IRM Work Plan. The IRM Report provides the documentation that the work required under this IRM Work Plan has been completed and has been performed in compliance with this plan. The IRM Report will provide a comprehensive account of all remediation wells and associated measurements and samples. The IRM Report will provide a description of the changes in the IRM from the elements provided in the IRM Work Plan. The IRM Report will provide a tabular summary of all performance evaluation sampling results and all material characterization results and other sampling and chemical analysis performed as part of the IRM. The IRM Report will be prepared in conformance with DER-10.

The IRM Report will include written and photographic documentation of the IRM.

The IRM Report will include an itemized tabular description of actual costs incurred during all aspects of the IRM.

The IRM will include an accounting of the destination of all IRM-related waste removed from the Property, including soil cuttings, development water, and purge water. Documentation associated with disposal of all material will also include records and approvals for receipt of the material. It will provide an accounting of the origin and chemical quality of all IRM-related material for backfill imported onto the Property, if any.

All project reports must be submitted in digital form on electronic media (PDF).

8.0 Schedule

Construction of the IRM will commence within 210 days of IRM Work Plan approval. Construction, including drilling, earth work, pilot testing, blower system delivery, and startup is expected to take approximately 210 calendar days due to the requirements for working on Sundays. Operation will then commence for 30,000 hours of SVE operation and 3,000 hours of bioventing operation, which is anticipated to take approximately four years.

TABLES

Table 4.1: Remedial Technology Screening Summary

Technology	Effectiveness Analysis	Effectiveness Result	Implementability Analysis	Retained for Alternative Development
Institutional Controls	Only effective in combination with other treatment methods. Essential in controlling access during planning and implementation of any remedial technology	Retained	Easy to implement. Property controls already in place.	Yes
Groundwater Extraction and Treatment	Mass removal occurs over a long period of time. Groundwater extraction is limited by the shallow, thin perched water. Groundwater extraction does not address contamination above the water table.	Not retained	Not applicable	No
Air Sparging, Soil Vapor Extraction, and Bioventing	Effective at removing VOC mass above and below water table. Also promotes aerobic degradation.	Retained	Because of the large radius of influence, SVE and bioventing are implementable using vertical or horizontal wells drilled from accessible areas of the site. Air sparging is less implementable because of the small radius of influence and the need to work and construct infrastructure in high traffic areas. Air sparging could only be used in targeted areas.	Yes

Table 4.1: Remedial Technology Screening Summary (continued)

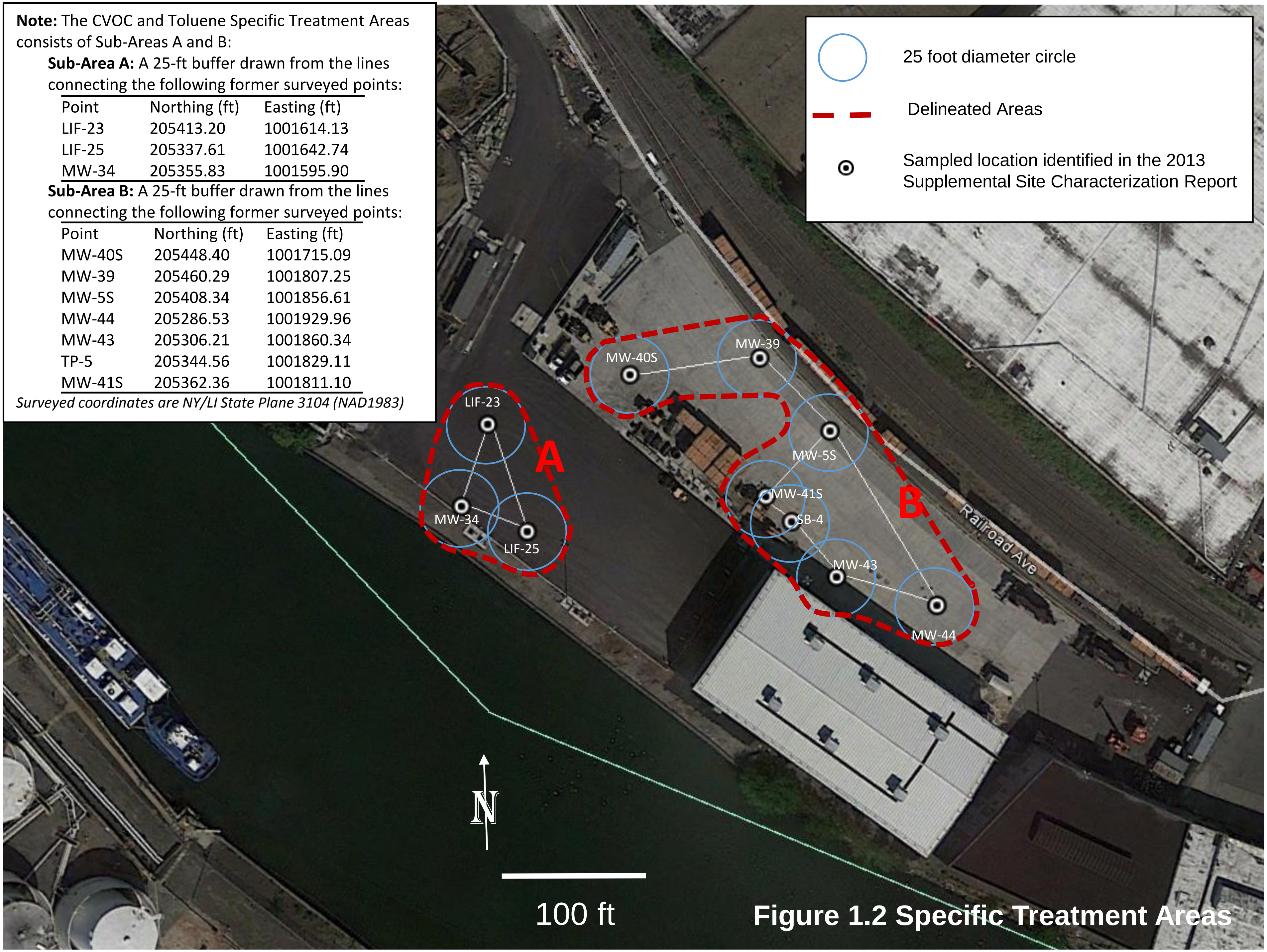
Technology	Effectiveness Analysis	Effectiveness Result	Implementability Analysis	Retained for Alternative Development
In situ Chemical Oxidation	Effective if proper dose and distribution can be achieved, but presence of high organic NAPL and coal ash in treatment area will result in an impractically high dose.	Not retained	Not applicable	No
Bioremediation	Oxidative pathways are effective for many of the CVOCs at this site (such as cis-1,2-dichloroethene and vinyl chloride). It is also very effective for toluene. Reductive dechlorination pathways are effective for the CVOCs but ineffective and detrimental to remediation of toluene.	Oxidative pathway is retained. Reductive dechlorination is not retained.	Implementable at the Property using bioventing and SVE because the large radius of influence allows oxygenation from accessible areas. Less implementable from injections of liquid substrates because of the limited radius of influence and the need to drill many wells or boreholes in areas with high Transfer Station traffic.	Yes
In situ Chemical Reduction	Effective for CVOCs but ineffective and detrimental to remediation of toluene.	Not retained.	Not applicable	No

Table 4.1: Remedial Technology Screening Summary (continued)

Technology	Effectiveness Analysis	Effectiveness Result	Implementability Analysis	Retained for Alternative Development
Excavation	Effective if extended to remove contaminant mass below the water table.	Retained	Target areas are in high traffic areas with busy schedules. Excavation could not be accomplished, backfilled, and resurfaced quickly enough to accommodate operations. Dewatering and excavation shoring would expand duration and footprint of excavation, further interfering with Transfer Station operations.	No
Thermal remediation	Typically, effective for VOCs but performance in and side effects from thermal remediation in coal ash material is unknown. In addition, fill is typically not electrically or thermally conductive, creating potential challenges to effectiveness.	Retained	Target areas are in high traffic areas with busy schedules. Electrode installation, trenching, and resurfacing would substantially interfere with Transfer Station operations.	No

FIGURES

Figure 1.1 Site Location Map



Note: The CVOC and Toluene Specific Treatment Areas consists of Sub-Areas A and B:

Sub-Area A: A 25-ft buffer drawn from the lines connecting the following former surveyed points:

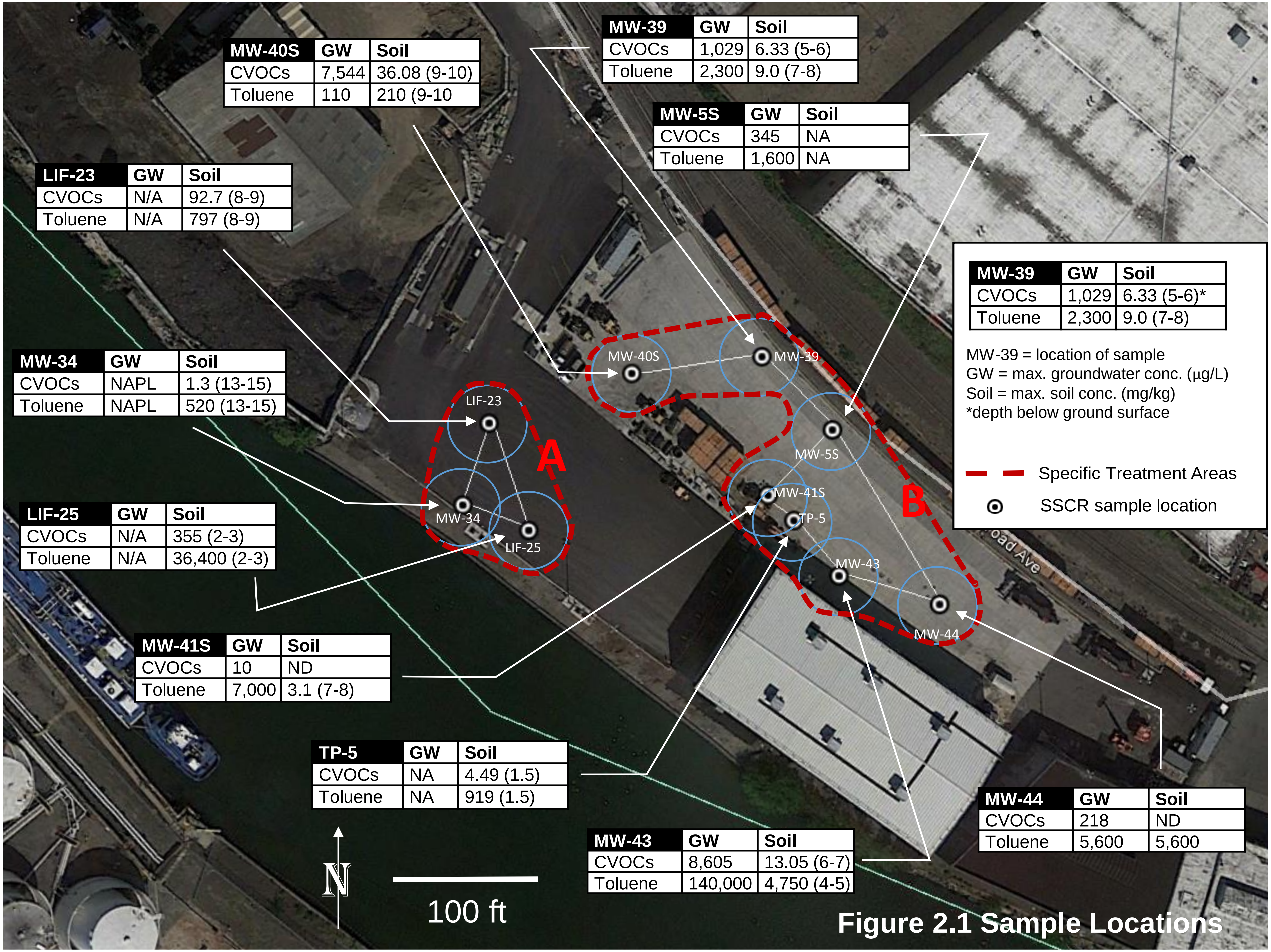
Point	Northing (ft)	Easting (ft)
LIF-23	205413.20	1001614.13
LIF-25	205337.61	1001642.74
MW-34	205355.83	1001595.90

Sub-Area B: A 25-ft buffer drawn from the lines connecting the following former surveyed points:

Point	Northing (ft)	Easting (ft)
MW-40S	205448.40	1001715.09
MW-39	205460.29	1001807.25
MW-5S	205408.34	1001856.61
MW-44	205286.53	1001929.96
MW-43	205306.21	1001860.34
TP-5	205344.56	1001829.11
MW-41S	205362.36	1001811.10

Surveyed coordinates are NY/LI State Plane 3104 (NAD1983)

Figure 1.2 Specific Treatment Areas



MW-40S	GW	Soil
CVOCs	7,544	36.08 (9-10)
Toluene	110	210 (9-10

MW-39	GW	Soil
CVOCs	1,029	6.33 (5-6)
Toluene	2,300	9.0 (7-8)

MW-5S	GW	Soil
CVOCs	345	NA
Toluene	1,600	NA

LIF-23	GW	Soil
CVOCs	N/A	92.7 (8-9)
Toluene	N/A	797 (8-9)

MW-34	GW	Soil
CVOCs	NAPL	1.3 (13-15)
Toluene	NAPL	520 (13-15)

LIF-25	GW	Soil
CVOCs	N/A	355 (2-3)
Toluene	N/A	36,400 (2-3)

MW-41S	GW	Soil
CVOCs	10	ND
Toluene	7,000	3.1 (7-8)

TP-5	GW	Soil
CVOCs	NA	4.49 (1.5)
Toluene	NA	919 (1.5)

MW-43	GW	Soil
CVOCs	8,605	13.05 (6-7)
Toluene	140,000	4,750 (4-5)

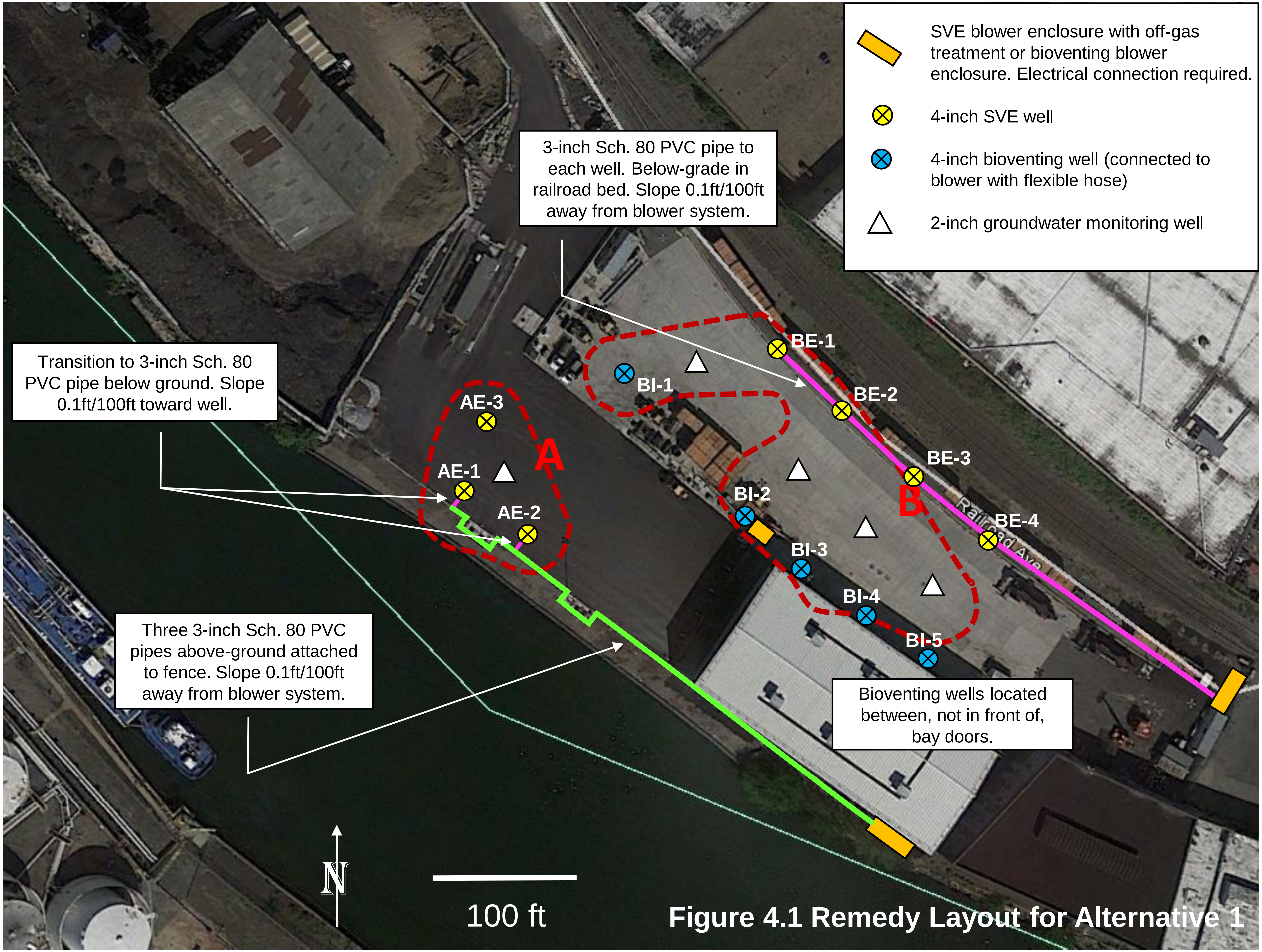
MW-44	GW	Soil
CVOCs	218	ND
Toluene	5,600	5,600

MW-39	GW	Soil
CVOCs	1,029	6.33 (5-6)*
Toluene	2,300	9.0 (7-8)

MW-39 = location of sample
GW = max. groundwater conc. (µg/L)
Soil = max. soil conc. (mg/kg)
*depth below ground surface

▬ ▬ Specific Treatment Areas
⊙ SSCR sample location

Figure 2.1 Sample Locations



SVE blower enclosure with off-gas treatment or bioventing blower enclosure. Electrical connection required.

⊗ 4-inch SVE well

⊗ 4-inch bioventing well (connected to blower with flexible hose)

△ 2-inch groundwater monitoring well

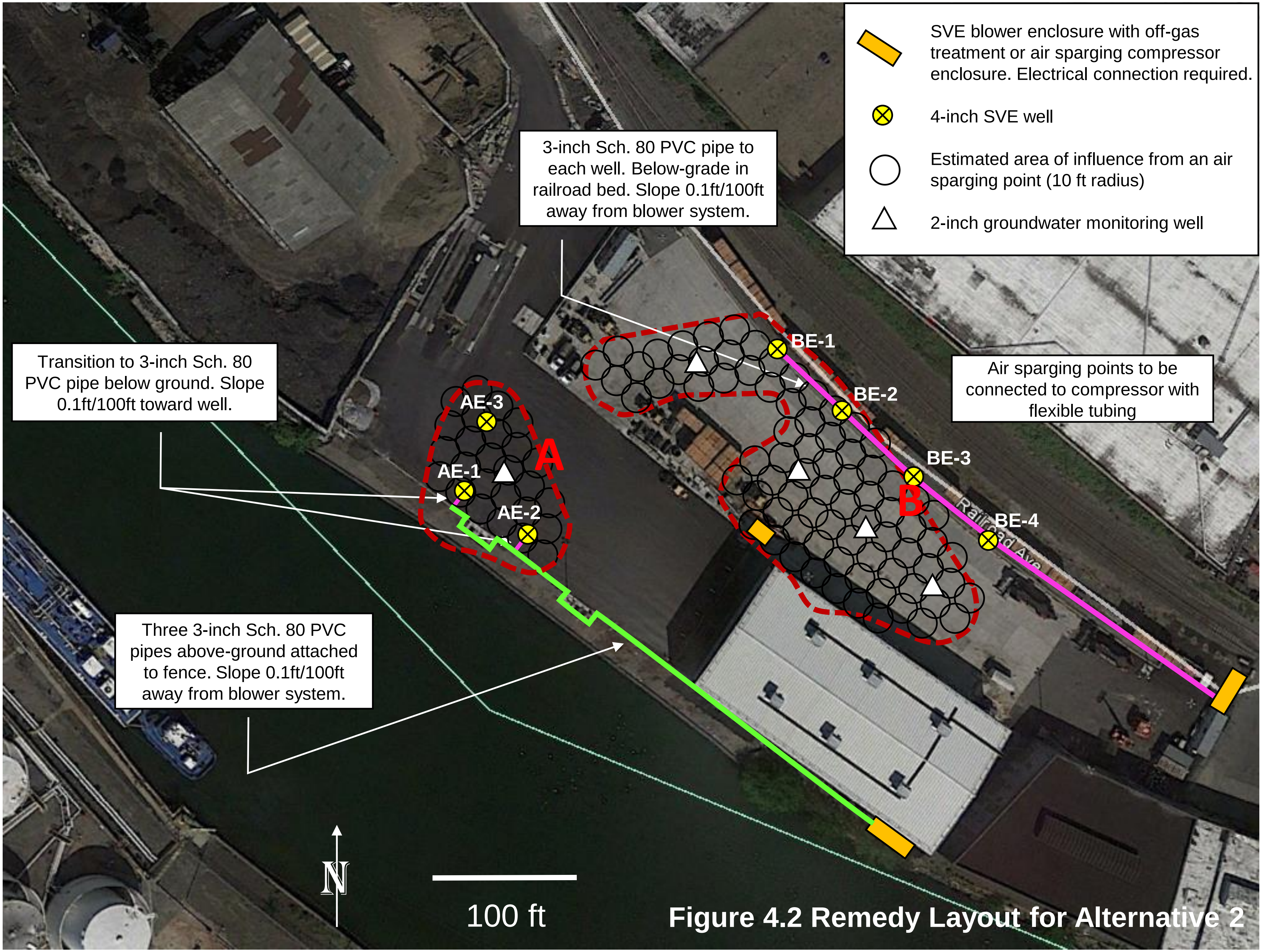
3-inch Sch. 80 PVC pipe to each well. Below-grade in railroad bed. Slope 0.1ft/100ft away from blower system.

Transition to 3-inch Sch. 80 PVC pipe below ground. Slope 0.1ft/100ft toward well.

Three 3-inch Sch. 80 PVC pipes above-ground attached to fence. Slope 0.1ft/100ft away from blower system.

Bioventing wells located between, not in front of, bay doors.

Figure 4.1 Remedy Layout for Alternative 1



3-inch Sch. 80 PVC pipe to each well. Below-grade in railroad bed. Slope 0.1ft/100ft away from blower system.

Transition to 3-inch Sch. 80 PVC pipe below ground. Slope 0.1ft/100ft toward well.

Air sparging points to be connected to compressor with flexible tubing

Three 3-inch Sch. 80 PVC pipes above-ground attached to fence. Slope 0.1ft/100ft away from blower system.

Figure 4.2 Remedy Layout for Alternative 2

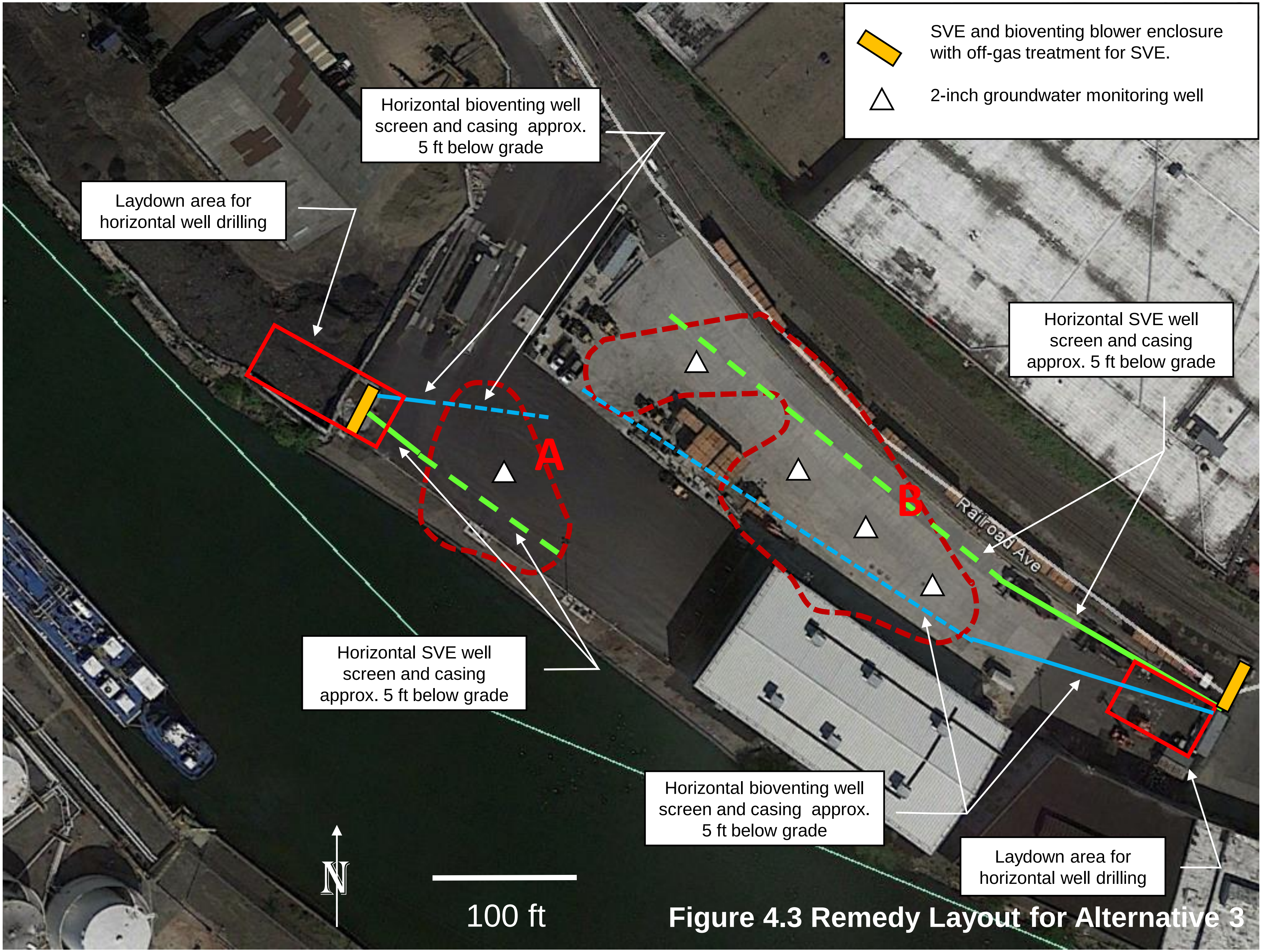


Figure 4.3 Remedy Layout for Alternative 3

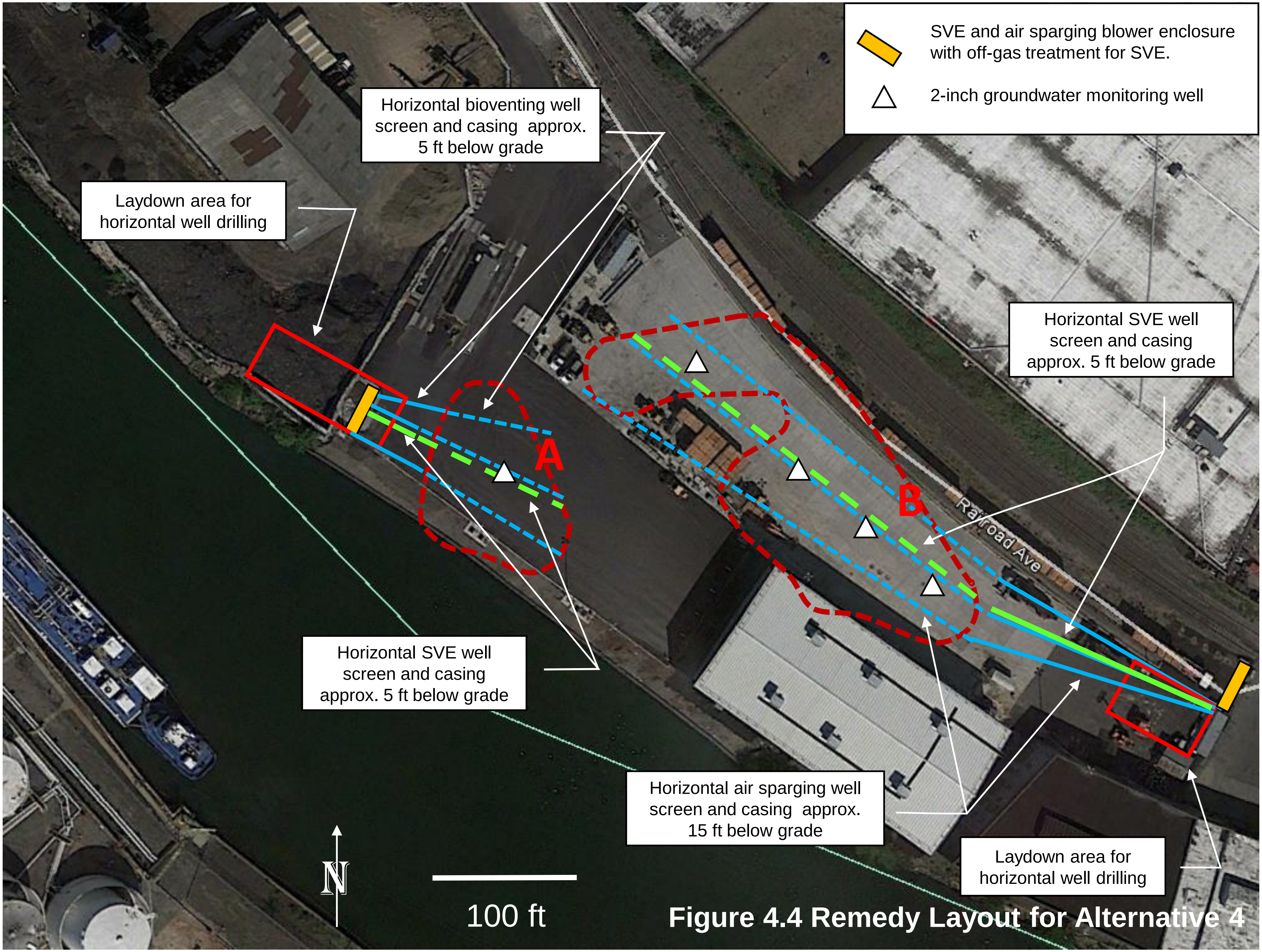
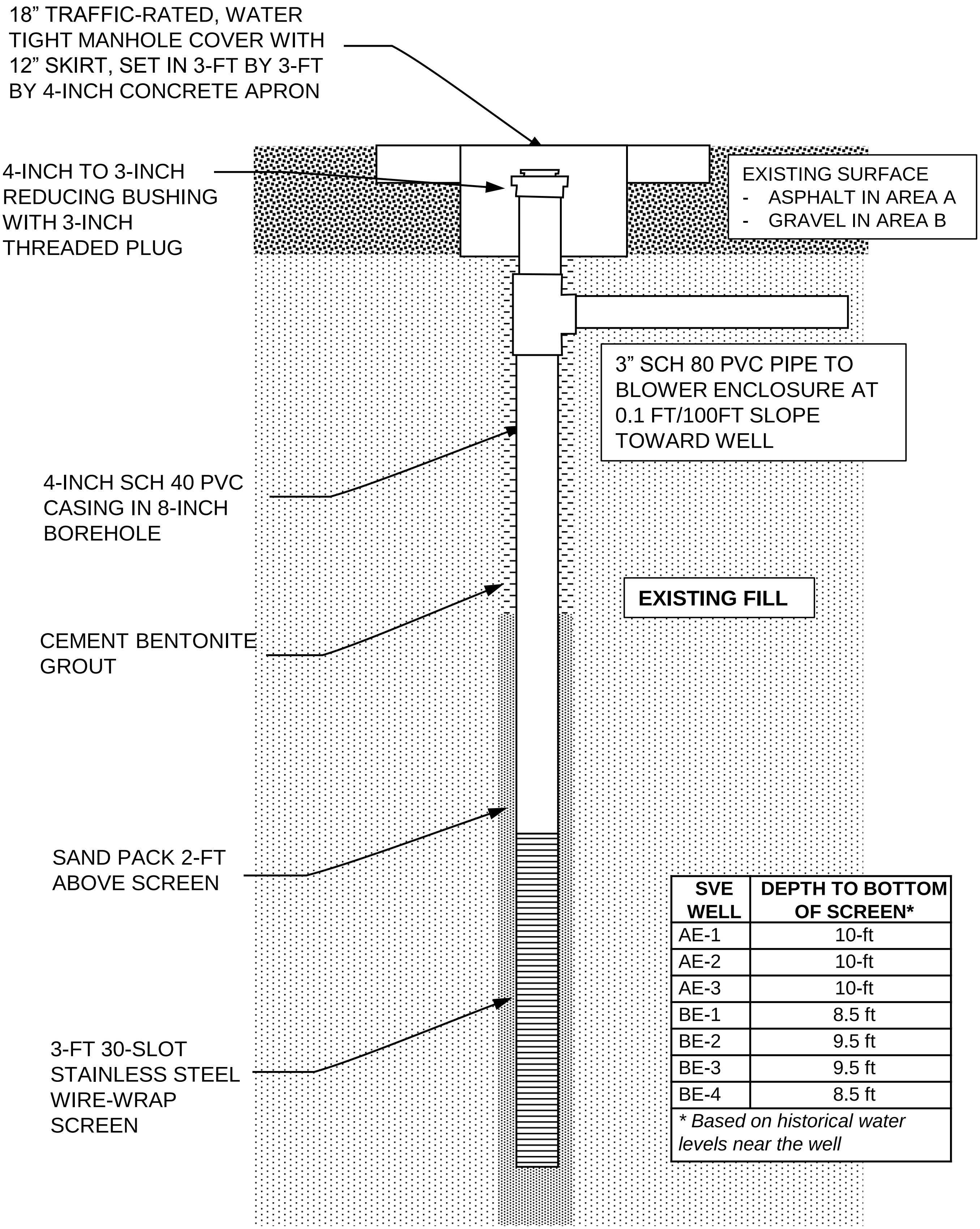


Figure 4.4 Remedy Layout for Alternative 4



SVE WELL	DEPTH TO BOTTOM OF SCREEN*
AE-1	10-ft
AE-2	10-ft
AE-3	10-ft
BE-1	8.5 ft
BE-2	9.5 ft
BE-3	9.5 ft
BE-4	8.5 ft

** Based on historical water levels near the well*

Figure 5.1 SVE Well Construction

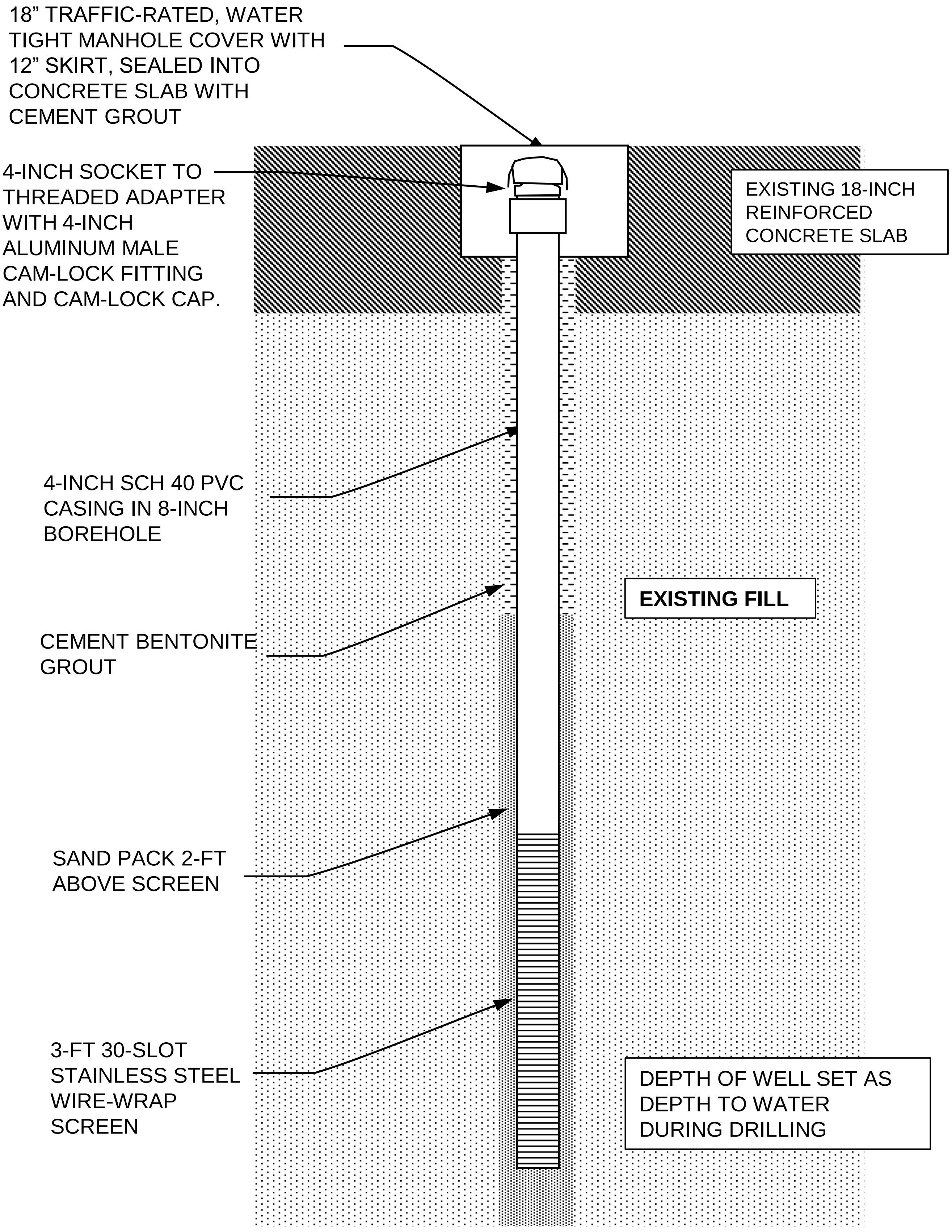


Figure 5.2 Bioventing Well Construction

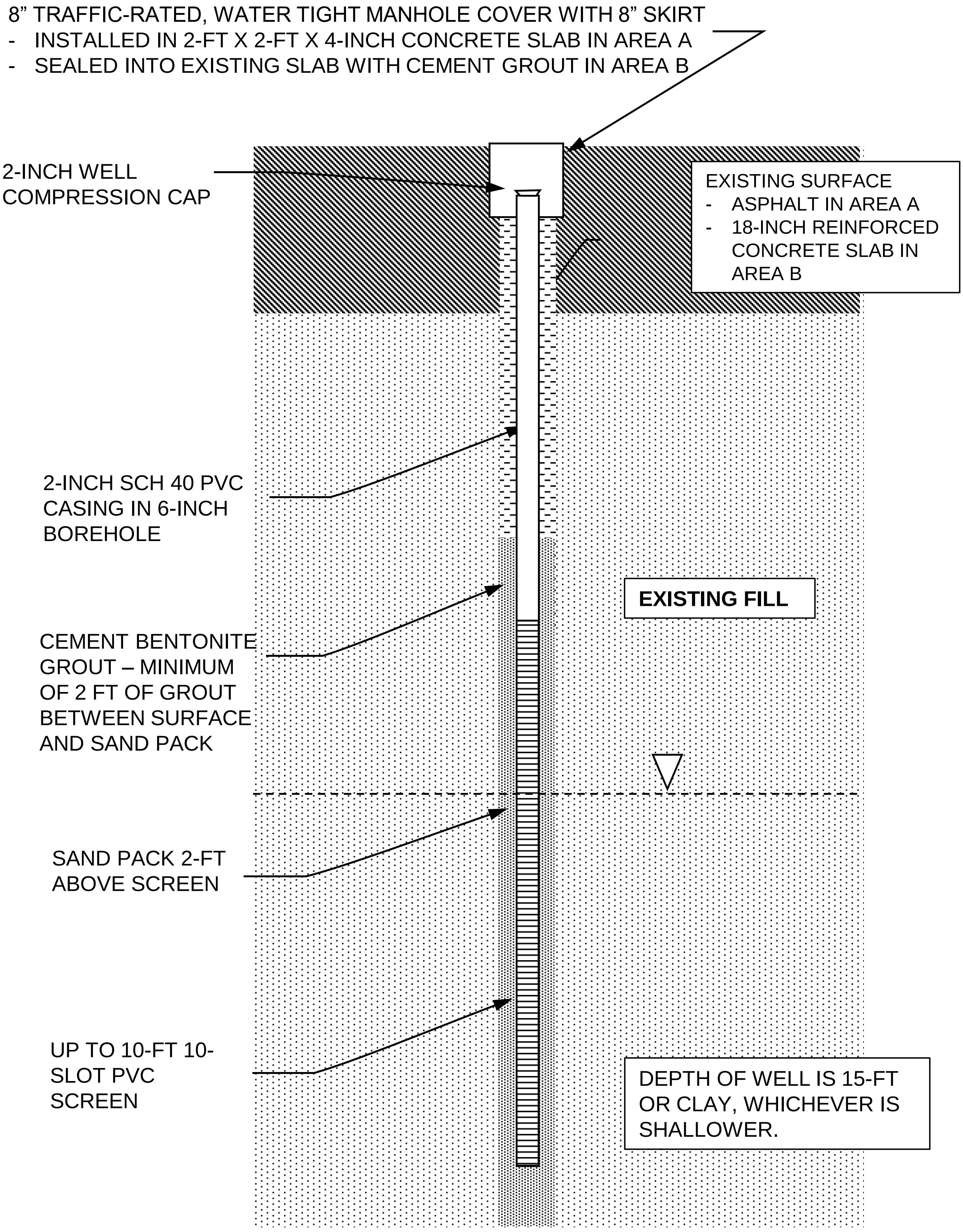


Figure 5.3 Groundwater Monitoring Well Construction

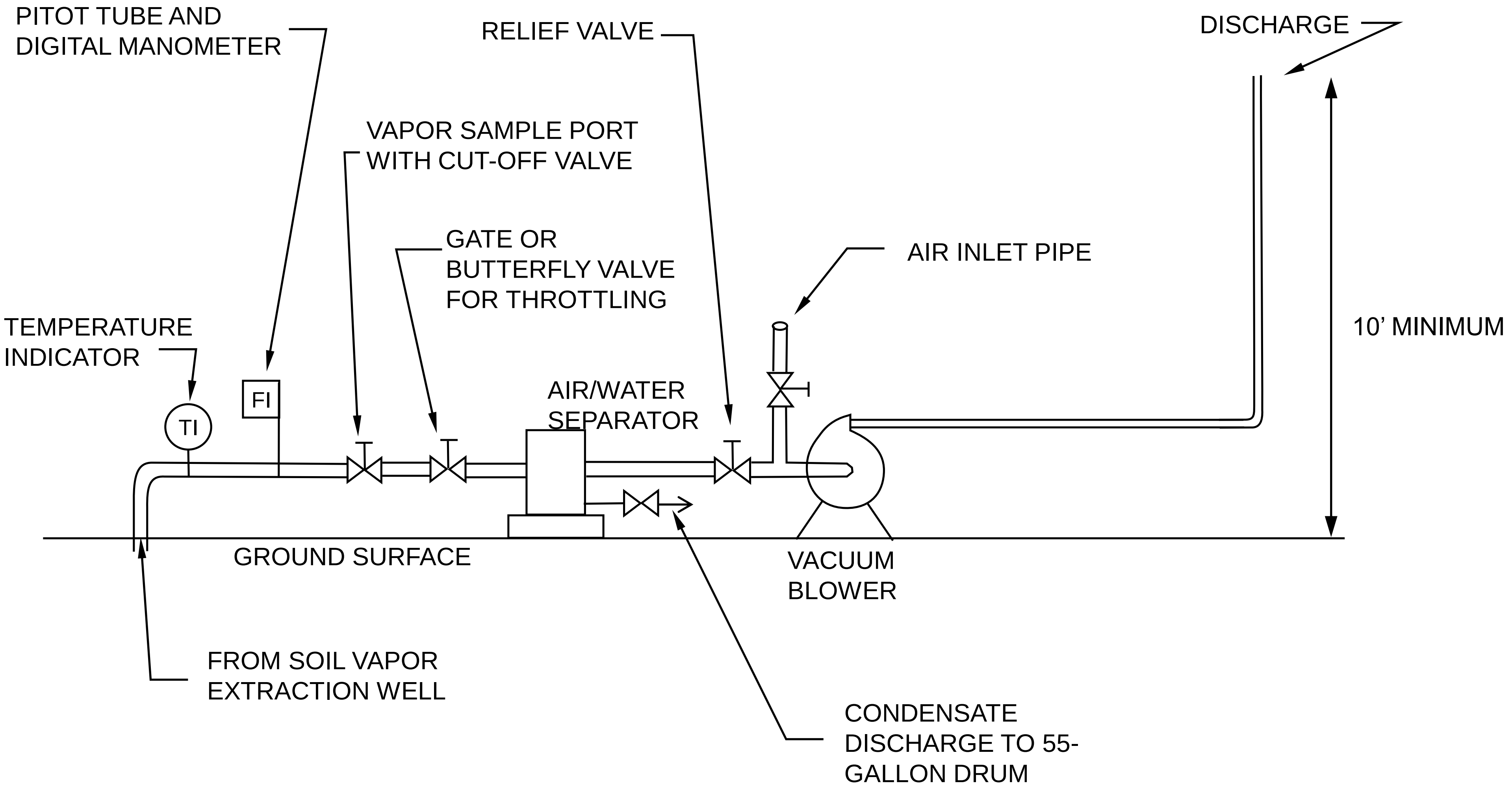
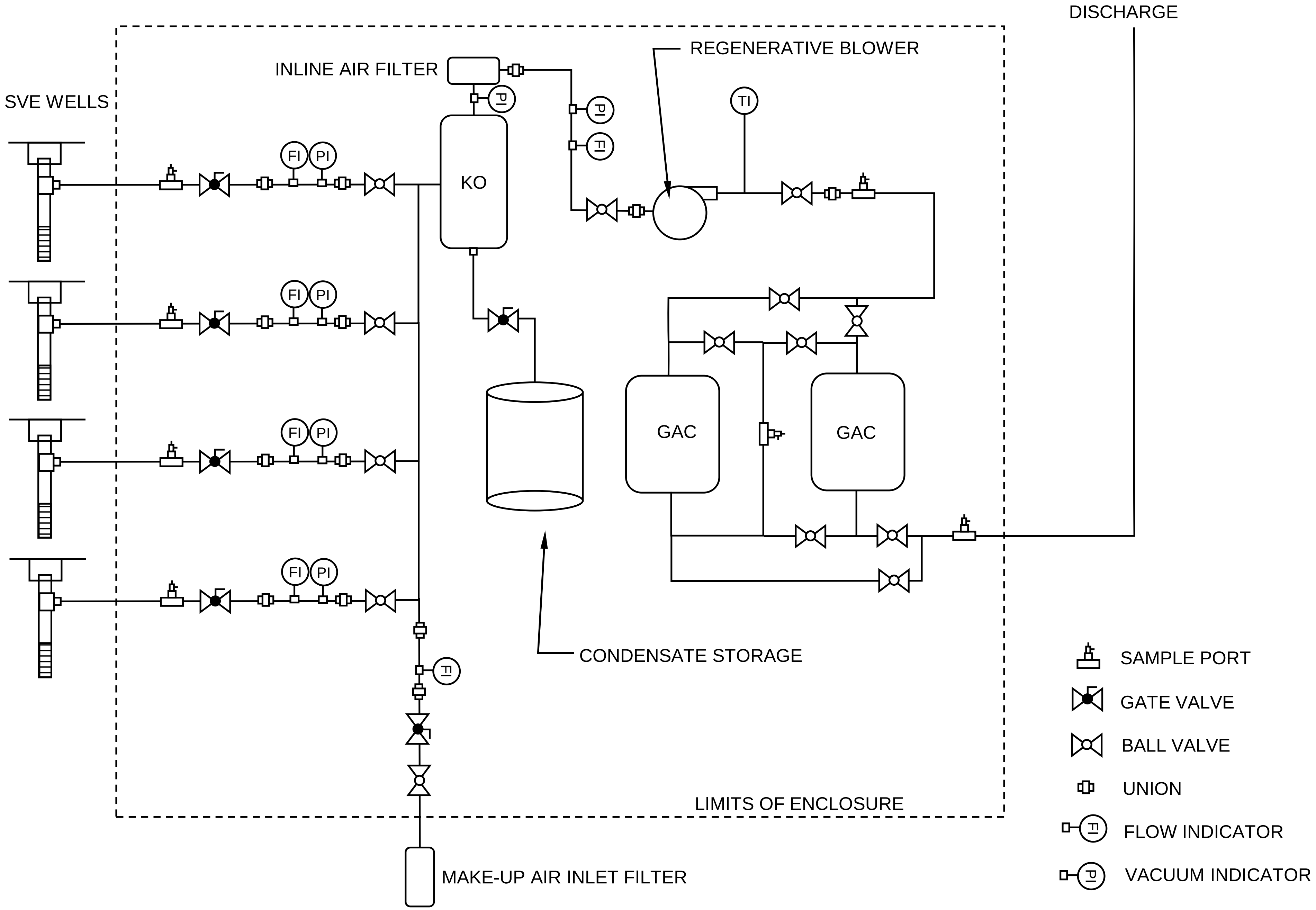


Figure 5.4 Conceptual Pilot Test Equipment Schematic



PIPE, FITTING, BLOWER, AND GAC
SIZES TO BE DETERMINED FROM
PILOT TEST

Figure 5.5 SVE Process Flow Diagram

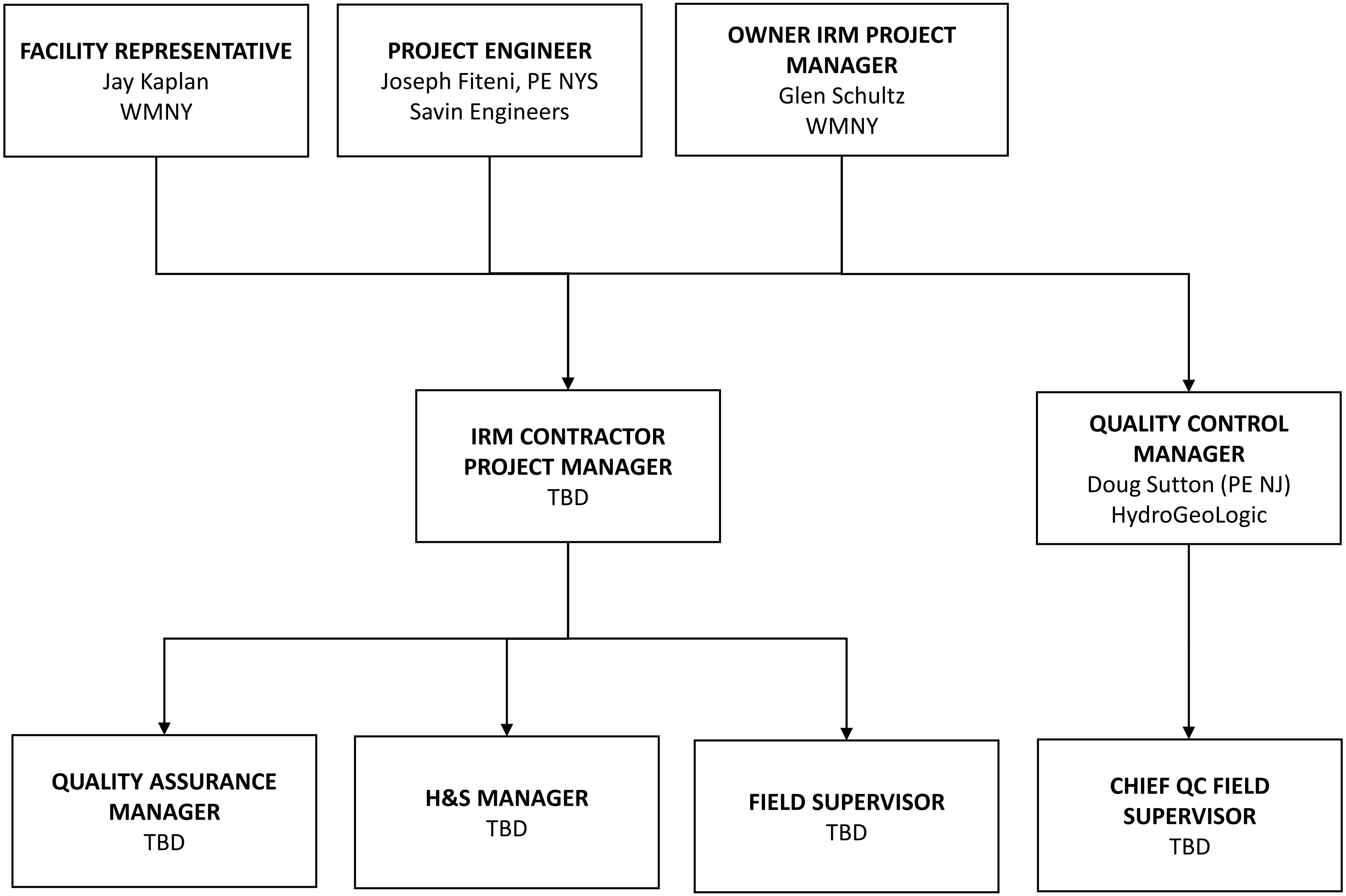


Figure 6.1 Project Organization Chart

APPENDIX A

No boring log for LIF-25.

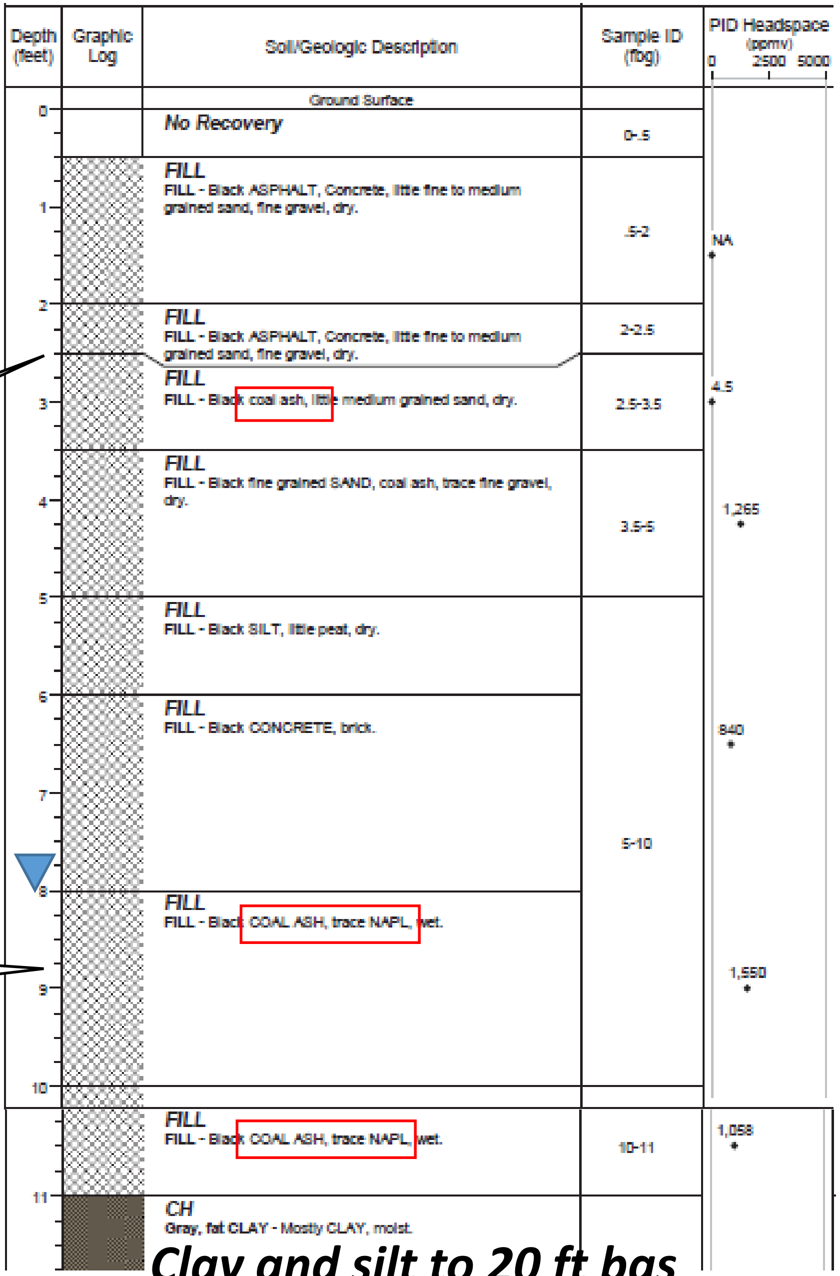
LIF-23 and LIF-25 Close-Up

No GW sample

LIF-25:
Toluene: **36,400 mg/kg**
CVOCs: 355 mg/kg

LIF-23:
Toluene: **797 mg/kg**
CVOCs: 92.7 mg/kg

Highest concentrations above the water table. Some mass below the water table. Contamination, co-located with NAPL and/or coal ash.



Depth (feet)	Soil/Geologic Description	Sample ID (fbg)	PID Headspace (ppmv) 0 2500 5000
	Ground Surface		
0	*No Recovery*	0-.5	
	FILL FILL - Black ASPHALT, Concrete, little fine to medium grained sand, fine gravel, dry.	.5-2	NA
2	*FILL* FILL - Black ASPHALT, Concrete, little fine to medium grained sand, fine gravel, dry.	2-2.5	
	FILL FILL - Black coal ash, little medium grained sand, dry.	2.5-3.5	4.5
	FILL FILL - Black fine grained SAND, coal ash, trace fine gravel, dry.	3.5-5	1,265
5	*FILL* FILL - Black SILT, little peat, dry.	5-10	
6	*FILL* FILL - Black CONCRETE, brick.		840
8	*FILL* FILL - Black COAL ASH, trace NAPL, wet.		1,550
10	*FILL* FILL - Black COAL ASH, trace NAPL, wet.	10-11	1,058
11	*CH* Gray, fat CLAY - Mostly CLAY, moist.		

Clay and silt to 20 ft bgs

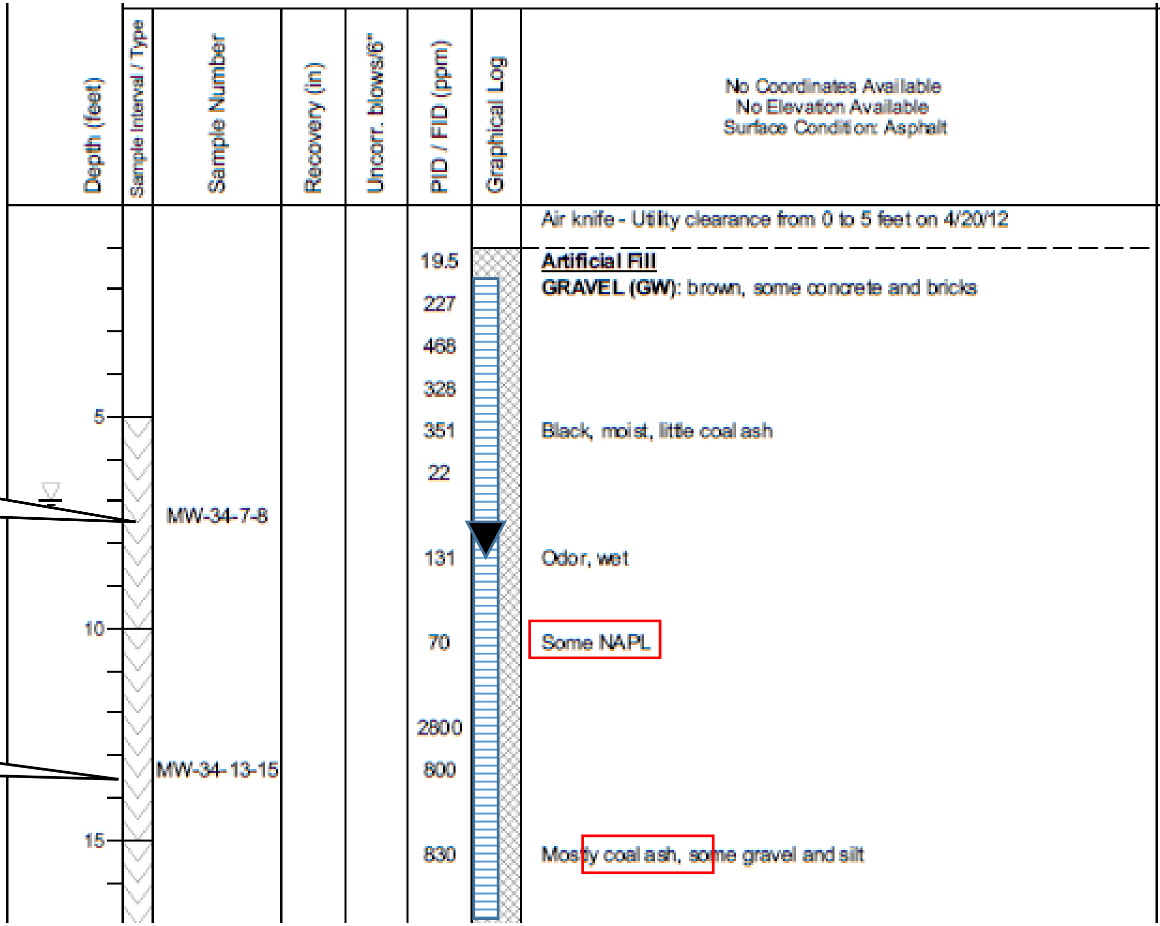
MW-34 Close-Up

No boring log for LIF-25.

GW Sample:
No GW sample (LNAPL)

Toluene: 0.065 mg/kg
CVOCs: < 0.01 mg/kg

Toluene: **520 mg/kg**
CVOCs: 1.3 mg/kg

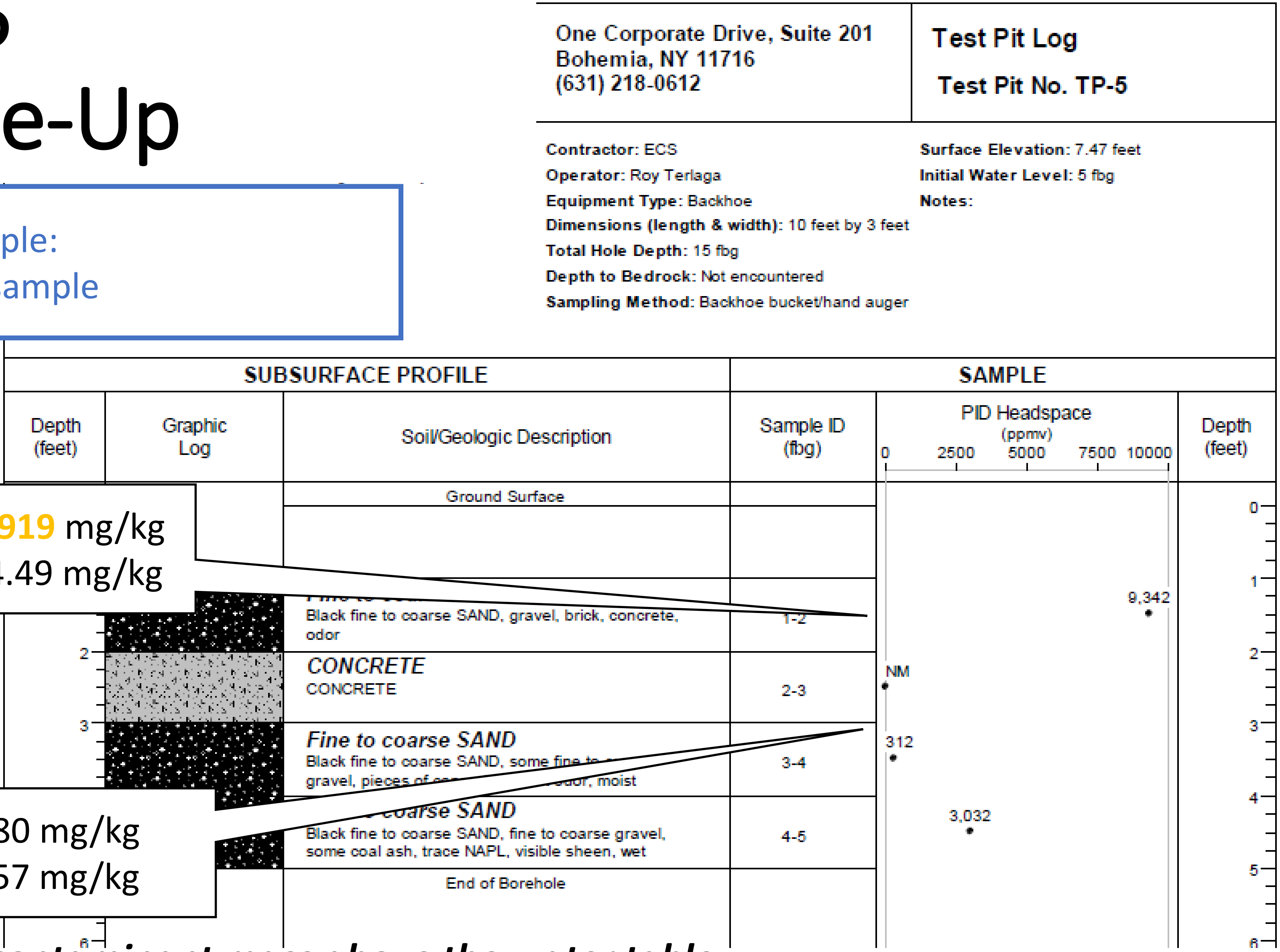


Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	No Coordinates Available No Elevation Available Surface Condition: Asphalt
							Air knife - Utility clearance from 0 to 5 feet on 4/20/12
					19.5		**Artificial Fill** **GRAVEL (GW)**: brown, some concrete and bricks
					227		
					468		
					328		
5					351		Black, moist, little coal ash
					22		
		MW-34-7-8					
					131		Odor, wet
10					70		Some NAPL
					2800		
		MW-34-13-15			800		
15					830		Mostly coal ash, some gravel and silt

Majority of contaminant mass at this location potentially at or below water table in NAPL.

TP-5
Close-Up

GW Sample:
No GW sample



One Corporate Drive, Suite 201
Bohemia, NY 11716
(631) 218-0612

Test Pit Log

Test Pit No. TP-5

Contractor: ECS
Operator: Roy Terlaga
Equipment Type: Backhoe
Dimensions (length & width): 10 feet by 3 feet
Total Hole Depth: 15 fbg
Depth to Bedrock: Not encountered
Sampling Method: Backhoe bucket/hand auger

Surface Elevation: 7.47 feet
Initial Water Level: 5 fbg
Notes:

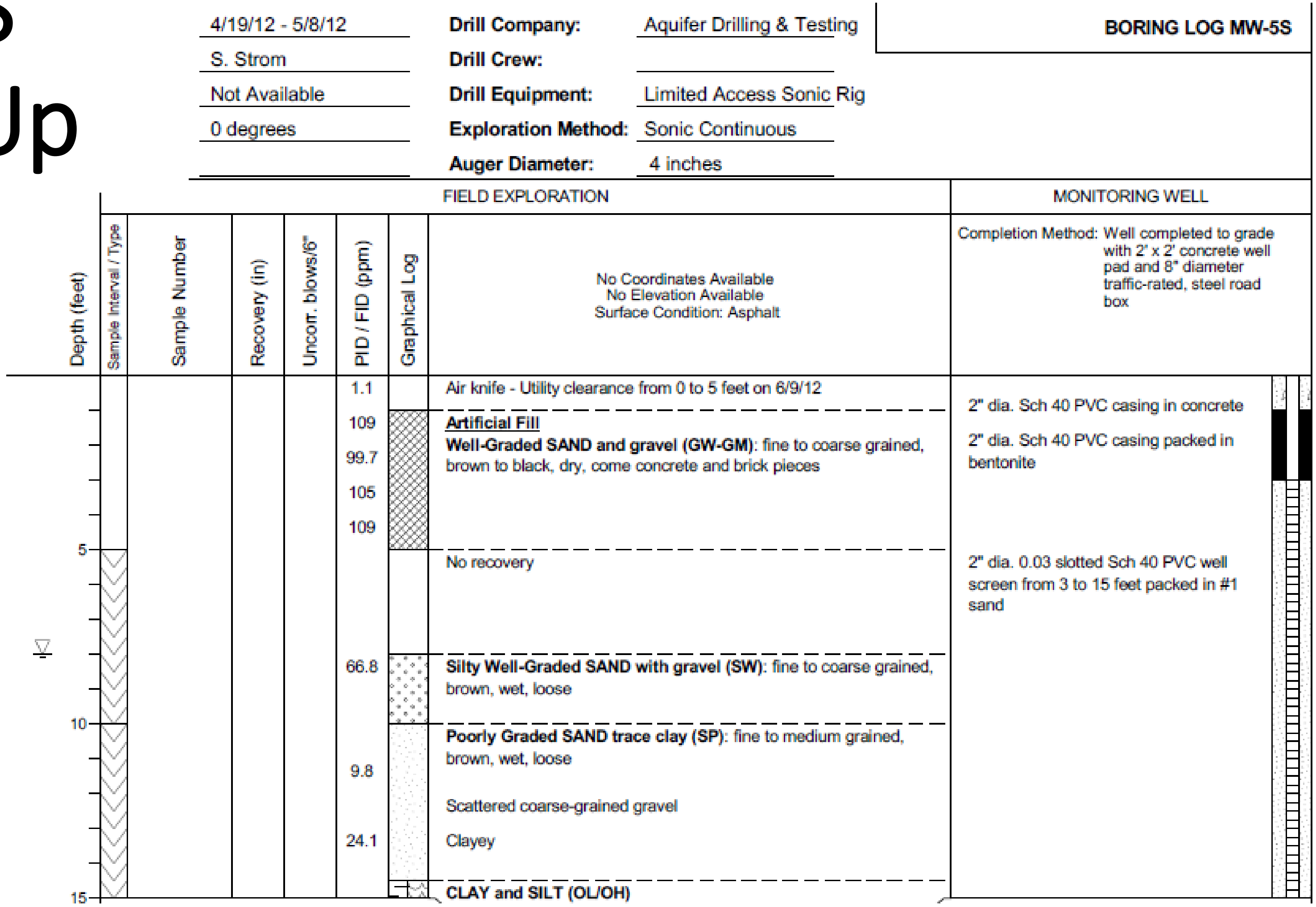
SUBSURFACE PROFILE			SAMPLE		
Depth (feet)	Graphic Log	Soil/Geologic Description	Sample ID (fbg)	PID Headspace (ppmv) 0 2500 5000 7500 10000	Depth (feet)
		Ground Surface			0
					1
		Black fine to coarse SAND, gravel, brick, concrete, odor	1-2	9,342	
2		*CONCRETE* CONCRETE	2-3	NM	2
3		*Fine to coarse SAND* Black fine to coarse SAND, some fine to gravel, pieces of odor, moist	3-4	312	3
		coarse SAND Black fine to coarse SAND, fine to coarse gravel, some coal ash, trace NAPL, visible sheen, wet	4-5	3,032	4
		End of Borehole			5
6					6

Toluene: 919 mg/kg
CVOCs: 4.49 mg/kg

Toluene: 180 mg/kg
CVOCs: 0.757 mg/kg

Detected contaminant mass above the water table.

MW-5S Close-Up



4/19/12 - 5/8/12
S. Strom
Not Available
0 degrees

Drill Company: Aquifer Drilling & Testing
Drill Crew:
Drill Equipment: Limited Access Sonic Rig
Exploration Method: Sonic Continuous
Auger Diameter: 4 inches

BORING LOG MW-5S

FIELD EXPLORATION

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt

MONITORING WELL

Completion Method: Well completed to grade with 2' x 2' concrete well pad and 8" diameter traffic-rated, steel road box

Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	Description	Monitoring Well
					1.1		Air knife - Utility clearance from 0 to 5 feet on 6/9/12	2" dia. Sch 40 PVC casing in concrete
					109		**Artificial Fill** **Well-Graded SAND and gravel (GW-GM)**: fine to coarse grained, brown to black, dry, come concrete and brick pieces	2" dia. Sch 40 PVC casing packed in bentonite
					99.7			
					105			
					109			
5							No recovery	2" dia. 0.03 slotted Sch 40 PVC well screen from 3 to 15 feet packed in #1 sand
∇								
					66.8		**Silty Well-Graded SAND with gravel (SW)**: fine to coarse grained, brown, wet, loose	
10							**Poorly Graded SAND trace clay (SP)**: fine to medium grained, brown, wet, loose	
					9.8			
							Scattered coarse-grained gravel	
					24.1		Clayey	
15							**CLAY and SILT (OL/OH)**	

GW Sample:
Toluene: **1,600 µg/L**
CVOCs: 431 µg/L

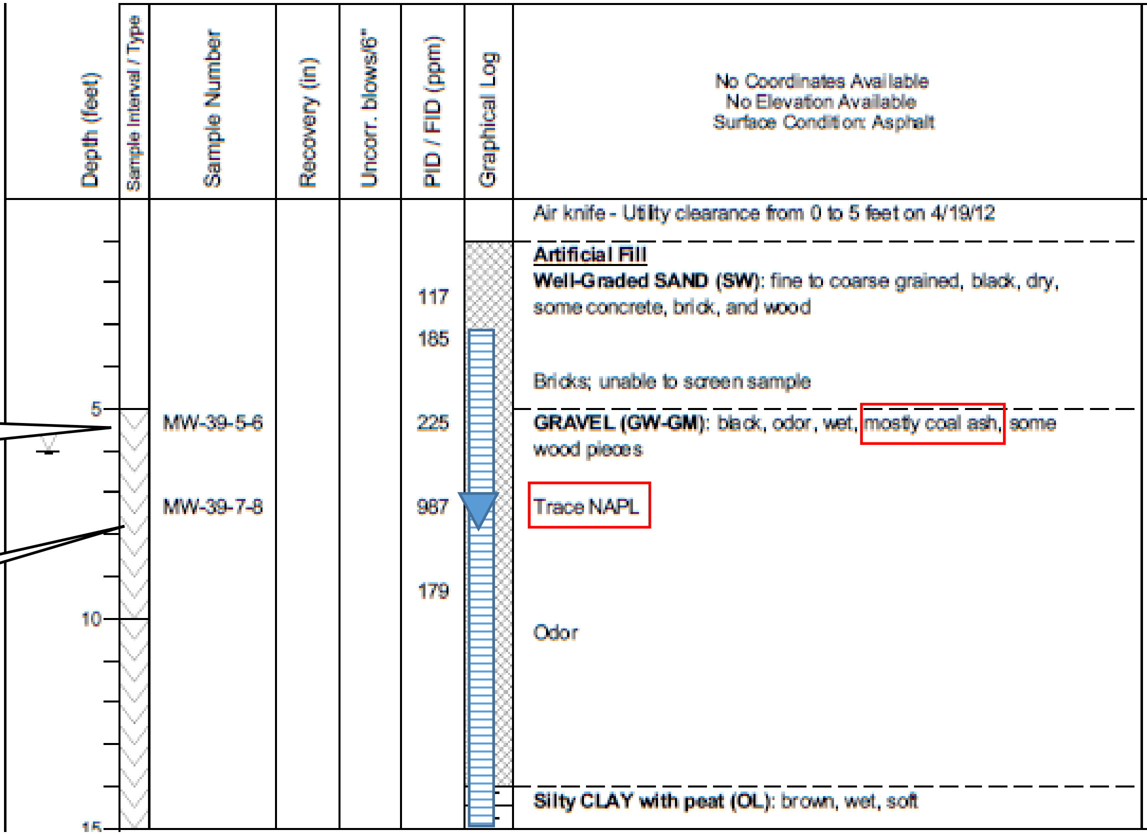
No soil sample, but highest PID readings are above the water table.

MW-39 Close-Up

GW Sample:
Toluene: **2,300 µg/L**
CVOCs: **1,029 µg/L**

Toluene: 7.9 mg/kg
CVOCs: 6.33 mg/kg

Toluene: 9.0 mg/kg
CVOCs: 2.08 mg/kg



Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	No Coordinates Available No Elevation Available Surface Condition: Asphalt
							Air knife - Utility clearance from 0 to 5 feet on 4/19/12
					117		**Artificial Fill** **Well-Graded SAND (SW)**: fine to coarse grained, black, dry, some concrete, brick, and wood
					185		
							Bricks; unable to screen sample
5		MW-39-5-6			225		**GRAVEL (GW-GM)**: black, odor, wet, mostly coal ash, some wood pieces
		MW-39-7-8			987		Trace NAPL
					179		
10							Odor
							Silty CLAY with peat (OL): brown, wet, soft
15							

Highest contaminant mass appears to be at water table, co-located with NAPL and coal ash.

MW-40S Close-Up

MW-40S GW:
Toluene: 110 µg/L
CVOCs: **7,544 µg/L**

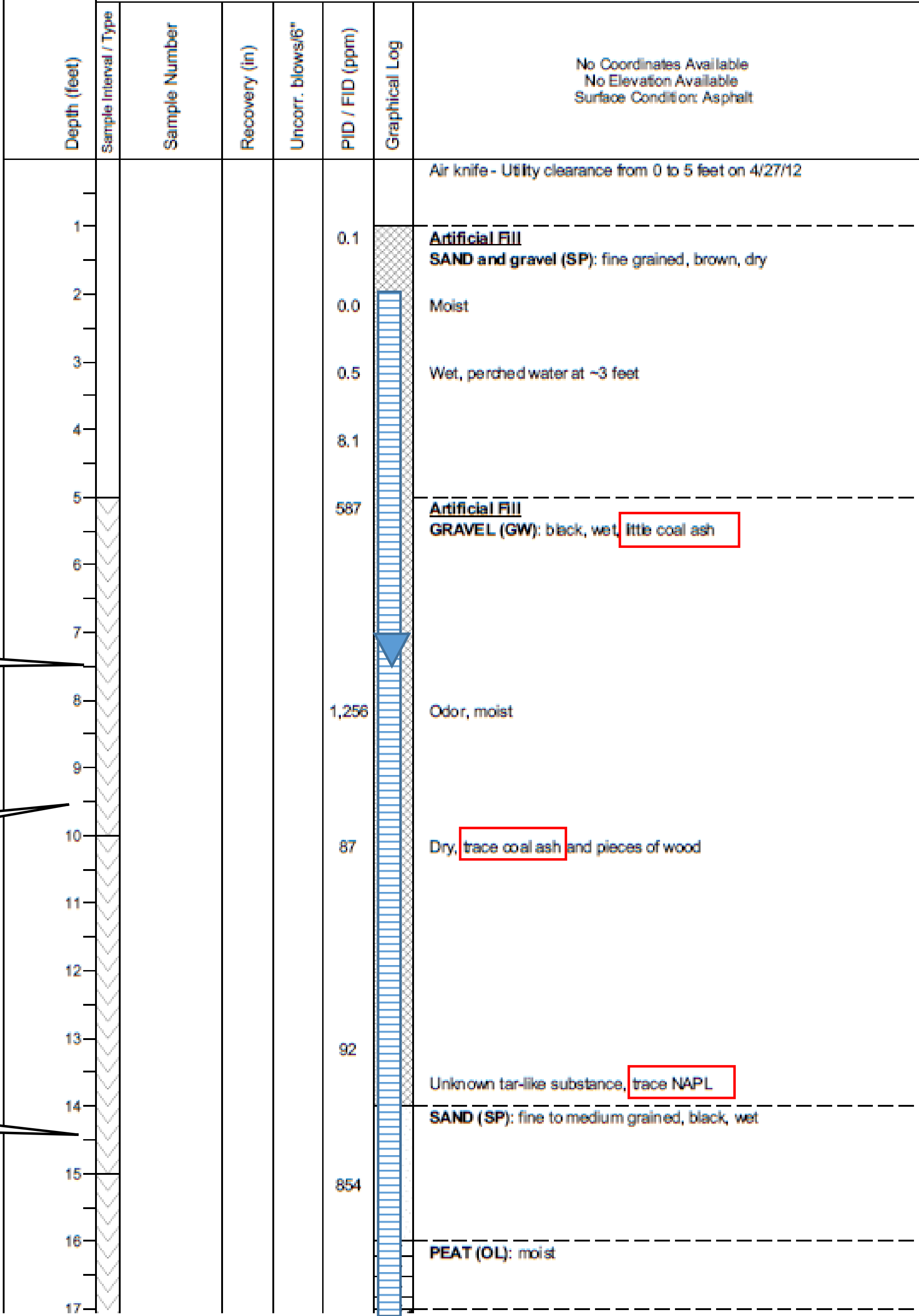
MW-40D GW:
Toluene: 45 µg/L
CVOCs: **1,172 µg/L**

Toluene: 21 mg/kg
CVOCs: 3.6 mg/kg

Toluene: 210 mg/kg
CVOCs: 36.08 mg/kg

Toluene: 4.1 mg/kg
CVOCs: 1.12 mg/kg

Contaminant mass co-located with NAPL and coal ash.



Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	No Coordinates Available No Elevation Available Surface Condition: Asphalt
							Air knife - Utility clearance from 0 to 5 feet on 4/27/12
1					0.1		**Artificial Fill** **SAND and gravel (SP)**: fine grained, brown, dry
2					0.0		Moist
3					0.5		Wet, perched water at ~3 feet
4					8.1		
5					587		**Artificial Fill** **GRAVEL (GW)**: black, wet, little coal ash
6							
7							
8					1,256		Odor, moist
9							
10					87		Dry, trace coal ash and pieces of wood
11							
12							
13					92		Unknown tar-like substance, trace NAPL
14							**SAND (SP)**: fine to medium grained, black, wet
15					854		
16							**PEAT (OL)**: moist
17							

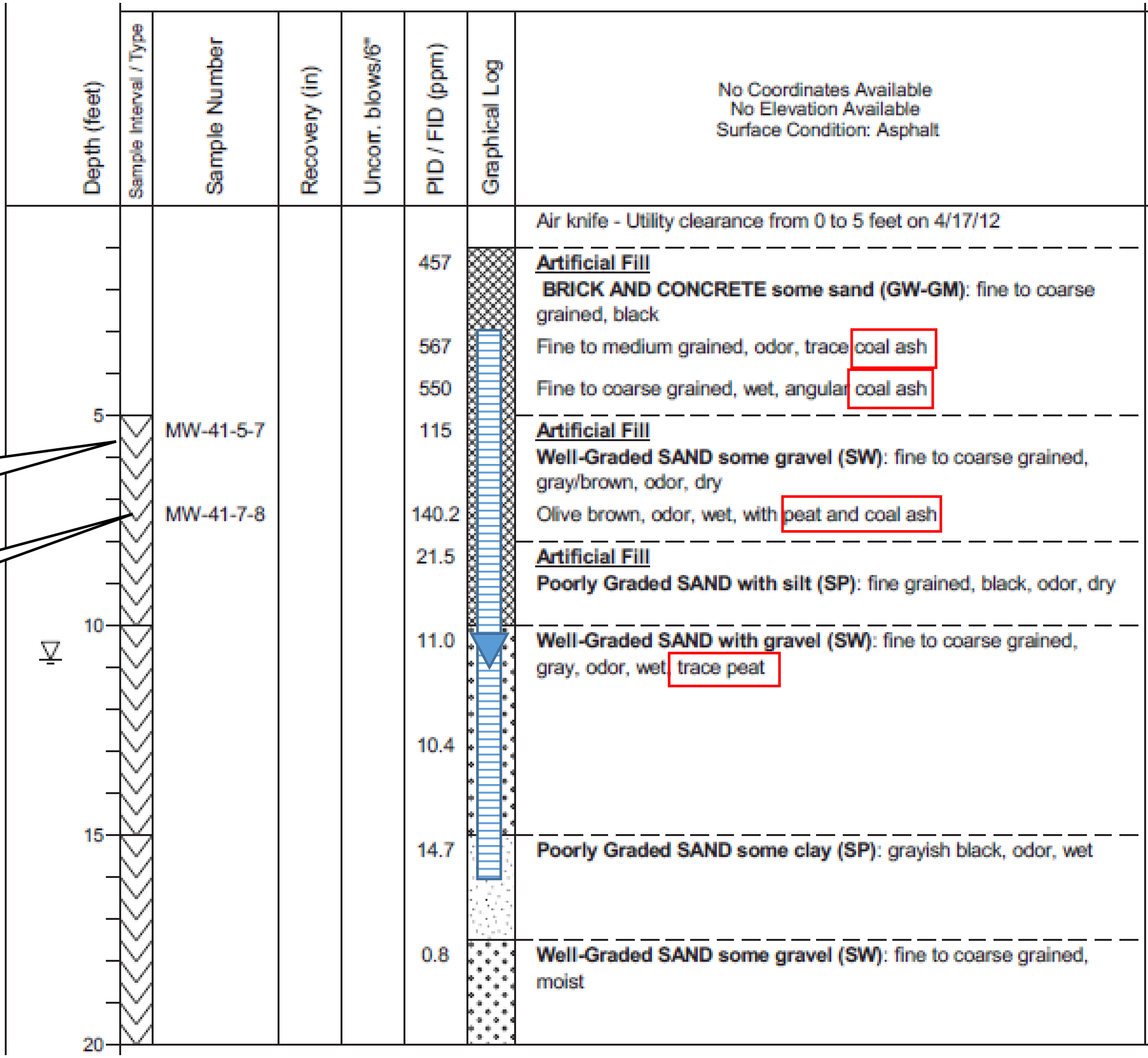
MW-41S Close-Up

GW Sample:
Toluene: **7,000 µg/L**
CVOCs: 10 µg/L

Toluene: 0.68 mg/kg
CVOCs: non-detect

Toluene: 3.1 mg/kg
CVOCs: non-detect

Highest contaminant mass above water table, co-located with coal ash. This location mixed during Acid Area IRM.



No Coordinates Available
No Elevation Available
Surface Condition: Asphalt

Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	
							Air knife - Utility clearance from 0 to 5 feet on 4/17/12
					457		**Artificial Fill** **BRICK AND CONCRETE some sand (GW-GM)**: fine to coarse grained, black
					567		Fine to medium grained, odor, trace coal ash
					550		Fine to coarse grained, wet, angular coal ash
5		MW-41-5-7			115		**Artificial Fill** **Well-Graded SAND some gravel (SW)**: fine to coarse grained, gray/brown, odor, dry
		MW-41-7-8			140.2		Olive brown, odor, wet, with peat and coal ash
					21.5		**Artificial Fill** **Poorly Graded SAND with silt (SP)**: fine grained, black, odor, dry
10 ∇					11.0		**Well-Graded SAND with gravel (SW)**: fine to coarse grained, gray, odor, wet, trace peat
					10.4		
15					14.7		**Poorly Graded SAND some clay (SP)**: grayish black, odor, wet
					0.8		**Well-Graded SAND some gravel (SW)**: fine to coarse grained, moist
20							

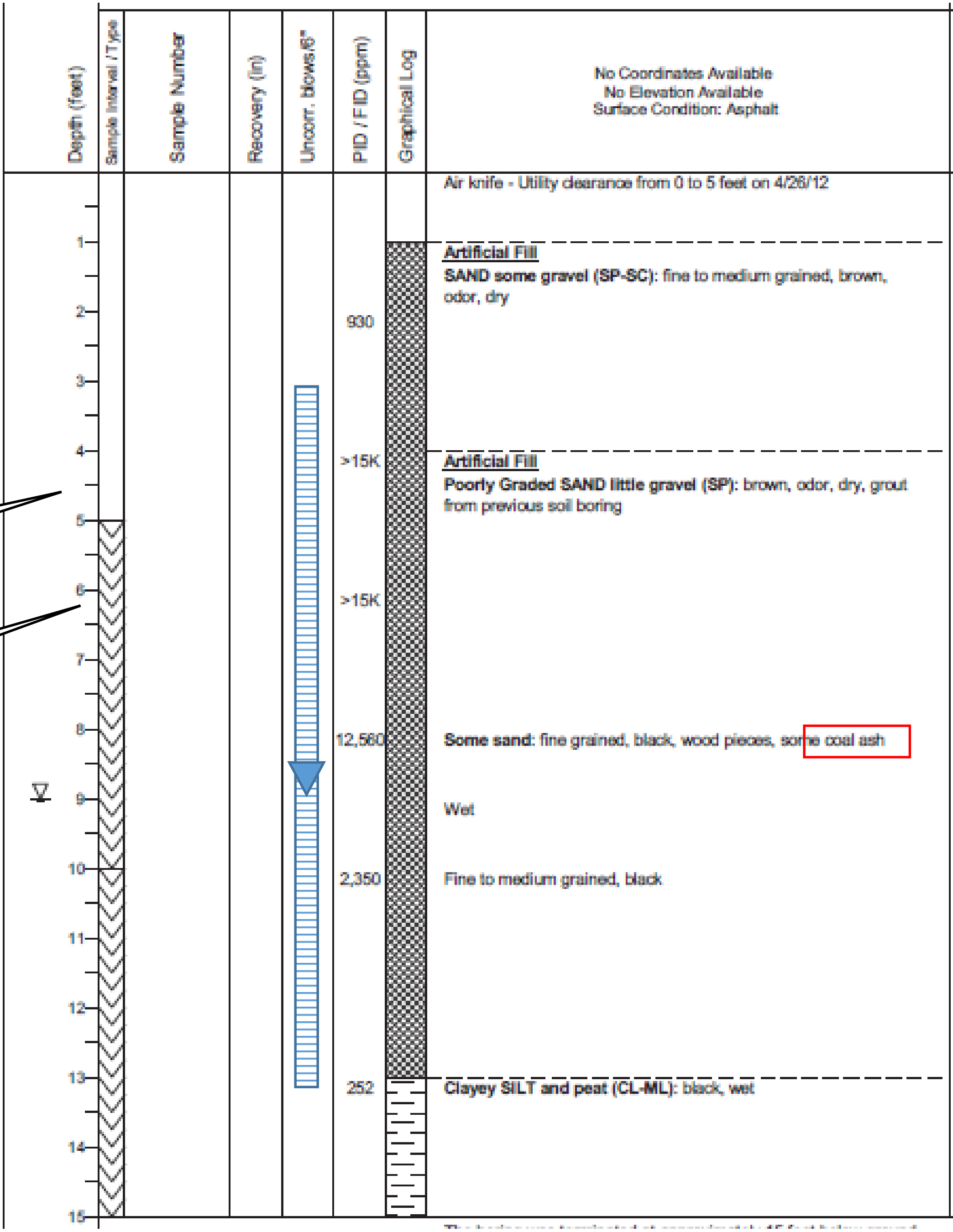
MW-43/SB-19 Close-Up

GW Sample:
Toluene: **140,000 µg/L**
CVOCs: **8,605 µg/L**

Toluene: **4,750 mg/kg**
CVOCs: 8.31 mg/kg

Toluene: **1,420 mg/kg**
CVOCs: 13.05 mg/kg

Highest contaminant mass at and above water table, co-located with coal ash.



Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	No Coordinates Available No Elevation Available Surface Condition: Asphalt
0							Air knife - Utility clearance from 0 to 5 feet on 4/26/12
1							**Artificial Fill** **SAND some gravel (SP-SC):** fine to medium grained, brown, odor, dry
2					930		
4					>15K		**Artificial Fill** **Poorly Graded SAND little gravel (SP):** brown, odor, dry, grout from previous soil boring
6					>15K		
8					12,560		**Some sand:** fine grained, black, wood pieces, some coal ash
9							Wet
10					2,350		Fine to medium grained, black
13					252		**Clayey SILT and peat (CL-ML):** black, wet

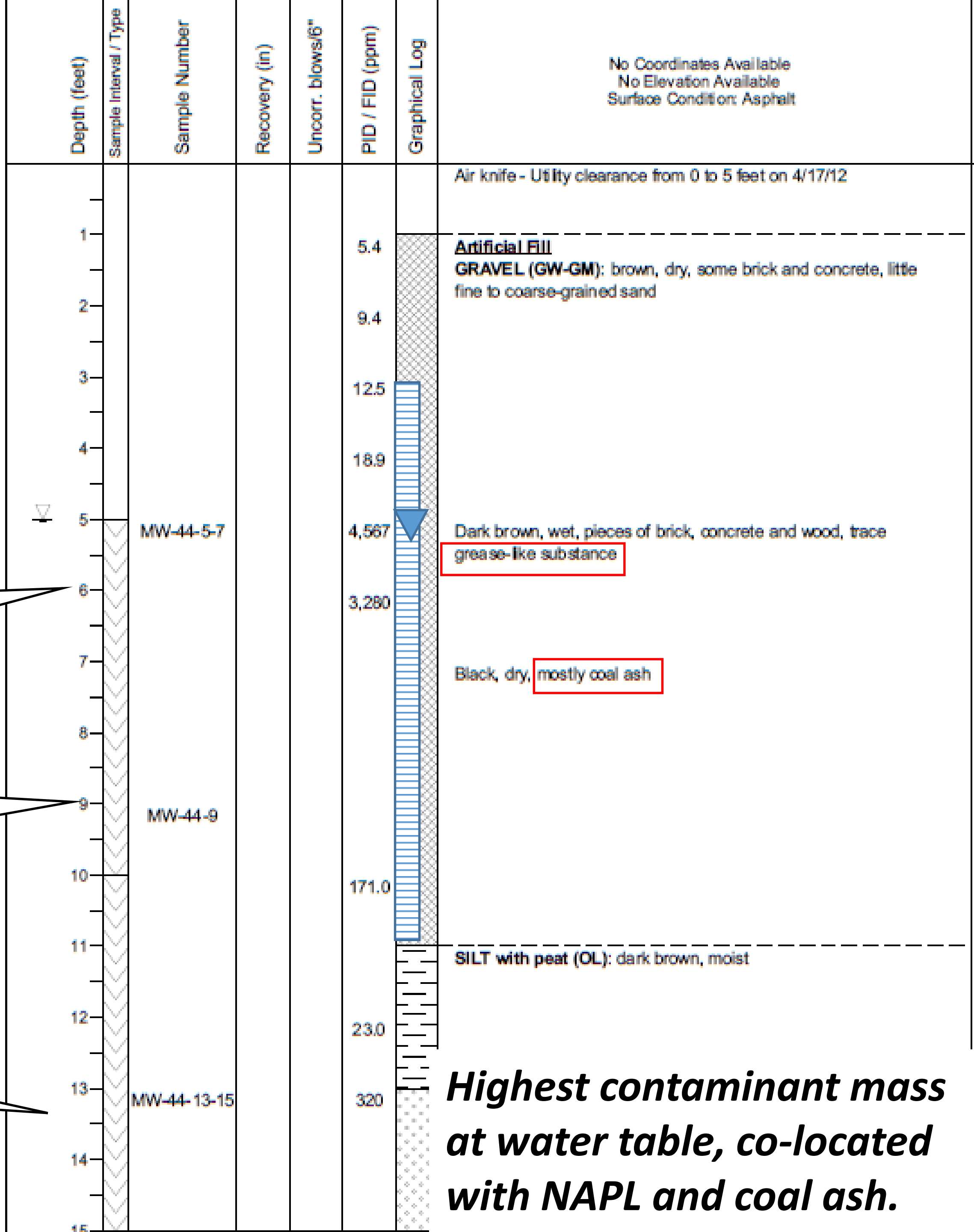
MW-44
Close-Up

GW Sample:
Toluene: **5,600 µg/L**
CVOCs: 218 µg/L

Toluene: **5,600 mg/kg**
CVOCs: non-detect (High DL)

Toluene: 17 mg/kg
CVOCs: non-detect (High DL)

Toluene: 0.02 mg/kg
CVOCs: non-detect



Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	No Coordinates Available No Elevation Available Surface Condition: Asphalt
							Air knife - Utility clearance from 0 to 5 feet on 4/17/12
1					5.4		**Artificial Fill** **GRAVEL (GW-GM)**: brown, dry, some brick and concrete, little fine to coarse-grained sand
2					9.4		
3					12.5		
4					18.9		
5		MW-44-5-7			4,567		Dark brown, wet, pieces of brick, concrete and wood, trace grease-like substance
6					3,280		
7							Black, dry, mostly coal ash
8							
9		MW-44-9					
10					171.0		
11							**SILT with peat (OL)**: dark brown, moist
12					23.0		
13		MW-44-13-15			320		
14							
15							

Highest contaminant mass at water table, co-located with NAPL and coal ash.

APPENDIX B

Joseph J. Fiteni, Jr., P.E.

Vice President, Water/Wastewater Facilities Group Manager

EDUCATION

MCE, Civil Engineering, Geology Minor, Cornell University, 1977
BS, Civil Engineering, Cornell University, 1976

PROFESSIONAL LICENSES

Professional Engineer, New York, #059843, 1983

PROFESSIONAL MEMBERSHIPS

American Society of Civil Engineers
Water Environment Association

RELEVANT EXPERIENCE

Mr. Fiteni has more than 30 years of experience in management, planning, environmental studies, design, permitting, and construction inspections for major projects related to waste management, water, wastewater, geotechnical engineering, waterfront facilities, and institutional buildings and facilities.

Site Assessment and Remediation

Waste Management, Inc., Phase I and II Environmental Assessments Program, New York and New Jersey. Principal-in-charge of environmental site assessments, including Phase I and II, at properties being considered for purchase by Waste Management, Inc. Sites are located throughout the New York/New Jersey metro area and includes transfer stations and trucking facilities with maintenance garages, many of which had leaky underground storage tanks and inadequate stormwater drainage. Facilities that were investigated were subjected to corrective action and permitting.

City of Stamford, Washington Boulevard Environmental Site Assessment, Stamford, Connecticut. Principal-in-charge of a Phase I environmental assessment for an urban manufacturing facility being purchased for use as a firehouse.

New Jersey School Construction Corporation, PS 3/MS 4 Staff Parking Feasibility Study, Jersey City, New Jersey. Project manager for a feasibility study for constructing a parking facility for approximately 100 faculty on a site totaling 20,000 square feet. Managing hazardous waste screening, environmental and land use issues, geotechnical utilities, traffic, architectural programming, and site design.

New Jersey School Construction Corporation, Cognis Corporation Site, Hoboken, New Jersey. Project manager for a site feasibility study in connection with the planned acquisition of a former polymer, paint and personal care product manufacturing facility subject to NJDEP Industrial Site Recovery Act (ISRA).

New Jersey School Construction Corporation, Early Childhood Center No. 14, Early Childhood Center No. 1, and Public School No. 2, Hudson County, New Jersey. Project manager for site feasibility studies in connection with the planned acquisition of commercial and industrial sites in Hudson County for future development as schools.

Solid Waste Management

Waste Management of New York – Review Avenue Transfer Station, Queens, New York. Project Manager for environmental and solid waste permitting, design, plans and specifications and construction inspection services for a new 2200TPD truck to rail putrescible solid waste transfer station. The transfer station will be 31,000 square foot state of the art fully enclosed odor controlled building designed to meet LEED certification requirements. Site work includes the reconstruction of an existing bulkhead, construction of on site intermodal rail loading are and use of best available control technology to manage potentially contaminated storm water.

Waste Management of New York – Varick 1. Transfer Station, Brooklyn, New York – Project Manager for permitting and design to convert a 4,400 TPD putrescible solid waste transfer station from a truck to truck to truck to rail transfer operation. Reconfigured existing tipping/ loading floor to allow waste to be containerized and designed intermodal rail yard on adjacent site for loading and unloading of rail containers to train.

Rhode Island Resource Recovery Corp., Central Landfill Solid Waste Tipping Facility, Johnston, Rhode Island. Principal-in-charge of the engineering design and final contract document preparation for a 4,000-ton per day, truck-to-truck solid waste transfer station. The multidisciplinary project includes project management, civil-site plan design, and architectural, electrical, mechanical, structural, and geotechnical services. The civil-site plan design work for the nine - acre site includes grading and drainage, roadways, and utilities.

Waste Management, Inc., Harlem River Yard Solid Waste Transfer Station, Bronx, New York. Program manager for the conceptual layout through the final design (including solid waste permitting) for a 5,000-tpd, truck-to-rail putrescible solid waste transfer station. The final design included all aspects of the facility including site, utility, railroad, architectural, foundation, structural, HVAC, Plumbing, electrical, odor control and fire protection. Building department permits and DEP permits were applied for and obtained CM services including coordination with general contractors were carried out. The project was recognized by the New York Association of Consulting Engineers with the 2000 Gold Award for Excellence in Environmental Engineering.

Hazardous Waste Remediation

US Army Corps of Engineers, Douglassville Disposal Superfund Site, Thermal Treatment Remedial Design, Berks County, Pennsylvania. Project manager for a 50-acre former waste oil recycling facility located on the flood plain of the Schuylkill River, provided field investigations, physical and chemical testing, regulatory and permitting reviews, a remedial design for incineration and chemical fixation, bench scale testing, a design for the landfilling of treated waste material, final capping and closure designs, and stormwater management and drainage designs for the site. Complete bidding and contract documents included plans, specifications, and cost estimates.

New York State Department of Environmental Conservation, Love Canal, Black and Bergholtz Creeks Remediation, Niagara Falls, New York. Project manager for design and construction services for the removal and secure land storage of dioxin-contaminated creek sediments in compliance with the RCRA. Subsequent phases included the design and formulation of contract documents for the on-site thermal destruction of 30,000 cubic yards of sediments.

New Jersey Department of Environmental Protection, Gloucester Environmental Management Services Landfill Site (NPL No. 12) Remediation, New Jersey. Team leader for Construction Contract 2, which included landfill capping and gas collection treatment systems development.

Wastewater

Westchester County DPW – New Rochelle WWTP Composite Performance Implementation and Plant Expansion – New Rochelle, NY. Project Manager for design and construction management of the expansion and system upgrades to the New Rochelle Wastewater Treatment Plant. The NRWWTP is being expanded from a 13.9 mgd average daily flow and all plant systems are being upgraded and processes added to handle the new flow and to meet new permit discharge limits.

Plant upgrades and expansion include: influent screening, main influent pumps, aerated grit separation facilities, primary tank mechanisms and covers, pure oxygen secondary treatment, liquid oxygen supply, final clarifiers, sludge pumping New Sludge Processing Building which includes sludge thickening with gravity belts, sludge drying with belt filter presses, additional dry sludge storage and loadout capacity, plant wide electrical system upgrade, new odor control systems, new ID card SCADA systems and upgrades to support systems and utilities.

Westchester County DPW – New Rochelle Wastewater Treatment Plant – BNR Upgrades. Project Manager for design and construction management of Biological Aerated Filter (BAF). BNR upgrades at the New Rochelle Wastewater Treatment Plant BAF. BNR is being added to the New Rochelle WWTP to meet new total nitrogen permit discharge limits. The addition of the BNR requires the construction of a 60 mgd pumping station, fine screens, nitrification and denitrification BAF's and a UV treatment system together with associated I&C and yard piping including large force and gravity mains.

New York City Department of Environmental Protection, Construction Safety and Health Management, Project Director for project to monitor environmental, safety, and health compliance on all NYCDEP capital project construction sites and improve EH&S policies, procedures and standards for BEDC.

DOUGLAS J. SUTTON, PH.D., PE

Principal Engineer

EDUCATION & TRAINING:	Ph.D., Civil and Environmental Engineering/Water Resources Engineering, Duke University, 2000. M.S., Civil and Environmental Engineering/Water Resources Engineering, Duke University, 1999. B.A., Earth and Planetary Sciences (Magna Cum Laude), Harvard University, 1994.
CERTIFICATIONS:	Licensed Professional Engineer: NJ Leadership in Energy and Environmental Design (LEED®) Accredited Professional, Spring 2006 Associate Value Specialist, Society of American Value Engineers (SAVE International), 2007

PROFESSIONAL EXPERTISE:

Dr. Sutton has 18 years of experience in environmental science and engineering with expertise in the following areas:

- Designing, evaluating, and/or operating pump and treat, air sparging/soil vapor extraction, bioremediation, in-situ chemical oxidation, in-situ thermal remediation and other groundwater remedies with particular emphasis on the following site types:
  - Wood treating (PAHs, pentachlorophenol, etc.)
  - Chlorinated solvents (TCE, PCE, etc.)
  - Heavy metals (arsenic, chromium, etc.)
  - DNAPL and LNAPL
  - 1,4-Dioxane
  - PCBs
- Conducting groundwater investigations including pump tests, tracer tests, and ground water monitoring.
- Developing, evaluating, and improving conceptual site models, including sources of contamination; interactions between soil, groundwater, and vapor contamination; and contaminant transport.
- Evaluating potential for vapor intrusion.
- Analytical and numerical modeling of environmental phenomena including groundwater flow and contaminant transport.
- Representing clients in cost allocation arbitration hearings.
- Operating and maintaining environmental field stations.
- Sustainability engineering:
  - Design and installation of photovoltaic systems
  - Design and feasibility analysis of geothermal heat pump systems
  - Sustainability evaluations for environmental remedies

RELEVANT EXPERIENCE:

Environmental Engineering Project Experience

- ***U.S. Environmental Protection Agency (USEPA) Office of Superfund Remediation and Technology Innovation (OSRTI), Optimization Technical Support, (2000-2013).*** Managed and served as technical lead for evaluating and improving EPA-financed groundwater remedies.
  - Conducted Remediation System Evaluations (RSEs), Independent Design Reviews (IDRs), and Optimization Reviews at approximately 70 Superfund sites on behalf of EPA (the majority were financed by USEPA).
  - For each site, reviewed documents, visited site (or conducted conference call), analyzed data, and prepared report highlighting recommendations to improve effectiveness, reduced operating costs, provided technical improvements, and speed site closeout. Topics include:
    - Improving the site conceptual model
    - Evaluating potential impact to nearby receptors (including potential for vapor intrusion)
    - Improving sampling programs
    - Improving extraction and treatment systems
    - Identifying viable alternative remedial strategies
  - Assisted USEPA with tracking progress toward implementation of recommendations
  - Provided technical assistance on an ongoing basis to assist with implementing recommendations.
  - Evaluations also conducted at 9 RCRA facilities and 3 UST sites.
  - RSEs/IDRs for 2009 and later have included sustainability or green remediation in the evaluation.

- ***Confidential Client, Legal Matter Technical Support, (2007-2013).*** Provided hydrogeologic and remedial engineering analysis regarding a litigation matter for a site in northern New Jersey. Issues involved likely sources, adequacy of previous investigations, likely fate and transport of contaminants, remedy performance, remedial strategy, and reasonableness of past costs. Case settled after mediation.

- ***Confidential Client, Gasoline Service Station Cost Allocation Hearing, (2003-2004).*** Managed and co-executed technical work for a project representing client in cost allocation hearings at over 40 sites. For each site, reviewed site documents, assisted client with developing its position on cost allocation, authored and submitted report to an arbiter, and presented position to arbiter in a cost allocation hearing.

- ***Confidential Client, Progress to Site Closure, (2011-2013).*** Assisted large, North American beverage manufacturer and counsel with closing a site in Pennsylvania with persistent groundwater contamination. Developed site conceptual model, remedial strategy, and manage field efforts.

- ***Confidential Client, In-Situ Chemical Oxidation Conceptual Design, (2005).*** Developed chemical oxidation remedial options with costs for hydrocarbon contamination under a commercial building. Options included modified Fenton's reagent injected with direct push technology, activated persulfate injected with direct push technology, and upgradient injection/flushing with persulfate catalyzed with high pH.

- ***Confidential Client, Source Area In-Situ Bioremediation Conceptual Design, (2010).*** Provide technical assistance for feasibility analysis and conceptual design of an in-situ bioremediation remedy for TCE groundwater contamination of a 5-acre area located under a manufacturing facility. Considerations included spot injections of donor, the use of horizontal wells, and the creation of recirculation cells.

- ***Confidential Client, Modeling of Biobarrier Performance, (2007-2013).*** Conducted modeling to evaluate the performance of a 1,000-foot long biobarrier that as designed to treat TCE concentration as high as 7,000 μg/L in a highly transmissive aquifer. Subsequently modeled future expected performance of that biobarrier and two other biobarriers to restore an aquifer to cleanup standards.

- ***Confidential Client, Natural Attenuation Decision Support, (2005).*** Applied USEPA BIOSCREEN Natural Attenuation Decision Support System with conservative parameters to demonstrate BTEX concentrations would be below Ohio EPA standards at the compliance point, avoiding the need for further groundwater remediation.

- ***Confidential Client, Vapor Intrusion Screening Evaluation, (2004).*** Evaluated potential for vapor intrusion for a site in central New Jersey using a tiered approach that is consistent with USEPA vapor intrusion guidance. Evaluation included comparison of volatile organic compound concentrations from existing data to screening levels, application of the Johnson-Ettinger model using site-specific information, and coordination of a limited field effort to confirm concentrations in shallow groundwater result in an acceptable risk to receptors.

- ***Confidential Client, Vapor Intrusion Evaluation with Sampling, (2005).*** Evaluated potential for vapor intrusion for a site in upstate New York following New York State Department Environmental Conservation (NYSDEC) and New York State Department of Health (NYSDOH) guidance. Project included sampling for volatile organic compounds (VOCs) in indoor air, sub-slab soil, groundwater, and ambient air for volatile organic compounds. Project also included data evaluation, report preparation, and briefing of the client.

- ***Confidential Client, Vapor Intrusion Evaluation of Industrial Facility, (2006).*** Provided expert review of a vapor intrusion assessment of an operating facility 500,000 square-foot facility in Ohio. The assessment included consideration of groundwater quality data, soil characteristics, building parameters, contaminant properties, and other parameters in accordance with USEPA and Ohio EPA guidance.

- ***Confidential Client, Oversight and Technical Support of Environmental Consultant for Multinational Conglomerate,* (*2003-2004).*** Co-managed efforts of prime environmental contractors and provided technical oversight at seven impacted sites in North America and Europe. Was responsible for seeing that regulatory and financial obligations were met, provided technical reviews of documents prior to submission to the regulator, and tracked expenditures relative to financial reserve allocated for each site. Managed activities included in-situ bioremediation of a pentachlorophenol (PCP) and hexavalent chromium plume at a site in the south central United States, LNAPL delineation and recovery at a site in Canada, and delineation and remedial planning for a multi-constituent plume at a site in Belgium.

- ***Confidential Client, Acid Mine Drainage System Design, Construction, and O&M, (2007-2013).*** Evaluated, designed, and installed improvements to a remote acid mine drainage site in Central Pennsylvania. Responsible for regulatory discussions with environmental and natural resources agencies, permitting, system design, system construction, and system start-up. Improvements include underground piping and valve pits, steel building for equipment, redundant diesel-powered generators for power (no line power available), auto-start diesel air compressors and sludge pumps for solids handling, new system controls and motor control center, and telemetry system with digital cellular technology. Provided O&M and remedial strategy for the site following upgrades.

- ***Confidential Client, Remedial Investigation and Remedy Selection of Former TSD Facility in New Jersey, (2005-2013).*** Managed all aspects of site investigation, regulatory negotiation, and remedial action selection for a former transport, storage, and disposal facility in New Jersey. Work includes coordinating responses with the regulator, preparing budgets for site work, coordinating field staff, analyzing data, work plan preparation, and remedial strategy. Remedies considered have included P&T, in-situ chemical oxidation, and in-situ thermal remediation.

- ***Confidential Client, Groundwater Remedy Project Management and P&T System Shutdown, (2006-2013).*** Managed all activities related to remedial strategy, reporting, and on-going ground water monitoring at a Superfund Site in Central New Jersey. Work included technical assistance to treatment plant operators, meetings with regulators, numerical modeling, analyzing data, preparing of O&M reports for pump and treat system, conducting quarterly ground water sampling events, validating data, managing the site database, and preparing quarterly ground water monitoring reports. The extraction system consists of five extraction wells. Treatment processes include metals removal and air stripping. Treated water is reinjected. Obtained approval for extraction system and treatment plant shut down in 2013.

- ***Confidential Client, Groundwater Remedy Project Management and Optimization, (2008-2013).*** Managed all activities related to remedial strategy, reporting, and on-going ground water monitoring at a Superfund Site in Central New Jersey. Work included technical assistance to treatment plant operators, optimization of treatment processes, meetings with regulators, analyzing data, and preparing reports, conducting annual groundwater sampling event. The extraction system consists of five wells (only three currently need to operate). Treatment processes include metals removal and treatment of organics with a biological powder activated carbon system. Treated water is discharged to surface water. Prepared initial design documents to streamline treatment plant to pre-treat for 1,4-dioxane, tetrahydrofuran, and other VOCs prior to discharge to the POTW. Scoped permit needs, worked with stakeholders, and prepared preliminary design for discharge line to convey fluids to the POTW.

- ***USEPA Office of Superfund Remediation and Technology Innovation (OSRTI), Preparation of EPA Groundwater Remediation Guidance Documents, (2004-2005).*** Co-authored USEPA guidance documents regarding design, operation, contracting, and reporting for ground water remedies (with emphasis on pump and treat systems) as well as evaluating plume capture with pump and treat systems.

- ***USEPA Office of Research and Development, Preparation of EPA Synthesis Report on DNAPL Remediation, (2007).*** Co-authored USEPA summary report on effectiveness of five DNAPL remediation pilot tests including resistive heating, steam injection, surfactant flushing, and air sparging/soil vapor extraction.

- ***Confidential Client. Expert Review of 1,4-Dioxane Treatment Options, (2013)***. Provided expert review of treatment options for 1,4-dioxane in water from a public water supply well field.

- ***Confidential Client, Private Sector Third-Party Remedy Reviews, (2005-2006).*** Provide "cold-eyes" reviews of multiple sites to provide input on effectiveness of the remedy to protect human health and the environment, to cost-effectively meet its remedial objectives, and to gain site closure. Reviews include evaluation of potential effects on local receptors from impacted groundwater and vapor intrusion. Reviews also include evaluation of completeness of site characterization, developing an appropriate remedial strategy, and assisting in overseeing implementation of that strategy.

- ***Confidential Client, Private Sector Third-Party Remedy Reviews, (2005).*** Perform third-party evaluation to help improve two operating remedies and help fulfill client's corporate requirements for quality control.

- ***Confidential Client, Private Sector Third-Party Remedy Review, (2004).*** Lead team on third-party evaluation of an operating remedy to identify a more appropriate remedy for reaching site closure in an appropriate time frame given the client's interest in divesting the site.

- ***USEPA Office of Superfund Remediation and Technology Innovation (OSRTI), Research for EPA on Technologies to Facilitate Groundwater Monitoring, (2003).*** Research the status of emerging technologies for facilitating monitoring of groundwater contaminants. Identify these emerging technologies and the research groups working on them, evaluate the progress of research and development, and estimate the impact technologies will have on groundwater monitoring. Review technologies such as surface acoustic wave, fiber optic, membrane coated electrochemical, and stripping analysis sensors.

- ***City of Ann Arbor, Evaluation of Capture of 1,4-Dioxane Plume with Numerical Groundwater Model, (2010).*** Developed a groundwater model for the Ann Arbor Landfill site to evaluate the capture of a 1,4-dioxane plume by an existing pump and discharge system. Conducted simulations with the calibrated model to evaluate a pumping strategy that would provide adequate capture while minimizing the extraction rate. Modeling results suggested that discontinuing operation of one extraction well would provide adequate capture while reducing the flow rate by 40%.

- ***City of Ann Arbor, Review of Hydraulic Analysis Report for 1,4-Dioxane Plume, (2009).*** On behalf of the city, evaluated a hydraulic analysis report on 1,4-dioxane plume submitted by a responsible party to the Michigan Department of Environmental Quality. Reported findings and expert opinion to the city regarding the work conducted by the responsible party's consultant. Participated in technical meetings with the City of Ann Arbor and the responsible party.

- ***Park Euclid WQARF Site, Tucson, Arizona, Contaminant Transport Modeling, (2008).*** Performed contaminant transport model calibration related to design of a groundwater extraction system.

- ***Duke University, Department of Civil and Environmental Engineering, Doctoral Research on Tracers for Aquifer Characterization, (1996-2000).*** Co-developed a single-borehole pumping and tracer test for aquifer characterization.
  - Programmed in FORTRAN semi-analytical and numerical models for groundwater flow and tracer transport in the subsurface.
  - Simulated groundwater flow and tracer transport in heterogeneous formations and developed relationships between results of a tracer test and aquifer properties.
  - Developed, conducted, and interpreted the results of tracer tests in a controlled laboratory environment.
  - Conducted and interpreted the results of pumping and tracer tests conducted in the field.

Sustainability Work Experience

- ***USEPA, Development of EPA Methodology for Environmental Footprint Analysis, (2010-2012).*** Developed USEPA document describing a methodology for environmental footprint analysis titled *Methodology for Understanding and Reducing a Project's Environmental Footprint* (EPA 542-R-12-002, February 2012). Also developed the USEPA Spreadsheets for Environmental Footprint Analysis (SEFA), which can be used to implement the methodology. Presented the contents of the document in a half-day training course at the National Association of Remedial Project Managers Conference in Kansas City, MO on May 18, 2010 and other training seminars.

- ***USEPA and U.S. Army Corps of Engineers, Green Remediation and Green and Sustainable Remediation Technical Support, (2010-2013).*** Provided green remediation evaluations and technical assistance to Superfund sites on behalf of USEPA. Review site documents, visit the site, and evaluate effective and efficient use of existing remedial technologies, evaluate the potential use of energy efficient technologies commonly used in other fields (e.g., combined heat and power and water source heat pumps), and consider potential opportunities to develop renewable energy to power the remedy. The evaluations focus on reducing the energy use, air emissions, water use, materials use, waste generation, and land disturbance associated with the remedy. Remedies evaluated include pump and treat, in-situ bioremediation, thermal remediation, in-situ chemical oxidation, soil excavation and disposal, monitored natural attenuation, landfill cover regarding, and phytoremediation.

- ***U.S. Department of the Navy – NAVFAC ESC, Environmental Footprint Analysis and Life-Cycle Assessment, (2011-2013).*** Served as a technical lead for the benchmark team in a project titled *Quantifying Life-Cycle Environmental Footprints of Soil and Groundwater Remedies* and funded by the U.S. Department of Defense Environmental Security Technology Certification Program (ESTCP). Ran Life-Cycle Assessment (LCA) software SimaPro™ on 20 different complex environmental remediation projects and used results to benchmark footprint analysis tools that have been developed by the Department of Defense.

- ***USEPA, Evaluation of Ecosystem Services Software, (2010).*** Served as senior technical reviewer on a project to evaluate ecosystem services software at an USEPA-funded mine reclamation project.

- ***U.S. Department of the Navy – NAVFAC ESC, Green and Sustainable Remediation Training, (2010).*** Prepared and co-presented training seminar on Green and Sustainable Remediation as part of the Navy Remediation Innovative Technology Seminar series in Spring 2010. Course was provided at six locations nationwide.

- ***USEPA, EPA Best Management Practices for Improving Sustainability of Pump and Treat Systems, (2009).*** Prepared an USEPA document on best management practices for improving sustainability of pump and treat remedies (EPA 542-F-09-005, December 2009).

- ***U.S. Army Corps of Engineers, Development and Demonstration of Green and Sustainable Remediation Procedures, (2010-2012).*** Executed project to pilot a green and sustainable remediation approach for the U.S. Army and provided recommendations for implementing the approach full-scale. The final report serves as the centerpiece for forthcoming U.S. Army guidance on conducting green and sustainable remediation at U.S. Army installations.

- ***USEPA, International Presentations on Behalf of EPA, (2010).*** Prepared and co-presented two courses on remedy optimization and prepared one course on green remediation on behalf of USEPA at the 2010 CONSOIL conference in Salzburg, Austria.

- ***Buckley Air Force Base, Renewable Energy Feasibility Assessment, (2009).*** Conducted a renewable energy feasibility assessment for the majority of the installation. Considered technologies including solar (PV), solar thermal, geothermal direct use, geothermal heat pumps, combined heat and power, anaerobic digestion, wind, and other technologies. Develop conceptual designs for implementing combined heat and power and geothermal applications.

- ***Residential Client, Photovoltaic Design and Installation, (2005).*** Designed and oversaw installation of a 4.42 kW roof-mounted photovoltaic system. Responsibilities included evaluating solar output and financial return of project, permitting, system design, equipment procurement, and oversight of construction contractor. System includes 52 85 W solar modules, grounding system, and two 2 kW inverters.

- ***Private Developer in New England, Renewable Energy and Energy Efficiency Feasibility Study, (2003).*** Prepared comprehensive feasibility study for renewable energy and energy efficiency technologies for a 200-acre mixed-use development that is currently in the planning stage. The study included technical and financial evaluations of PV systems, geothermal heat pumps, cogeneration, and various “green building” design technologies. The study also included a review of the LEED® certification process, the applicability to the project, and a preliminary strategy for obtaining LEED® certification for individual buildings that are part of the project. Also contributed energy-efficiency and water conservation language for the Expanded Environmental Notification Form that was submitted for the project.

- ***PEPCO Energy Services, Inc., Photovoltaic and Solar Thermal Feasibility Study, (2004).*** Prepared comprehensive feasibility study for solar electric (PV) and solar thermal technologies for a leachate treatment building at a landfill in central Pennsylvania. The study included technical and financial evaluations for both technologies, including financial incentives related to the Pennsylvania Energy Harvest Grant. The cost-effectiveness of the two technologies was compared. PV would help offset electricity used to power pumps and other aspects of the treatment plant. Solar thermal would help offset propane used to pre-heat the leachate prior to treatment.

- ***Confidential Private Client in New Jersey, Negotiation of Solar Renewable Energy Certificate Purchasing Contract, (2005).*** Negotiated a project contingent purchasing contract for Solar Renewable Energy Credits (SRECs) between a load serving entity (e.g., power company) and a solar project customer. The purchasing contract would help the load serving entity meet its targets for solar energy and help the solar project client finance a >500 kW solar project.

- ***Confidential Private Client in New Jersey. Photovoltaic Design and Analysis (2005).*** Designed 200 kW PV system, including system orientation/layout, specification of materials, diagrams, and costing. The design included the following:
    - Financial analysis for system that incorporates various New Jersey and Federal incentives plus sale of Solar Renewable Energy Certificates

  - Ballasted mounting system that eliminates the need for penetrating the roof and minimizes the need for pre-installation roofing upgrades
  - Photovoltaic system monitoring with secure internet access to view electricity production data
  - Detailed analysis of panel tilt vs. energy production

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  - Maintained and serviced field station equipment (sonic anemometer, cup anemometer, temperature probes, carbon dioxide and water vapor monitors, solar radiation sensors)
  - Processed and analyzed data
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APPENDIX C

Quality Assurance Project Plan

For

The Interim Remedial Measure to Address Chlorinated Volatile Organic Compounds and Toluene in Specific Treatment Areas on Parcel A of the Former Pratt Oil Works Site, Long Island City, Queens, New York

Prepared for NYSDEC Division of Environmental Remediation

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Appendix 2. Standard Operation Procedure 2.01: *Sampling Equipment Cleaning and Decontamination*

List of Acronyms

CVOC	chlorinated volatile organic compound as defined in this QAPP
ELAP	Environmental Laboratory Approval Program
IRM	Interim Remedial Measures
L	liter
mL	milliliter
µg/L	micrograms per liter
NaOH	sodium hydroxide
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSPE	New York State Professional Engineer
PARCC	precision, accuracy, representativeness, completeness, and comparability
PE	Professional Engineer
PID	photoionization detector
QAPP	Quality Assurance Project Plan
QA	quality assurance
QAO	Quality Assurance Officer
QC	quality control
SCO	Soil Cleanup Objective
SSCR	Supplemental Site Characterization Report (Kleinfelder, 2013)
SVE	soil vapor extraction
SVOCs	semi-volatile organic compounds
TOGS	Technical and Operational Guidance Series
VOCs	Volatile organic compounds

1.0 Introduction

This Quality Assurance Project Plan (QAPP) has been prepared to guide sampling and sample preservation activities associated with the Interim Remedial Measure (IRM) to reduce chlorinated volatile organic compound (CVOC) and toluene concentrations in the Specific Treatment Areas A and B on a portion of what is presently known as Lot 300, Block 312 at the Former Pratt Oil Works Site in Long Island City, Queens, New York (Property). The Property is currently owned by Waste Management of New York, LLC (WMNY), which operates a non-hazardous solid waste transfer station (Transfer Station) in accordance with a permit issued by the New York City Department of Sanitation (NYCDOS) and the New York State Department of Environmental Conservation (NYSDEC). The Specific Treatment Areas are depicted in Figure 1.2 of the February 2017 *Interim Remedial Measure Work Plan to Address Chlorinated Volatile Organic Compounds and Toluene in Specific Treatment Areas on Parcel A of the Former Pratt Oil Works Site (IRM Work Plan)*. The IRM Work Plan identifies soil vapor extraction (SVE) and bioventing, with follow-up targeted air sparging, as the preferred approach to achieve the IRM objectives. The proposed remedy layout is depicted in Figure 4.1 of the IRM Work Plan. Air sparging locations are not specified because the locations for targeted air sparging will be determined at a later date based on SVE operations data and access. The IRM Work Plan also identifies a general site plan for IRM implementation and a performance monitoring program.

For the purposes of this project, a CVOC is defined as follows:

- A CVOC that the 2013 *Supplemental Site Characterization Report* (SSCR) reports as being detected in groundwater within the Specific Treatment Areas above a NYSDEC standard or guidance value defined in NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1., Ambient Water Quality Standards and Guidance Values, June 1998 and Addendum April 2000.
- A CVOC that the 2013 SSCR reports as being detected in soil within the Specific Treatment Areas above the Soil Cleanup Objective (SCO) for Protection of Groundwater as defined in 6 New York Codes, Rules, and Regulations Part 375-6, Table 375-6.8(b).

Table 1 identifies the specific target compound list for CVOCs and toluene for this IRM. Additional parameters may be analyzed for waste disposal purposes.

Table 1. Target Compound List for the IRM

Chlorobenzene	cis-1,2-dichloroethene
Chloroethane	trans-1,2-dichloroethene
Chloroform	Methylene chloride
1,2-Dichlorobenzene	1,1,1-trichloroethane
1,4-Dichlorobenzene	Tetrachloroethene
1,1-Dichloroethane	Toluene
1,2-Dichloroethane	Trichloroethene
1,1-Dichloroethene	Vinyl chloride

2.0 Scope of Work

The scope of work covered by this QAPP are as follows:

- Characterization of well installation soil cuttings and development water for off-site disposal
- Pilot study used to collect information for SVE and bioventing system design
- Performance vapor and groundwater monitoring conducted during system operation

Waste Characterization

Soil cutting and development water characterization will involve collecting soil and water samples and submitting them for analyses required by the disposal facility.

Pilot Test

The pilot testing will involve the following steps:

- Individual SVE well pilot testing
    - Measure the depth to water in an extraction well.
    - Determine the maximum vacuum to apply to the extraction well during testing based on depth to groundwater and the SVE well screen interval.
    - Apply one third of the maximum vacuum to the extraction well for two hours.
    - During extraction, monitor vacuum, flow rate, total volatile organic compounds (VOCs) (with a photoionization detector, PID), and oxygen and carbon dioxide (with a gas meter) in the extracted vapors during testing.
    - During extraction, monitor vacuum at other wells in the Specific Treatment Area undergoing the pilot test at 15-minute intervals if Transfer Station traffic allows.
    - Increase the vacuum (and therefore flow rate) to two thirds of the maximum vacuum for two hours and monitor the same parameters from the same locations.
    - Increase the vacuum to the maximum vacuum for that well for two hours and monitor the same parameters from the same locations.
    - Prior to discontinuing extraction, sample vapors for CVOCs and toluene.
    - Continue to monitor vacuum in wells at 15-minute intervals for one hour (if Transfer Station traffic allows) after extraction has stopped to monitor recovery.
    - Repeat the above process for the other extraction wells.
- Individual bioventing well pilot testing (Area B only)
    - Inject air into a bioventing well at a pressure of 20 inches of water for one hour and monitor pressures at other wells in Area B at 15-minute intervals if Transfer Station traffic allows.
    - Increase the air injection pressure to 40 inches of water for one hour and repeat pressure monitoring of other wells at 15-minute intervals if Transfer Station traffic allows.
    - Continue monitoring at 15-minute intervals for one hour after injection has stopped to monitor recovery.
- Full system pilot testing for Area A

  - Operate the two hard-piped Area A extraction wells at vacuums and flow rates established from the individual well testing.
  - Monitor vacuum, flow rate, total VOCs (with a PID), and oxygen and carbon dioxide (with a gas meter) in the extracted vapors during testing.
  - Monitor vacuum at other Area A wells at 15-minute intervals if Transfer Station traffic allows.
  - After 8 hours, sample the extracted vapor for CVOCs and toluene, and then stop extraction.
- Full system pilot testing for Area B
  - Operate the four hard-piped Area B extraction wells at vacuums and flow rates established from the individual well testing.
  - Monitor vacuum, flow rate, total VOCs (with a PID), and oxygen and carbon dioxide (with a gas meter) in the extracted vapors during testing.
  - Monitor vacuum at other Area B wells at 15-minute intervals if Transfer Station traffic allows.
  - After 8 hours, sample the extracted vapor for CVOCs and toluene.
  - While continuing to extract vapors, inject air into the bioventing wells at the pressures and flows determined from individual well testing.
  - Monitor vacuum, flow rate, total VOCs (with a PID), and oxygen and carbon dioxide (with a gas meter) in the extracted vapors during testing.
  - Monitor vacuum at other Area B wells at 15-minute intervals if Transfer Station traffic allows
  - After 8 hours of combined extraction and injection, sample the extracted vapor for CVOCs and toluene.

IRM Operation

IRM system operation is described in the IRM Work Plan and will involve continuous operation of the SVE systems for 30,000 hours at the design flow rate and operation of the bioventing system for 3,000 hours at the design flow rate as Transfer Station traffic allows. Extracted vapors will be treated in accordance with an air permit, if one is required. Performance monitoring will include the following:

- Measuring and reporting vacuums and flow rates for each extraction well two times per week.
- Measuring total VOCs (with a PID) and oxygen and carbon dioxide (with a gas meter) for each extraction well monthly.
- Monitoring extracted and treated vapors as required by the air permit, if one is required.
- Monitoring of CVOCs and toluene in extracted vapors prior to treatment no less than one every 6 months.
- Monitoring CVOCs and toluene in groundwater from the five IRM monitoring wells on a quarterly basis for four years using low-flow sampling.

3.0 Data Quality Objectives

The data quality objectives of the IRM monitoring are as follows:

- Provide the information needed to appropriately transport and dispose of soil cuttings and development water off-site at an appropriate facility in accordance with State and Federal regulations.
- Provide the information needed for NYSDEC to prepare an air permit for the SVE systems, if one is required, and to design an off-gas treatment system to comply with that permit.
- Provide the information needed on a monthly basis to adjust the SVE and bioventing systems to improve mass removal of CVOCs and toluene within the Specific Treatment Areas.
- Document and document mass removal and groundwater concentration reductions for CVOCs and toluene in the Specific Treatment Areas.

All laboratory data will be of Level 3 quality, in which all analyses are performed by an off-site New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified analytical laboratory following standard USEPA protocols. The level of Quality Control (QC) provided by the laboratory will be as required by Analytical Services Protocol.

Precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters are indicators of data quality. The following PARCC goals have been established for this project to aid in assessing data quality.

Precision

The acceptable relative percent difference limit for field duplicates is less than or equal to 20 percent for aqueous samples and 35 percent for soil samples

Precision

Accuracy will be measured by percent recovery, which will be evaluated during data validation.

Representativeness

The representativeness of sample results will be assessed qualitatively by reviewing the sampling and analytical procedures and quantitatively by reviewing the results of blank samples. If an analyte is detected in a method, preparation, trip, or rinsate blank, any associated positive result may be considered a false positive result and qualified as a potential artifact of the sampling and analysis process.

Completeness

The completeness goal for this project is 90 percent, calculated for the entire project dataset. Data rejected during the review process will not be considered usable. If the completeness goal is not met, the effect of not meeting this goal and potential corrective action will be discussed with NYSDEC. Data gaps caused by rejected results or by planned samples that could not be collected will also be evaluated, even if overall completeness goals are met.

Comparability

To ensure comparability of results with those collected during previous sampling, newly available data under this IRM will be compared with previously collected data from this IRM.

4.0 Analytical Laboratory

All laboratory analyses for soil and groundwater will be conducted by ELAP-certified TestAmerica Buffalo. All analyses for CVOCs and toluene in vapor will be conducted by ELAP-certified TestAmerica Burlington.

5.0 Project Personnel

The project engineer will be Joseph Fiteni (NYSPE) of Savin Engineers, P.C. A representative of the construction contractor will be the construction Quality Assurance Manager for construction. Doug Sutton, Ph.D. (PE New Jersey) of HydroGeoLogic, Inc. will be the Quality Control Manager for construction. For sampling and analysis, Dr. Sutton will be the Quality Assurance Officer (QAO). The field analyst will report to Dr. Sutton, and will be determined prior to project kickoff. Mr. Fiteni's contact information is 914-769-3200. Dr. Sutton's contact information is 732-233-1161. Resumes for Mr. Fiteni and Dr. Sutton are included as Appendix B of the IRM Work Plan.

6.0 Field Measurements, Sampling, and Analytical Instrumentation

Field measurements and sampling are conducted to provide operational information about the SVE system during the pilot study and system operation. Field measurements, sampling, and analytical instrumentation are summarized in Table 2. The instruments will be calibrated and maintained in accordance with the manufacturer's instructions, including each day before work commences. Calibration information will be recorded in the site logbook or field sheets.

Table 2 Summary of Field Measurements, Sampling, and Analytical Instrumentation

Parameter	Activity	Instrument	Calibration Frequency
Depth to water	Pilot testing Groundwater sampling	Water level indicator	Daily inspection
Vacuum	Pilot testing SVE operation	Vacuum/pressure gauge	Daily inspection
Vapor flow rate	Pilot testing SVE operation	Pitot tube and digital manometer	Per manufacturer
Total VOCs	Pilot testing SVE operation CAMP	PID	Daily calibration
Oxygen and carbon dioxide	Pilot testing SVE operation	Landfill gas meter	Daily inspection, calibration per manufacturer
pH, conductivity, turbidity, dissolved oxygen, ORP	Groundwater sampling	Water quality meter and flow through cell	Daily inspection and calibration

7.0 Sampling Methodology for CVOCs and Toluene

The sampling methodologies for CVOCs and toluene in extracted vapors and groundwater are described below.

7.1 Extracted Vapors

Extracted vapors will be collected from a dedicated sample port on the SVE piping prior to the make-up air inlet and prior to the blower. A grab sample of air (collected over several seconds) will be withdrawn into a certified clean and evacuated Summa canister by virtue of a certified clean flow controller in accordance with the following procedure:

- Inspect the canister for damage. Do not use a canister that has visible damage.
- Remove protective cap from the valve on the canister.
- Attach the test gauge, open the canister to record the initial vacuum, close the canister, and remove the test gauge. The initial vacuum should be higher than 25 inches of mercury. If it is not, obtain a replacement canister.
- In the field log record the canister identification, test gauge identification, initial vacuum, sample location information, and all other information pertinent to the sampling effort.
- Attach the 7 micron particle filter to the canister and connect the filter and canister to the sample port. Tighten the fittings as to be leak free but do not over tighten (a quarter turn past snug is usually enough).
- To sample, slowly open the canister valve one half turn, leave it open for up to 30 seconds, and close the canister valve by hand.
- Confirm the final canister pressure by attaching the test gauge, opening the canister valve for 1-2 seconds, recording the canister pressure, closing the canister valve, and removing the test gauge.
- Apply the brass cap to the canister.
- Complete the chain of custody and sample tags and return the canister to the lab in the provided shipping container.
- When packing the canisters for shipment, verify that the valve (just past finger tight) and valve caps are snug (quarter turn past finger tight), and use sufficient clean packing to prevent the valves from rubbing against any hard surfaces.

7.2 Groundwater

Groundwater samples will be collected using the low-flow sampling methodology following the HydroGeoLogic, Inc. Standard Operating Procedure 2.02: *Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures*, which is provided as Appendix 1 of this QAPP and includes an example field sampling form. Field equipment will be decontaminated following the HydroGeoLogic, Inc. Standard Operation Procedure 2.01: *Sampling Equipment Cleaning and Decontamination* provided as Appendix 2 of this QAPP.

8.0 Analytical Methods/Quality Assurance for CVOCs and Toluene

The sampling matrix, IRM activity, approximate number of samples, quality assurance samples, and analytical methods are summarized in Table 3. The associated sample containers, preservation, minimum sample volumes, and maximum holding times are summarized in Table 4.

Table 3. Summary of Sampling for Laboratory Analysis for CVOCs and Toluene

Matrix	Activity	Method	Number of Samples
Vapor	Pilot testing	TO-15	10
Vapor	SVE Operation	TO-15	As required by air permit, minimum of once every 6 months from sampling port prior to off-gas treatment
Vapor	Field duplicate	TO-15	1 every 10 samples, 1 per event minimum
Groundwater	Groundwater sampling	8260B	80 (5 per quarter for 4 years)
Water	Trip blank	8260B	One per cooler containing CVOC and toluene samples
Groundwater	Field duplicate	8260B	1 per every 10 field samples, 1 per event (minimum)
Groundwater	Matrix Spike / Matrix Spike Duplicate	8260B	1 per every 20 samples, 1 per event (minimum)
Water	Equipment blank	8260B	1 per every 20 samples, 1 per event (minimum)

Table 4. Sampling Containers, Preservation, Volumes, and Holding Times

Name	Analytical Method	Container	Preservation	Minimum Sample Volume or Weight	Maximum Holding Time
Aqueous Samples					
CVOCs and Toluene	8260B	3x40 mL G	Cool 4 °C, HCl, pH < 2	80 mL	14 days
Vapor Samples					
CVOCs and Toluene	TO-15	6 L Summa Canister	None	6 L Summa Canister	None
Waste Samples					
Flash point (aqueous waste); ignitability (solid waste)	SW1010A or SW1020B; SW1030	G	Cool 4 °C	500 mL or 4 ounces	7 days
Corrosivity as pH (aqueous waste and solid waste)	SW9040C; SW9045D	G	Cool 4 °C	500 mL or 4 ounces	7 days
TCLP - VOCs - semi-VOCs (SVOCs) - pesticides - metals - mercury	SW1311 (prep) 8260B 8270C 8081B 6010B 7471	G – size varies by method, matrix, and parameter	Cool 4 °C	Sample size depends on analyses to be performed after extraction	7-14 days to extraction (organics); 180 days to extraction (metals)
Cyanide (aqueous waste)	SW9012B	P	Cool 4 °C; NaOH to pH> 12, 6 g ascorbic acid	500 mL	14 days
Cyanide (solid waste)	SW9012B	G	Cool 4 °C	4 ounces	14 days
Sulfide (aqueous waste)	9030B/9034	P	Cool 4 °C; NaOH to pH> 9, 2 mL zinc acetate	500 mL	14 days
Sulfide (solid waste)	9030B/9034	P,G	Cool 4 °C	4 ounces	14 days
Paint filter test (solid waste)	9095B	G	Cool 4 °C	8 ounces	14 days

Table 5. Laboratory Reporting Limits

Parameter	Aqueous using 8260B TestAmerica Buffalo (µg/L)	Vapor using TO-15 TestAmerica Burlington (parts per billion)
Chlorobenzene	1	0.2
Chloroethane	1	0.5
Chloroform	1	0.2
1,2-Dichlorobenzene	1	0.2
1,4-Dichlorobenzene	1	0.2
1,1-Dichloroethane	1	0.2
1,2-Dichloroethane	1	0.2
1,1-Dichloroethene	1	0.2
cis-1,2-dichloroethene	1	0.2
trans-1,2-dichloroethene	1	0.2
Methylene chloride	1	0.5
1,1,1-trichloroethane	1	0.2
Tetrachloroethene	1	0.2
Toluene	1	0.2
Trichloroethene	1	0.2
Vinyl chloride	1	0.2

9.0 Record Keeping and Chain of Custody

Field Logs

The logbooks must be bound and the entries recorded in waterproof ink. The logbook must contain sufficient information to distinguish samples from one another and describe all site activities and conditions relevant to the sample collection process. Logbooks can be supplemented by other documentation and checklists, such as well stabilization forms, field sampling forms, and daily QC forms. Logbook entries will be reviewed on a daily basis by the field analyst to ensure that entries are complete and properly formatted. The field analyst will also use site documentation to verify sampling completeness on an ongoing basis to ensure that all projected samples and analytical fractions, including all required associated field QC samples, are collected and submitted for analysis. At a minimum, the following information will be recorded in the site logbook:

- The name of the person to whom the logbook is assigned;
- The logbook number;
- The project name;
- The project start date;
- The names and responsibilities of on-site project personnel, including subcontractor personnel;
- The arrival/departure of site visitors;
- The arrival/departure of equipment;
- Sampling activities and sample log sheet references;
- A description of subcontractor activities;
- Sample pickup information including traffic report/chain-of-custody numbers, airbill numbers, carrier, time, and date;
- A description of borehole or monitoring well installation activities and operations;
- Health and safety issues; and
- A description of photographs including the date, time, photographer, roll and picture number, location, and compass direction of the photograph.

The equipment used to collect the sample will be noted in the logbook, along with date and time of sampling, sampler’s name, sample description, sample location, and the volume and number of containers collected. QC sample information will be appropriately recorded to allow for the association of QC samples with field samples.

All entries will be written in ink, and no erasures will be made. If an incorrect entry is made, the incorrect information will be indicated with a single strike line; the person making the correction will initial and date the change. The correct information will be entered close to the incorrect entry and in such a fashion that it is clear that this information replaces the crossed-out entry.

Chain of Custody

Chain-of-custody records for all samples will be maintained throughout the sampling and analysis process. A sample will be considered to be "in custody" of an individual if the sample is either in direct view of directly controlled by that individual. Storage of samples during custody will be accomplished according to established preservation techniques, in appropriately sealed storage containers. Chain-of-custody will be accomplished when the samples or sealed sample coolers are directly transferred from one individual to the next, with the first individual witnessing the signature of the recipient upon the chain-of-custody record. If samples are to be sent via a courier (e.g., Federal Express), signed Chain-of Custody Forms will be included in each cooler documenting sample content. In addition, the project manager or other designated member of the sampling team will confirm that the samples were received by the laboratory approximately 24 to 36 hours after shipment of the samples to confirm their arrival at the laboratory. Chain-of-Custody Forms will be placed in a zip-lock bag or equivalent sealable pouch and attached to the inside lid of the sample cooler. A copy will be kept by the sampling personnel.

10.0 Reporting of Sampling Data

Field measurements and analyses will be reported in monthly O&M reports within two weeks following the end of the month being reported. CVOC and toluene data will be submitted in quarterly IRM status report submitted within 30 days of the end of the quarter being reported. The quarterly reports will include calculations for CVOC and toluene mass removal, mass removal trends, and groundwater concentration trends for that quarter and previous quarters. A final IRM Engineering Report will also present all collected data. The monthly, quarterly, and final IRM engineering report will be submitted in an electronic format that complies with NYSDEC's Electronic Document Standards. Laboratory reports will be Category B deliverables under the Analytical Services Protocol, and data will be provided to NYSDEC in electronic data deliverables that comply with NYSDEC's Electronic Data Warehouse Standards.

FIGURES

Note: The CVOC and Toluene Specific Treatment Areas consists of Sub-Areas A and B:

Sub-Area A: A 25-ft buffer drawn from the lines connecting the following former surveyed points:

Point	Northing (ft)	Easting (ft)
LIF-23	205413.20	1001614.13
LIF-25	205337.61	1001642.74
MW-34	205355.83	1001595.90

Sub-Area B: A 25-ft buffer drawn from the lines connecting the following former surveyed points:

Point	Northing (ft)	Easting (ft)
MW-40S	205448.40	1001715.09
MW-39	205460.29	1001807.25
MW-5S	205408.34	1001856.61
MW-44	205286.53	1001929.96
MW-43	205306.21	1001860.34
TP-5	205344.56	1001829.11
MW-41S	205362.36	1001811.10

Surveyed coordinates are NY/LI State Plane 3104 (NAD1983)

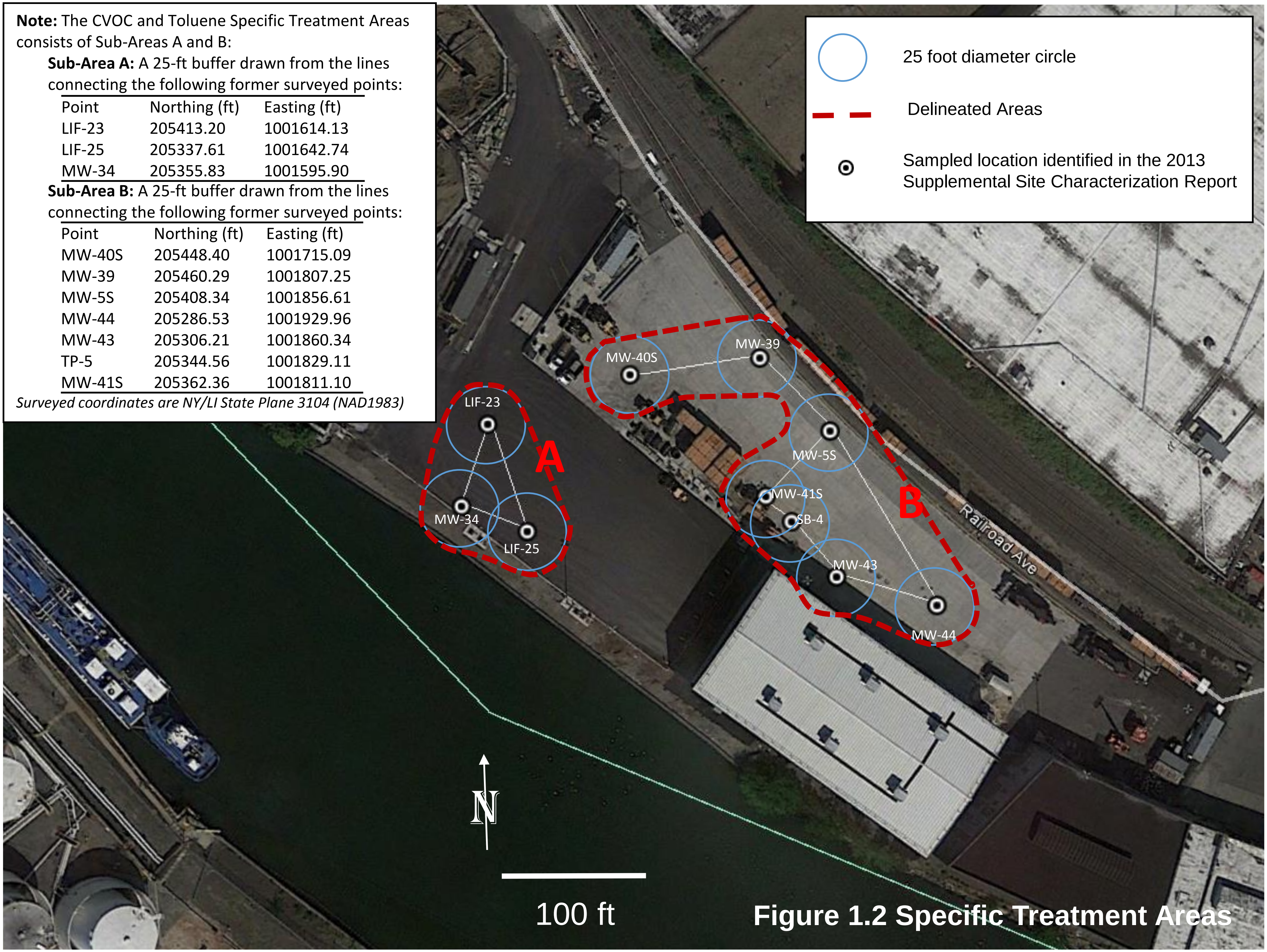
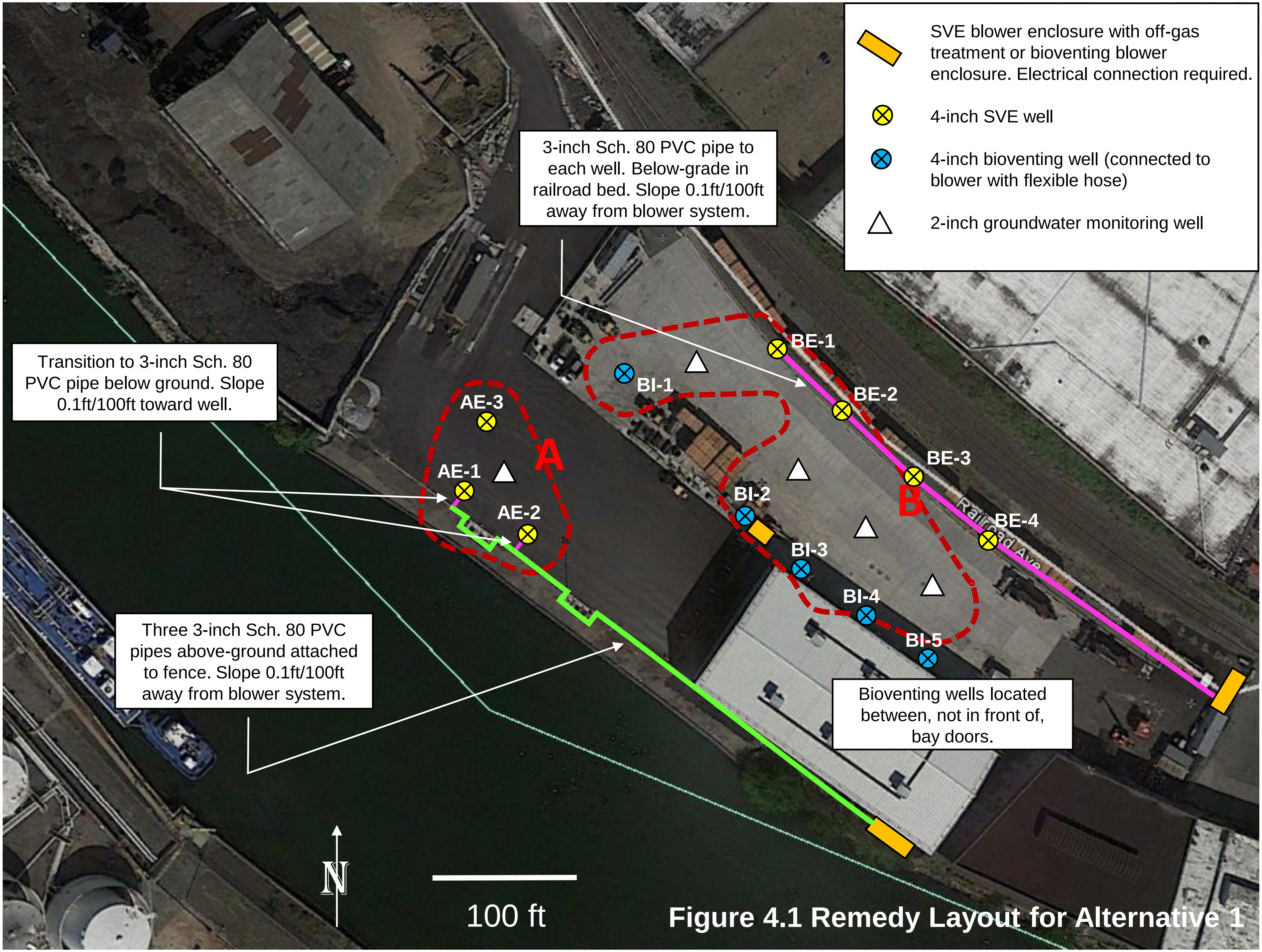


Figure 1.2 Specific Treatment Areas



🟧 SVE blower enclosure with off-gas treatment or bioventing blower enclosure. Electrical connection required.

⊗ 4-inch SVE well

⊗ 4-inch bioventing well (connected to blower with flexible hose)

△ 2-inch groundwater monitoring well

3-inch Sch. 80 PVC pipe to each well. Below-grade in railroad bed. Slope 0.1ft/100ft away from blower system.

Transition to 3-inch Sch. 80 PVC pipe below ground. Slope 0.1ft/100ft toward well.

Three 3-inch Sch. 80 PVC pipes above-ground attached to fence. Slope 0.1ft/100ft away from blower system.

Bioventing wells located between, not in front of, bay doors.

Figure 4.1 Remedy Layout for Alternative 1

APPENDIX 1

STANDARD OPERATING PROCEDURE

Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures	**SOP No.: 2.02** **SOP Category: HTRW** **Revision No.: 1** **Date: March 2012**

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the standard method and equipment used to perform low-flow (minimal drawdown) groundwater sampling using dedicated low-flow bladder pump equipment or a non-dedicated pump. The general techniques described in this procedure are in general agreement with the procedures outlined in the U.S. Environmental Protection Agency (EPA) publication entitled "Low-Flow (Minimal Drawdown) Ground Water Sampling Procedures" (EPA, 1996).

2.0 SCOPE AND APPLICATION

The low-flow (minimal drawdown) groundwater sampling procedures are used to facilitate collecting depth-specific samples and offer the following advantages:

- The water column in the well experiences minimal disturbance during the purging and sampling procedure.
- The volume of purge water to achieve stabilization parameters is greatly reduced.
- The work effort associated with field decontamination of sampling equipment is greatly reduced.

3.0 EQUIPMENT AND SUPPLIES

- Pump with the capability to produce consistent, low-flow rates ranging from 0.1 to 0.5 liters per minute (L/m). Dedicated pumps should be equipped with Teflon® tubing to reduce the contamination of the tubing over time, and nondedicated pumps should either use Teflon tubing, with proper decontamination between wells, or disposable one-time-use polyethylene tubing);
- Pump controller;
- Portable air compressor or compressed gas;
- Water level meter;
- Horiba U-22 water quality analyzer (with flow-through cell);
- Plastic sheeting;
- Personal protective equipment (PPE), nitrile gloves, Tyvek®, overboots, etc.;
- 55-gallon drum or equivalent container to collect purge water;

- Field logbook; and
- Groundwater field sampling data sheet.

4.0 PROCEDURES

4.1 WELL INSPECTION/GAUGING

Before groundwater sampling begins, wells will be inspected for signs of tampering or other damage. If tampering is suspected (that is, casing is damaged or lock or cap is missing), this will be recorded in the field logbook and reported to the field operations manager. Wells that display signs of tampering will not be sampled until the field operations manager has discussed the matter with the project manager (PM).

Before sampling activities begin, all nondedicated purging and sampling equipment will be decontaminated. Plastic sheeting will be placed on the ground surrounding the well. Any water in the protective casing or in the vaults around the well casing will be removed before venting and purging. Each time a casing cap is removed to measure water level or collect a sample, the air in the breathing zone and the air in the well casing will be checked with a photoionization detector. Procedures in the health and safety plan will be followed when high concentrations of organic vapors or explosive gases are detected. Air monitoring data will be recorded in the field logbook.

An interface probe will be used if a nonconductive floating product layer is suspected in the well. The interface probe will be used to determine the presence of floating product, if any, before the groundwater level is measured. The groundwater level will then be measured to the nearest 0.0l foot using an electric water-level indicator. Water levels will be measured from the notch located at the top of the well casing. If well casings are not notched, measurements will be taken from the north edge of the top of the well casing, and a notch will be made using a decontaminated metal file. Water level measurements will be recorded in the field logbook and on field sheets.

The total depth of the well from the top of the casing will be determined using an electric sounder and recorded. If the total depth of the well is already known, the total depth will not be measured until sampling has concluded to avoid disturbing the water column. The screened interval should be known and the height of the water column present within the screened portion of the well (that is, not above the top or below the bottom of the screen) will be calculated. This is the saturated screened interval to be used when determining the proper placement of the sampling pump. All water level and total depth measuring devices will be routinely checked with a tape measure to ensure measurements are accurate.

4.2 PURGING

The monitoring wells should be purged and sampled in order of increasing expected contamination (least contaminated to most contaminated). This practice will help reduce the potential for cross contamination between wells by accessory sampling equipment.

> **Note:** Dedicated bladder pumps will be prepositioned at the desired depth during initial installation. The desired depth is the middle of the saturated screened interval or slightly above the interval; that is, a measured depth of 43 percent of the saturated screened interval. A minimum of 6 inches will be maintained between the bottom of the pump and the bottom of the well. A pump should not be positioned beyond the final placement depth and raised back up. If this should occur, the well should be sampled 24 hours later to ensure that equilibrium has been achieved.

After water levels are measured in the well, the dedicated bladder pump accessory equipment will be attached to the well cap according to manufacturer’s instructions, or the non-dedicated pump will be lowered to the desired sampling depth. The groundwater discharge line will be attached to an in-line flow-through cell to facilitate collecting field parameters. After accessory equipment is attached and operational, the purging procedure can commence at a rate of approximately 0.1 to 0.5 liter per minute (L/m). Water level should remain constant while stabilization parameters are measured. Any drawdowns should occur before attempts are made to stabilize these parameters. The purge water should be discharged into a suitable container of a known volume to allow the groundwater discharge rate to be measured.

Water levels should be continuously recorded to monitor drawdown in the well and to allow for flow rate adjustment before the maximum drawdown is exceeded. When pump placement inhibits measuring the water level in the well, purge rates from previous sample events will not be exceeded and the water discharge line will be closely monitored for air bubbles. If air bubbles are detected at any point during purging, the bladder pump will be shut down and the validity of lowering the pump or adjusting the purge rate will be evaluated. The goal is to purge the well at a rate that does not draw down the static water level more than 0.33 foot. This goal may not be achievable in all wells based on geologic conditions. In any case, continuous monitoring of the drawdown will be accomplishing throughout the purging process. Groundwater discharge will be calculated from the flow rate using containers of known volumes during purging.

Temperature, pH, electrical conductivity (EC), dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity should be measured during purging and recorded. Measurements will be taken every 3 to 5 minutes when flow rates are in the 0.1 to 0.5 L/m range. Stabilization is achieved after all parameters have stabilized for three consecutive readings as outlined below (EPA, 1996):

- temperature ± 0.5 degrees Celsius (°C),
- pH ± 0.1 units,
- EC ± 3 percent,
- DO ± 10 percent,
- ORP ± 10 millivolts (mV), and
- turbidity <50 nephelometric turbidity units (NTU) or ± 10 percent.

Turbidity readings below 50 NTUs are desired, especially when metal samples are to be collected. When turbidity is high, the purge time will be extended for turbidity to reach a value below 50 NTUs; however, if turbidity stabilizes above 50 NTUs for 15 to 30 minutes, then turbidity will be considered stable as defined above. Groundwater samples will be collected using the pump used in the purging procedure. If the parameters do not stabilize when the drawdown indicates a laminar flow, a subset (pH, EC, and turbidity or DO) will be used as the stabilization parameters. If subset parameters do not stabilize, then the sample will be collected when a maximum number of parameters stabilize, and the anomalous parameters will be brought to the attention of the field operations manager.

If, during low-flow sampling, the turbidity cannot be reduced to a level that is less than 50 NTUs, then both filtered and unfiltered samples will be sent to the laboratory for analysis. If a particular well routinely produces turbid water (that is, about 50 NTUs), then the contractor will consult with the client and the well may be redeveloped or abandoned and replaced with a new well. For wells known to have a less than a 0.1 L/m flow rate, a flow rate of 0.05 to 0.1 L/m should be attempted. If the drawdown is greater than 0.33 foot using this flow rate, then the micropurge technique is assumed to be invalid and should be discontinued because groundwater flow to the pump is no longer considered to be laminar across the screen within the aquifer. The flow in the vicinity of the pump now contains a vertical component from the stagnant water column in the filter pack and screened casing.

When micropurging is not effective on wells containing at least 1 foot of water, the well construction data should be reevaluated to determine whether the well was properly installed within the water-bearing unit. If necessary, wells should be redeveloped during the same sampling event. Redevelopment should be conducted in accordance with ASTM International procedures. The well should be purged, and a minimum of 24 hours should be allowed following redevelopment. If redevelopment of the well is not successful in achieving a flow rate conducive to micropurging, the well should either be removed from the sampling event or purged dry. The sample will be collected when a sufficient volume of water has accumulated in the well (generally left overnight). A determination must be made whether a sufficient volume is present to collect the samples with a pump (preferable) or if a bailer must be used (not preferable—especially when collecting metals).

A maximum of five well volumes may be removed from any well before it is sampled. However, five well volumes need not be removed if the purge parameters have stabilized with less than 0.33

foot of drawdown. The well volume is defined as the volume of submerged casing, screen, and filter pack. One well volume can be calculated using the following equation:

$$V_w = HV_{ft}$$

where

V_w = Well volume (gallons)
H = Well depth minus depth to water (feet)
V_{ft} = Volume of 1-foot length of borehole (gallons/feet)

$$V_{ft} = 7.481\pi\left(\frac{D}{2}\right)^2$$

and where

D = Inside diameter of well borehole (feet)

4.3 SAMPLE COLLECTION

Before sample collection, the flow-through chamber used to measure parameters will be disconnected and the flow rate adjusted to maintain the established purge rate. Sample containers will be filled from the pump discharge line using a slow, controlled pour down the side of a tilted sample container. All sample containers should be properly labeled before sample collection.

VOC Samples

VOC samples should be collected first. VOC sample vials will be pre-preserved by the laboratory. The VOC sample vial will be filled using a slow, controlled pour down the side of a tilted sample vial to minimize volatilization and loss of preservative until a meniscus is visible. The VOC vial will be sealed immediately. When the container is capped, it will be inverted and gently tapped to ensure no air bubbles are present in the vial. If, after the initial filling, bubbles are present, the vials will be discarded and the VOC sampling effort will be repeated. Refilling vials will result in a loss of preservatives. After the VOC vials are sealed, sample degassing may cause bubbles to form; these bubbles will be left in the container. VOC sample vials should immediately be stored (inverted) on ice until receipt at the laboratory. These VOC samples will never be composited, homogenized, or filtered. (Note: If a bailer must be used, the sample will be collected from the bailer using a slow, controlled pour down the side of a tilted sample vial to minimize volatilization.)

Other Samples

After VOC samples have been collected, the remaining water samples will be collected in the following order:

- semivolatile organic compounds, including polynuclear aromatic hydrocarbons;
- pesticides/polychlorinated biphenyls;
- metals, including mercury and cyanide;
- radiological parameters; and
- common anions.

Water samples should be collected immediately after parameter stabilization using the same pump used for purging. Field equipment should be calibrated every morning and if erroneous readings occur during the day. (No negative DO values should be obtained.)

5.0 RECORDS

Record purging, sampling, and equipment calibration information in the field logbook. Complete the Groundwater Field Sampling Data Sheet (Attachment 1). Record measurement times, parameter values, purge volume, water levels, etc.). Record calibration details on the Equipment Calibration Log (Attachment 2).

6.0 QUALITY CONTROL

The project quality assurance (QA)/quality control (QC) officer is responsible for ensuring that all equipment is calibrated daily before use and recording the calibration results on the Calibration Log. The QA coordinator is responsible for periodically reviewing these results.

7.0 REFERENCES

U.S. Environmental Protection Agency, 1996. Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, EPA/540/S-95/504. April.

ATTACHMENTS

Attachment 1 – Groundwater Field Sampling Data Sheet
Attachment 2 – Equipment Calibration Log

Page __ of __

ATTACHMENT 1
GROUNDWATER FIELD SAMPLING DATA SHEET

Well No.:		Site:	
Sampler(s):		Project No.:	
Well Depth:		Date:	Time:
DTW (ft):	DTP (ft):	Courier: ___UPS ___Hand ___Other	
MP Ht. Aboveground/Below Ground Surface:		Sampling Method (G=grab, B=bailer, SP=submersible pump	
Condition of Bottom of Well:		Type of Pump:	
Screen Interval (ft):		Weather (sun/clear, overcast/rain, wind direction, ambient temperature):	
Well Diameter (in):			
Placement of Pump (ft):			

FIELD PARAMETERS

TIME	DEPTH TO WATER (FT)	FLOW RATE (GPM)	TOTAL VOLUME (GAL)	PH	TEMP. (°C)	COND. (UMHOS/ CM)	ORP (mV)	D.O. (MG/L)	TURB (NTU)	COMMENTS

OBSERVATIONS

Color: Clear Other (describe):
Odor: None Low Medium High Very Strong H2S Fuel-Like
Notes:
PURGE VOLUME CALCULATIONS For: well casing volume = J $(Rc)^2$ (well depth - static H_2O depth) x (conversion 7.48 gal/ft^3)
Signed/Sampler(s):

ATTACHMENT 2
CALIBRATION LOG

Page __ of ____

Project Name:____

Project No.____

Date/Time	Calibrated by	Instrument	Standard/ Manufacturer Lot No.	Standard Concentration	Instrument Reading	Comments

APPENDIX 2

Sampling Equipment Cleaning and Decontamination

SOP No.: 2.01
SOP Category: HTRW
Revision No.: 1
Date: December 2010

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe decontamination methods and related issues involving the physical process of removing chemical and radioactive contaminants from sampling equipment.

2.0 SCOPE AND APPLICATIONS

This procedure is specifically applicable to decontaminating the surfaces of sampling equipment that come in direct contact with actual samples during sample collection and processing. This SOP describes the procedures to be followed to achieve effective decontamination as follows: (1) remove contaminants from contaminated surfaces, (2) minimize the spread of contamination to uncontaminated surfaces, (3) avoid any cross-contamination of samples, and (4) minimize personnel exposures. The intent is to accomplish the required level of decontamination while minimizing the generation of additional solid and liquid waste.

Other decontamination procedures may apply to a specific project; refer to the work plan for project-specific decontamination methods and schedules.

3.0 GENERAL REQUIREMENTS

All work will be performed in a manner that is consistent with Occupational Safety and Health Administration established standards and requirements. Refer to the site- or project-specific health and safety plan for relevant health and safety requirements. All activities will be conducted in conformance with the Site Health and Safety Plan. Procedures for packaging and disposing of all waste generated during field activities will be described in the project-specific work plan.

Personnel who use this procedure must provide documented evidence to the program manager or project manager that they have been trained on the procedure. This documentation will be retained in the project file.

Any deviations from specified requirements will be justified to and authorized by the project manager and/or the relevant program manager and discussed in the approved project plans. Deviations from requirements will be sufficiently documented to re-create the modified process.

4.0 DEFINITIONS

Deionized Water: Tap water treated by passing through a standard deionizing resin column. The deionized water should contain no heavy metals or other inorganic compounds (in other words, compounds at or above analytical detection limits) as defined by a standard inductively coupled argon plasma spectrophotometer scan.

Equipment: Those items (variously referred to as "field equipment" or "sampling equipment") necessary to conduct sampling activities, but that do not directly contact the samples.

Laboratory Detergent: A standard brand of phosphate-free laboratory detergent, such as Liquinox®, or the equivalent.

Organic-Free Water: Tap water treated with activated carbon and deionizing units or water from a Milli-Q® system (or equivalent). This water should not contain pesticides, herbicides, extractable organic compounds, and less than 50 micrograms per liter of purgeable organic compounds as measured by a low-level gas chromatography/mass spectrometry scan. Organic-free water should be stored only in glass or Teflon® containers and dispensed from only glass, Teflon, or stainless steel containers.

Sampling Devices: Utensils and other implements that come into direct contact with samples during their collection and processing.

Solvent: Substance capable of dissolving other substances. Pesticide-grade isopropanol is the most common solvent used to decontaminate equipment. Using any other solvent must be justified and approved by the responsible project personnel and documented on the Daily Field Report forms or in the field logbooks.

Tap Water: Water from a tested and approved water system.

5.0 PROCEDURES

5.1 GENERAL

Decontamination of sampling devices will be performed in a designated decontamination area, removed from any sampling location. This designated area must also be in a location free of direct exposure to airborne and radiological surface contaminants, and downwind of the location where clean field equipment, clean sample devices, and sample containers are stored.

As a minimum, nitrile or equivalent gloves will be worn while decontaminating equipment. Safety glasses or goggles, uncoated Tyvek® coveralls, laboratory coat, or splash apron will be worn if justified by the contaminant concentration and potential adverse effects. If cleaning with steam or high-temperature water, a face shield, heavy-duty polyvinyl chloride (PVC) or equivalent gloves, coated Tyvek or equivalent coveralls will be worn. Ground-fault circuit interrupters will be used to supply power to any portable electrical equipment in the equipment decontamination area. Solvent rinsing will be conducted in an open, well-ventilated area or under a fume hood. No eating, smoking, drinking, chewing, or hand-to-mouth contact will be permitted during decontamination activities. A 15-minute eyewash will be available within 100 feet if corrosive (concentrated acids or bases) decontamination fluids are used.

- Contaminated or dirty sampling devices/equipment should not be stored with clean (decontaminated) sampling devices/equipment.
- Clean, decontaminated sampling devices should be segregated from all other equipment and supplies.
- Paint or any other coatings must be removed from any part of a sampling device that may either contact a sample or may otherwise affect sample integrity. After such coatings are removed, the sampling device will then require decontamination by the appropriate method.
- The brushes used to clean sampling devices must not be of the wire-wrapped type.
- For any of the specific decontamination methods that may be used, the substitution of higher-grade water is permitted (for example, using organic-free water in place of deionized water). However, it must be noted that deionized water and organic-free water are less effective than tap water in rinsing away the detergent during the initial rinse.
- Decontaminated sampling devices and all filled and empty sample containers will be stored in locations that are protected from exposure to any contaminant.
- The method for decontaminating sampling devices and the exterior of sample containers that have been exposed to radioactive material is based on the material contaminated, the sample medium, the radiation levels, and the specific radionuclides to be removed.
- The release of decontaminated sampling devices and sample containers for unrestricted use is based on site-specific criteria. These site-specific criteria should be detailed in the project-specific work plan.
- Rags used during decontamination activities may become a hazardous waste and require segregation. Refer to the project work plans for hazardous waste disposal requirements.

5.2 DECONTAMINATION SCHEDULES

- Sampling devices must be decontaminated before being used in the field to prevent potential contamination of a sample.
- Sampling devices must be decontaminated between samples to prevent cross-contamination.
- Sampling devices must be decontaminated at the close of the sampling event before being taken off site.

- An acceptable alternative to cleaning and decontaminating sampling devices is using items cleaned or sterilized by the manufacturer that are discarded after use. Care must be exercised to ensure such previously cleaned or sterilized items do not retain residues of chemical or radioactive sterilizing agents that might interfere with analytical techniques.
- Whenever visible dirt, droplets of liquid, stains, or other extraneous materials are detected on the exterior of a sample container, the exterior surfaces must be decontaminated. This step should be performed before the container is placed in a sample cooler or shipping container.
- For sample containers used in controlled access areas, a more rigorous cleaning and/or radiation monitoring may be required before removal from the site. Refer to the project-specific work plan for details.

5.3 DECONTAMINATION METHODS

The following decontamination methods are examples of some of those most commonly used in field investigations. Note that the decontamination methods described in this section are for guidance only; the field operations manager will adjust decontamination practices to fit the sampling situation and applicable requirements.

- The exterior of sample containers This decontamination will be performed at the sample location before the sample container is placed in the sample cooler or shipping container as follows:
    - The exterior surfaces of the sample container must be wiped with disposable rags/toweling, or rinsed with deionized water.
    - If rinsing with deionized water, the exterior of the sample container must be wiped dry with disposable rags/toweling, or allowed to air dry.
    - All visible dirt, droplets of liquid, or other extraneous materials must be removed.
    - For containers used in controlled-access areas or where the sample media are difficult to remove (for example, sludge), a more rigorous cleaning and/or radiation monitoring may be required. Refer to the project-specific work plan for details.
- Decontaminating stainless steel, Teflon, or metal sampling devices used to collect samples for trace organic compounds and/or metals analyses:
    - Clean with a tap water and laboratory detergent solution. Use phosphate-free detergent, such as Liquinox or equivalent. Use a brush to remove particulate matter and surface film.
    - Rinse thoroughly with organic-free water.

  - Rinse twice with solvent (pesticide-grade isopropanol).
  - Allow to air dry for 24 hours, if possible.
  - If it is not possible to air dry for 24 hours, then rinse twice with organic-free water and allow to air dry as long as possible.
  - Wrap sampling devices with aluminum foil (with shiny side facing outward).

Note: When a sampling device is used to collect samples that contain oil, grease, or other hard-to-remove materials, it may be necessary to rinse the device several times with an approved solvent (one that meets the requirements of the work plan) before initiating decontamination. In extreme cases, it may be necessary to steam clean, brush, or sandblast the sampling device before using this decontamination method. If the sampling device cannot be adequately cleaned using the above means, it must be discarded.

- Decontaminating glass sampling devices used for the collection of samples for trace organic compounds and/or metals analyses
  - Wash thoroughly with laboratory detergent and hot water using a brush to remove any particulate matter or surface film.
  - Rinse thoroughly with hot tap water.
  - Rinse thoroughly with tap water.
  - Rinse twice with solvent and allow to air dry for at least 24 hours, if possible.
  - Wrap with aluminum foil (shiny side facing outward) to prevent contamination during storage and/or transport to the field.

Note: When a sampling device is used to collect samples that contain oil, grease, or other hard-to-remove materials, it may be necessary to rinse the device several times with an approved solvent (one that meets the requirements of the work plan) before initiating decontamination. In extreme cases, it may be necessary to steam clean, brush, or sandblast the sampling device before using this decontamination method. If the sampling device cannot be adequately cleaned using the above means, it must be discarded.

5.4 QUALITY CONTROL

The quality of the deionized and organic-free water used may be monitored by collecting samples in standard precleaned sample containers and submitting them to the laboratory for a standard inductively coupled plasma scan. Organic-free water should be submitted for low-level pesticide, herbicide, extractable, or purgeable compounds analyses, as appropriate.

The effectiveness of the decontamination procedures is monitored by submitting samples of rinse water to the laboratory for low-level analyses of the parameters of interest. An attempt should be made to select different sampling devices each time devices are decontaminated to ensure a representative sampling of all devices is obtained over the length of the project. Note on the Daily Field Report Form or in the field logbooks the devices being used for the rinsate samples.

6.0 RECORDS

Documentation generated as a result of this procedure is collected and maintained in accordance with requirements specified in the work plan.

ATTACHMENTS

Below is Attachment 1, Field Checklist

ATTACHMENT 1
FIELD CHECKLIST

________ Daily Field Report Forms or Field Logbooks
________ Safety Glasses or Monogoggles
________ Black, Indelible Pen
________ Decontamination Equipment
________ Work Plan
________ Appropriate Containers for Waste and Equipment
_______ Gloves
_______ Safety Shoes
_______ Plastic Sheeting
_______ Health and Safety Plan
_______ Monitoring Instruments

APPENDIX D

(to be provided under separate cover)

SITE SPECIFIC HEALTH AND SAFETY PLAN

SECTION 1: GENERAL INFORMATION & DISCLAIMER

CLIENT NAME: Waste Management of New York	PROJECT NAME: FPOW CVOC/Toluene IRM
PROJECT MANAGER: Doug Sutton	
PROJECT LEADER: To be determined	REVISION DATE: May 3, 2017
SITE SAFETY OFFICER: To be determined	
PREPARED BY: Doug Sutton	DATE: May 3, 2017

NOTE: This Site Specific Health and Safety Plan (HASP) has been prepared for use by HGL, Inc. employees for work at this site. HGL, Inc. is not responsible for its use by others. **The plan is written for the specific site conditions, purposes, tasks, dates and personnel specified and must be amended and reviewed by those named in Section 16 if these conditions change.**

Subcontractors shall be solely responsible for the health and safety of their employees and shall comply with all applicable laws and regulations. In accordance with 1910.120(b)(1)(iv) and (v), HGL, Inc. will inform subcontractors of the site emergency response procedures, and any potential fire, explosion, health, safety or other hazards by making this Site Specific Safety and Health Plan and site information obtained by others available during regular business hours. All contractors and subcontractors arhaze responsible for: (1) developing their own Health and Safety Plan including a written Hazard Communication Program and any other written hazard specific programs required by federal, state and local laws and regulations; (2) providing their own personal protective equipment; (3) providing documentation that their employees have been health and safety trained in accordance with applicable federal, state and local laws and regulations; (4) providing evidence of medical surveillance and medical approvals for their employees; and (5) designating their own site safety officer responsible for ensuring that their employees comply with their own Health and Safety plan and taking any other additional measures required by their site activities.

This HASP must be reviewed/approved by Corporate Health and Safety.

SECTION 2: PROJECT INFORMATION

(1) SITE INFORMATION

Site Name:	Former Pratt Oil Works CVOC/Toluene IRM	Site Project Client Contact:	Glen Schultz
Address:	38-34 Review Avenue (block 312, lot 300)	Phone No.:	215-269-2198
	Long Island City, Queens, NY	Site Health & Safety Contact:	Glen Schultz
		Phone No.:	215-269-2198

(2) SITE CLASSIFICATION: (check all that apply)

	Hazardous (RCRA)	Other
	Construction	
	Sanitary or C and D Landfill	Explain:
	First Entry	
X	Hazardous (State Cleanup Program)	Under consent order with NYSDEC
	UST/LUST	
	Manufacturing	
	Previously Characterized	
X	Active	NYC Dept. of Sanitation permitted waste transfer station
	Inactive	

(3) ENTRY OBJECTIVES AND DATES OF FIELD VISIT(S):

Remedy installation, including well installation, piping, testing, and delivery/connection of pre-fabricated system.

Dates: To be determined between 8/1/2017 and 12/31/2017

(4) HGL TASKS:

1) Oversight and air monitoring for installation of vacuum extraction, bioventing, and groundwater monitoring wells
2) Oversight and air monitoring for Installation of above-ground and below ground piping
3) Vacuum and low-pressure testing of wells
4) Testing of pre-fabricated blower systems
5) Groundwater sampling

TASKS PERFORMED BY OTHERS:

Well drilling

Installation of above-ground and below-ground piping – below-ground piping is shallow trenching (< 4 ft deep)

Installation and connection of pre-fabricated systems in enclosures

(5) PROJECT ORGANIZATION AND COORDINATION - The following HGL personnel are designated to carry out the stated project job functions on site. (Note: One person may carry out more than one job function.)

	PROJECT MANAGER	Doug Sutton
	SITE SAFETY OFFICER	To be determined
	ALTERNATE SITE SAFETY OFFICER (if needed)	To be determined
	PUBLIC INFORMATION OFFICER	N/A
	SITE RECORDKEEPER	Nikos Fytilis
	ON-SITE PERSONNEL WITH CPR/FA	To be determined
	FIELD TEAM LEADER	To be determined
	FIELD TEAM MEMBERS	To be determined
VISITORS:	FEDERAL AGENCY REPS (i.e., EPA, OSHA)	Not applicable
	STATE AGENCY REPS	John Grathwol (NYSDEC)
	LOCAL AGENCY REPS	N/A
SUBCONTRACTORS:	SUBCONTRACTOR(S)' SITE SAFETY OFFICERS	To be determined

All personnel arriving or departing the site should log in and out with the Record Keeper.

(6) ONSITE CONTROL

Intrusive work will be conducted when the facility is not active. During this period, the FTL (TBD) has been designated to coordinate access control and security for HGL operations on site. A safe perimeter will be established during field operation. The perimeter will be constructed using caution tape and other physical barriers.

No unauthorized person should be within this area.

The wind direction will be interpreted by a flag or other visual indicator. Personnel not directly involved in drilling activities or oversight will be located upwind of the drilling activities.

Control boundaries will be established around and Exclusion Zones for each well to be drilled.)

These boundaries will be identified by traffic cones and/or caution tape.

SECTION 3: PHYSICAL HAZARDS INFORMATION

(1) IDENTIFY POTENTIAL PHYSICAL HAZARDS TO WORKERS:

Confined Space
X Heavy equipment
X Moving parts
X Heavy Lifting
X Electrical
Overhead Hazards
Chemical Burns or Irritation

Steep/uneven terrain
X Heat stress
X Extreme cold
Ionizing Radiation
X Traffic
X Biological Hazards
X Lacerations and/or Contusions

X Fatigue/extended work shifts
X Drum handling
X Noise
Non-Ionizing Radiation
Falls

Describe other unsafe environments:

(2) SAFETY EQUIPMENT REQUIRED FOR HGL EMPLOYEES

Combustible Gas Meter
Fall Protection/ Arrest
Confined Space
Equipment
Ladder
X First Aid Kit
EPI Pens

X Eye Wash
Emergency Shower
X Barrier Tape
X Traffic Cones
Stretcher
X A-B-C Fire Extinguisher
Insect/Tick Repellant

X PID
Floatation Device (USCG Type III)
Emergency Air Horn
Lights
Lights - emergency
Communications - On Site
Communications - Off Site

SECTION 4: CHEMICAL HAZARDS INFORMATION

(1) IDENTIFIED CONTAMINANTS

Known or suspected hazardous/toxic materials (attach historical information, physical description, map of contamination and tabulated data, if available) – SOIL CONCENTRATIONS REPORTED BELOW FOR VOCS – SEE ATTACHED MAPS FOR OTHER CONTAMINANTS IN SOIL AND GROUNDWATER.

MEDIUM	SUBSTANCES INVOLVED	CHARACTERISTICS	ESTIMATED CONCS.	TLV (PPM)
SL	Toluene	TO, VO	36,400 mg/kg	20
SL	Benzene	TO, VO	96 mg/kg	0.5
SL	Ethylbenzene	TO, VO	1,900 mg/kg	20
SL	Xylenes	TO, VO	8,940 mg/kg	100
SL	Chloroform	TO, VO	9.35 mg/kg	10
SL	1,1-DCA	TO, VO	3.65 mg/kg	100
SL	1,2-DCA	TO, VO	34.3 mg/kg	10
SL	cis-1,2-DCE	TO, VO	170 mg/kg	200
SL	1,2-Dichlorobenzene	TO, VO	125 mg/kg	25
SL	1,4-Dichlorobenzene	TO, VO	22.4 mg/kg	10
SL	Methylene chloride	TO, VO	7.52 mg/kg	50
SL	tetrachloroethene	TO, VO	23.2 mg/kg	25
SL	1,1,1-trichloroethane	TO, VO	4.75 mg/kg	350
SL	Trichloroethene	TO, VO	324 mg/kg	10
SL	Vinyl chloride	TO, VO	184 mg/kg	1

Media types:	GW (ground water), SW (surface water), WW (wastewater), AIR (air), SL (soil), SD (sediment), WL (waste, liquid), WS (waste, solid), WD (waste, sludge), WG (waste, gas), OT (other).
Characteristics:	CA (corrosive, acid), CC (corrosive, caustic), IG (ignitable), RA (radioactive), VO (volatile), TO (toxic), RE (reactive), BIO (infectious), UN (unknown), OT (other, describe)

(2) DESCRIBE POTENTIAL FOR CONTACT WITH EACH MEDIUM TYPE FOR EACH OF THE HGL TASKS LISTED IN SECTION 2.4:

HGL TASK #	ROUTE OF EXPOSURE	POTENTIAL FOR CONTACT	METHOD OF CONTROL
GW sampling, drilling, trench excavation	Inhalation of vapors	Moderate	Operation of equipment in well ventilated space
GW sampling, drilling, trench excavation	Direct contact with affected groundwater or soil	Moderate	PPE/Gloves

The Site Safety Officer will brief the HGL field team on symptoms and signs of overexposure to chemical hazards.

SECTION 5: HAZARD COMMUNICATION PROGRAM

If chemicals are introduced to the site by HGL, Inc. (e.g., decontamination liquids, preservatives, etc.), bring a SDSs to the site. The Site Safety Officer will review this information with all field personnel prior to the start of the project. The Comprehensive List of Chemicals for this site includes:

Motor oil and fuel (for generators/compressors)	Hydrochloric acid (preservative)
Alconox and Liquinox	See Attached SDS
Methanol (preservative)	See Attached SDS
Polyisobutylene (calibration gas)	
water	

SECTION 6: ENVIRONMENTAL MONITORING

(1) The following environmental monitoring instruments shall be used on site at the specified intervals.

EQUIPMENT		MONITORING PERIOD	Air Contaminant	PEL/REL/TLV	ACTION LEVEL
PID (Lamp 10.6 eV)	-	continuous/hourly/daily/**As needed**	CVOCs/BTEX	Total Organic vapor (BETX) 300 ppm	10 ppm

(2) Monitoring equipment is to be calibrated according to manufacturers' instructions. Record calibration data and air concentrations in the Health and Safety on-site log book.

(3) Recommended Action Levels for Upgrade or Downgrade of Respiratory Protection or Site Shutdown and Evacuation. These are average values. Consideration should be given to the potential for release of highly toxic compounds from the waste or from reaction by-products. Levels are for persistent (> 10 min) breathing zone measurements.

	Airborne Vapors or Gases	Characterized Gases, Vapors, Particulates*
Level D	Background* to 50% TLV or STEL	Up to 50% of PEL, STEL or TLV
Level C	Upgrade at 50% TLV or STEL	Up to 25 times PEL, REL or TLV
Level B	25 times TLV or STEL to 500 times PEL	Up to 500 times PEL, REL or TLV
Level A	If there is a skin hazard concern	Up to 1000 times PEL, REL or TLV

*Off-site "clean" air measurement.

*Use mixture calculations (% allowed = $\Sigma C_n / PEL_n$) if more than one contaminant is present.

Oxygen Deficiency

Concentration	Action Taken
< 19.5% O_2	Leave Area. Reenter only with supplied-air respirators.
19.5 % to 25% O_2	Work may continue. Investigate changes from 21%.
> 25% O_2	Work must stop. Ventilate area before returning.

Flammability

Concentration	Action Taken
< 10% of LEL	Work may continue. Consider toxicity potential.
10% to 25% LEL	Work may continue. Increase monitoring frequency.
> 25% LEL	Work must stop. Ventilate area before returning.

Radiation

Intensity	Action Taken
<0 .5 mR/hr	Work may continue.
< 1 mR/hr	Work may continue. Continue to monitor. Notify Corporate H&S
5 mR/hr	Radiation work zone. Work must stop.

SECTION 7: HEALTH AND SAFETY TRAINING AND MEDICAL MONITORING PROGRAM

The project staff is included in the HGL Health and Safety training and medical monitoring programs.

HAZWOPER TRAINING

Name	Medical (Date)	Initial (Hrs/Date:	Refresher (Date)	MGR/SUPV (Date)	CPR/FA/BBP Dates	Fit Test (Make/Size/Type/Date)
TBD						

SECTION 8: PERSONAL MONITORING

The following personal monitoring will be in effect on site:

Personal exposure sampling:

N/A

Medical monitoring: The expected air temperature will be 40-60 F. If it is determined that heat stress monitoring is required (mandatory for heavy exertion in PPE at temperatures over 70°F) the following procedures shall be followed (describe procedures in effect, i.e., monitoring body temperature, body weight, pulse rate): See Appendix for heat and cold stress procedures

A copy of personal monitoring results is to be sent to Corporate Health and Safety for inclusion in the Employee's Confidential Exposure Record File.

SECTION 9: CONFINED SPACE ENTRY

(1) WILL CONFINED SPACE ENTRY TAKE PLACE? Yes _____ No X

If yes, attach **Confined Space Entry Program** and complete the **Pre-Entry Inspection Checklist** and **Confined Space Entry Permit** prior to entering each confined space, each work shift. The Confined Space Permit must be posted outside the confined space.

Permits will be saved and logged with project documentation.

SECTION 10: COMMUNICATIONS PROCEDURES

The following standard hand signals will be used in case of failure of radio communications:

Hand gripping throat	Out of air, can't breathe
Grip partner's wrist or both hands around wrist	Leave area immediately
Hands on top of head	Need assistance
Thumbs up	OK, I am all right, I understand
Thumbs down	No, negative

If applicable, telephone communication to the Command Post should be established as soon as practicable. The stationary and/or mobile phone number(s) are TBD and TBD.

SECTION 11: DECONTAMINATION PROCEDURES

Personnel and equipment leaving the Exclusion Zone shall be thoroughly decontaminated. The Site Safety Officer is responsible for monitoring adherence with this decontamination plan. The standard level **D** decontamination protocol shall be used with the following decontamination stations*:

(1) Rinse sampling equipment with soap and water
(2) During well drilling, large equipment will be rinsed in decontamination area – including plastic sheeting with rise water collected in drums
(3) Groundwater well purge water will be drummed and disposed of off site
(4) Cuttings from well drilling or residual material from trenching will be disposed of off-site
(5)
(6)
(7)
(8)
(9)
(10)
Other

*See the HGL Health and Safety Procedures Manual, Procedure 06, Personal Protective Equipment, for sample decontamination station descriptions.

The following decontamination equipment is required:

Water, Alconox, small table, basin/bucket, towels; Plastic sheeting, bolsters to prevent runoff, drums, brushes

Other procedures as outlined in HGL H&S Procedure No.: 27 Drilling Safety

Alconox will be used as the decontamination solution.

SECTION 12: EMERGENCY PROCEDURES

The following standard emergency procedures will be used by onsite personnel. The Site Safety Officer (SSO) shall be notified of any onsite emergencies and be responsible for ensuring that the appropriate procedures are followed.

Personnel Injury in the Exclusion Zone: Upon notification of an injury in the Exclusion Zone, the designated emergency signal 3 bursts of an air horn or car horn shall be sounded. All site personnel shall assemble at the decontamination line. An outside rescue team summoned by the field team leader or SSO will enter the Exclusion Zone (if required) to remove the injured person to the hotline. The SSO and Field Team Leader should evaluate the nature of the injury, and the affected person should be decontaminated to the extent possible prior to movement to the Support Zone. The onsite CPR/FA personnel shall initiate the appropriate first aid, and contact should be made for an ambulance and with the designated medical facility (if required). No persons shall reenter the Exclusion Zone until the cause of the injury or symptoms are determined.

Personal Protective Equipment Failure: If any site worker experiences a failure or alteration of protective equipment that affects the protection factor that person and his/her buddy shall immediately leave the Exclusion Zone. Reentry shall not be permitted until the equipment has been repaired or replaced.

Fire/Explosion: Upon notification of a fire or explosion on site, the designated emergency signal 3 bursts of an air horn or car horn shall be sounded and all site personnel assembled at the decontamination line. The fire department shall be alerted and all personnel moved to a safe distance from the involved area.

Other Equipment Failure: If any other equipment on site fails to operate properly, the Field Team Leader and Site Safety Officer shall be notified and then determine the effect of this failure on continuing operations on site. If the failure affects the safety of personnel or prevents completion of the Work Plan tasks, all personnel shall leave the Exclusion Zone until the situation is evaluated and appropriate actions taken.

The following emergency escape routes are designated for use in those situations where egress from the Exclusion Zone can not occur through the decontamination line (attach map if available):

Initial movement away from the hazard until a safe distance has been achieved followed by relocating to the asphalt area inside the gate on the southern end of the landfill property.

In all situations, when an onsite emergency results in evacuation of the Exclusion Zone, personnel shall not reenter until:

1. The conditions resulting in the emergency have been corrected.
2. The hazards have been reassessed by the SSO.
3. The Site Safety Plan has been reviewed by the SSO and Corporate Health and Safety Director.
4. Site personnel have been briefed on any changes in the Health and Safety Plan by the SSO.

SECTION 13. EMERGENCY INFORMATION

TO BE POSTED IN SITE-TRAILER/OFFICE AND IN FIELD VEHICLES

(1) LOCAL RESOURCES

Ambulance (name):		Phone:	911
Hospital (name):	NYU Medical Center	Phone:	212-263-7300
Police (local or state):	NYPD	Phone:	911
Fire Dept. (name):	NYFD	Phone:	911
HAZ MAT Responder:		Phone:	
Nearest phone:			
On-Site CPR/FA(s):			

The hospital is 10 minutes from the site (without traffic) and 25 minutes with traffic. The ambulance response time is 13 minutes. When IDLH conditions exist, arrangements should be made for onsite standby of emergency services.

(2) DIRECTIONS TO NEAREST HOSPITAL - ATTACH MAP:

(3) CORPORATE RESOURCES

Steve Davis, CIH, CSP

Corporate Health & Safety Director 865-659-0499 (Cell)

(Office Health & Safety Coordinator)

HGL Corporate Occupational Physician

Dr. Greaney 888-449-7787

WorkCare 24/7 Emergency hotline

HGL 24/7 Emergency Contact Number: **800-341-3647**

(4) WHOM TO NOTIFY IN CASE OF ACCIDENT:

Doug Sutton (project manager), 732-233-1161

SECTION 14: PROTECTIVE EQUIPMENT LIST

TASK*	RESPIRATORS & CARTRIDGE* (change out frequency)	USE	CLOTHING	GLOVES	BOOTS	OTHER
1. Drilling install/oversight	N/A	N/A	LEVEL D	T	S	H/G/N
2. Piping install/oversight	N/A	N/A	LEVEL D	T	S	H/G/N
3. Vacuum/pressure testing	N/A	N/A	LEVEL D	T	S	H/G/N
4. Blower install/testing	N/A	N/A	LEVEL D	T	S	H/G/N
5. Groundwater sampling	N/A	N/A	LEVEL D	T	S	H/G/N

*Same as in Section 4(2).

RESPIRATORS	APR CARTRIDGES	USE	CLOTHING	GLOVES	BOOTS	OTHER
B = SCBA(self-contained breathing apparatus)	O = Organic vapor	Cont = Continuous	T = Tyvek	B = Butyl	F = Firemans	F = Face Shield
APR = Air purifying respirator	G = Organic vapor/acid gas	UP = Upgrade	P = PE Tyvek	L - Latex	L = Latex	G = Goggles
E = Escape	P = Particulate		C = Coveralls	T = Nitrile	S = Safety	H = Hardhat
AL = Airline	C = Combination organic vapor & particulate			V = Viton		N = Hearing Protection
				PA = Polyvinyl Alcohol		

SECTION 15: SAFE WORK PRACTICES

THE FOLLOWING PRACTICES MUST BE FOLLOWED BY PERSONNEL ON SITE

1. Smoking, eating, chewing gum or tobacco, or drinking are forbidden except in clean or designated areas.
2. Ignition of flammable liquids within or through improvised heating devices (e.g., barrels) is forbidden.
3. Contact with samples, excavated materials, or other contaminated materials must be minimized.
4. Wearing jewelry that could become entangled in equipment is prohibited.
5. Do not kneel on the ground when collecting samples, or walk through stained soils, pools or mud
6. Running and horseplay are prohibited in all areas of the site.
7. All electrical equipment used in outside locations, wet areas or near water must be plugged into ground fault circuit interrupter (GFCI) protected outlets.
8. A "Buddy System" in which another worker is close enough to render immediate aid will be in effect.
9. Good housekeeping practices are to be maintained.
10. Where the eyes or body may be exposed to corrosive materials, suitable PPE will be worn and facilities for quick drenching or flushing shall be available for immediate use.
11. In the event of treacherous weather-related working conditions (i.e., thunderstorm, limited visibility, extreme cold or heat) field tasks will be suspended until conditions improve or appropriate protection from the elements is provided.

Site Specific Safe Work Practices: **Morning safety briefings prior to start of work; Daily activity logs, Drilling operations pre-mobilization inspection form**

SECTION 16: EMPLOYEE ACKNOWLEDGEMENTS

PLAN REVIEWED BY:		DATE
Corporate Health & Safety:	TO BE REVIEWED WHEN FINALIZED	
Site Safety Officer:	TO BE REVIEWED WHEN FINALIZED	
Project Manager:	TO BE REVIEWED WHEN FINALIZED	
Project Leader:	TO BE REVIEWED WHEN FINALIZED	

I acknowledge that I have read the information on this Site Safety Plan Short Form and the attached Safety Data Sheets (SDSs). I understand the site hazards as described and agreed to comply with the contents of this Plan.

EMPLOYEE (print name)	SIGNATURE	DATE

FIGURES

Figure 1.1 Site Location Map

Note: The CVOC and Toluene Specific Treatment Areas consists of Sub-Areas A and B:

Sub-Area A: A 25-ft buffer drawn from the lines connecting the following former surveyed points:

Point	Northing (ft)	Easting (ft)
LIF-23	205413.20	1001614.13
LIF-25	205337.61	1001642.74
MW-34	205355.83	1001595.90

Sub-Area B: A 25-ft buffer drawn from the lines connecting the following former surveyed points:

Point	Northing (ft)	Easting (ft)
MW-40S	205448.40	1001715.09
MW-39	205460.29	1001807.25
MW-5S	205408.34	1001856.61
MW-44	205286.53	1001929.96
MW-43	205306.21	1001860.34
TP-5	205344.56	1001829.11
MW-41S	205362.36	1001811.10

Surveyed coordinates are NY/LI State Plane 3104 (NAD1983)

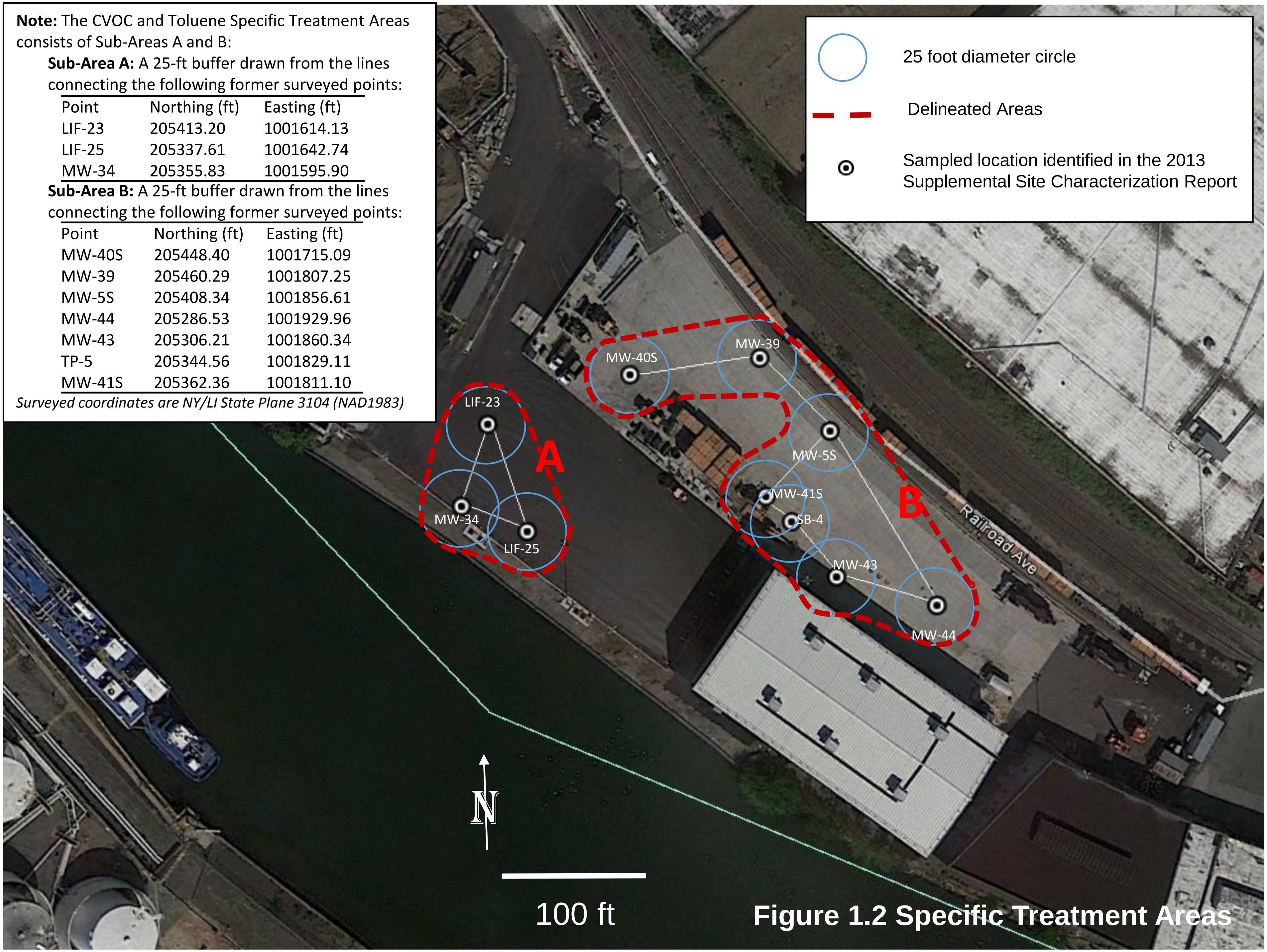
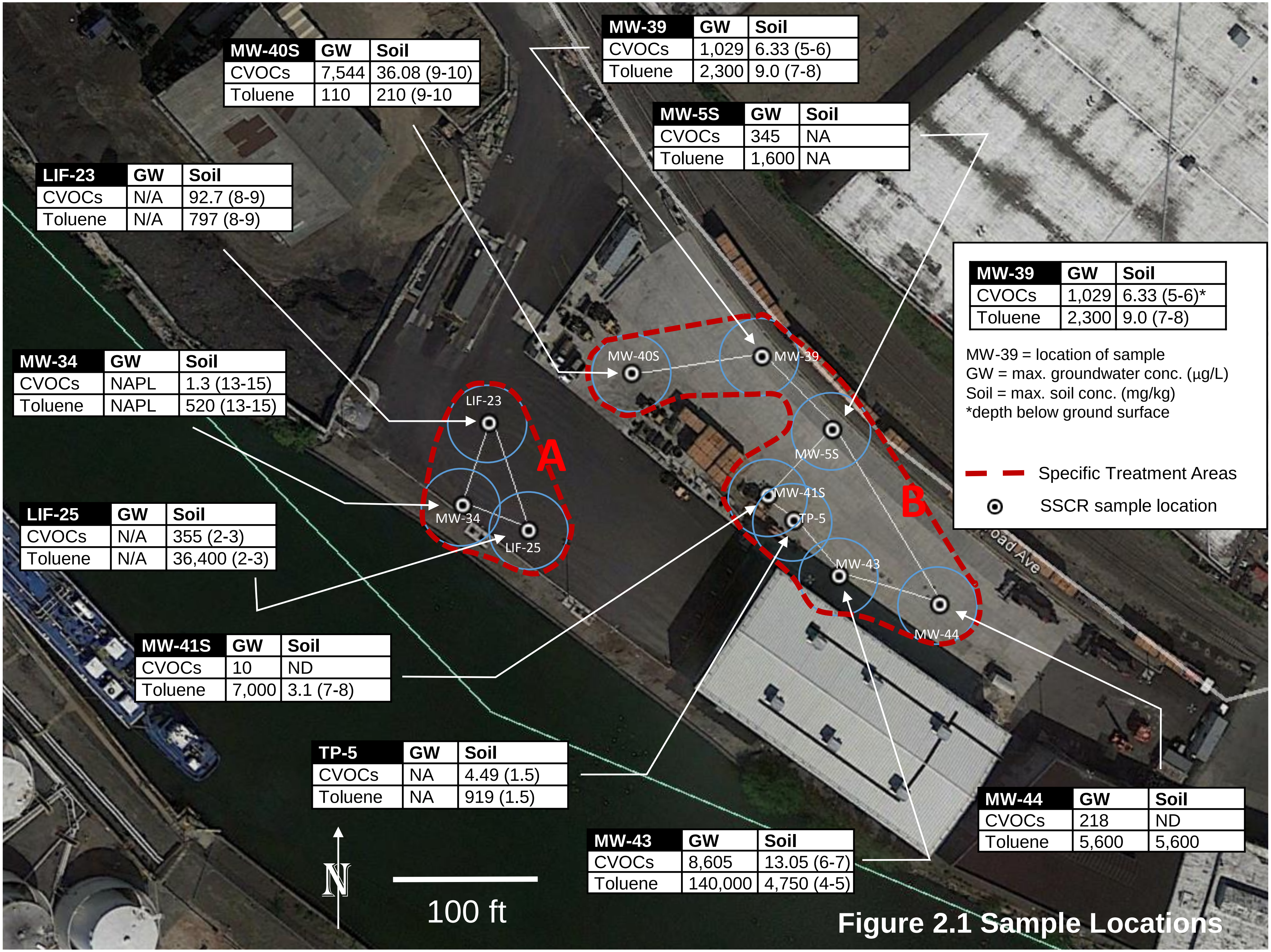


Figure 1.2 Specific Treatment Areas



MW-40S	GW	Soil
CVOCs	7,544	36.08 (9-10)
Toluene	110	210 (9-10

MW-39	GW	Soil
CVOCs	1,029	6.33 (5-6)
Toluene	2,300	9.0 (7-8)

MW-5S	GW	Soil
CVOCs	345	NA
Toluene	1,600	NA

LIF-23	GW	Soil
CVOCs	N/A	92.7 (8-9)
Toluene	N/A	797 (8-9)

MW-34	GW	Soil
CVOCs	NAPL	1.3 (13-15)
Toluene	NAPL	520 (13-15)

LIF-25	GW	Soil
CVOCs	N/A	355 (2-3)
Toluene	N/A	36,400 (2-3)

MW-41S	GW	Soil
CVOCs	10	ND
Toluene	7,000	3.1 (7-8)

TP-5	GW	Soil
CVOCs	NA	4.49 (1.5)
Toluene	NA	919 (1.5)

MW-43	GW	Soil
CVOCs	8,605	13.05 (6-7)
Toluene	140,000	4,750 (4-5)

MW-44	GW	Soil
CVOCs	218	ND
Toluene	5,600	5,600

MW-39	GW	Soil
CVOCs	1,029	6.33 (5-6)*
Toluene	2,300	9.0 (7-8)

MW-39 = location of sample
GW = max. groundwater conc. (µg/L)
Soil = max. soil conc. (mg/kg)
*depth below ground surface

▬ ▬	Specific Treatment Areas
⊙	SSCR sample location

Figure 2.1 Sample Locations

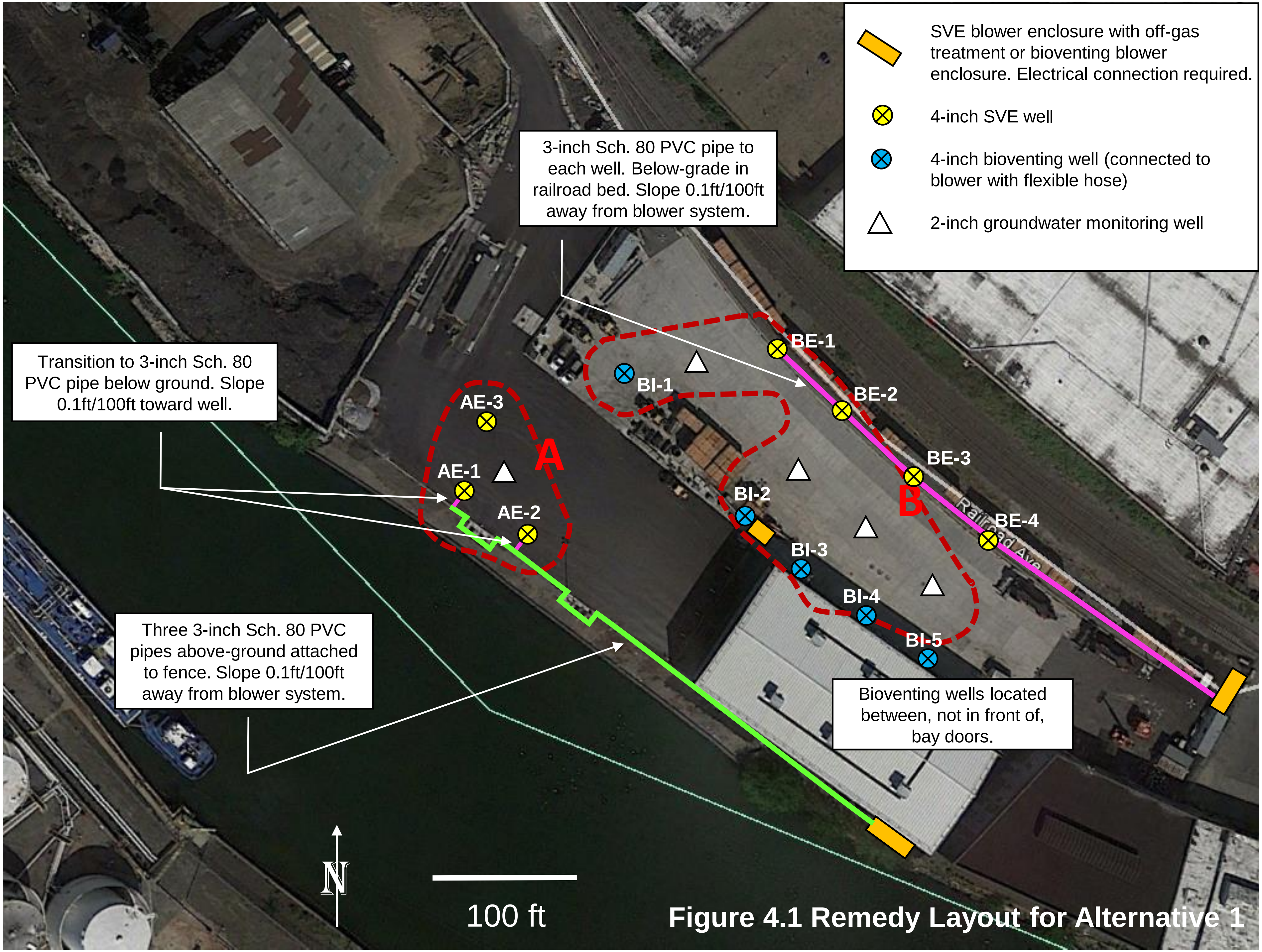


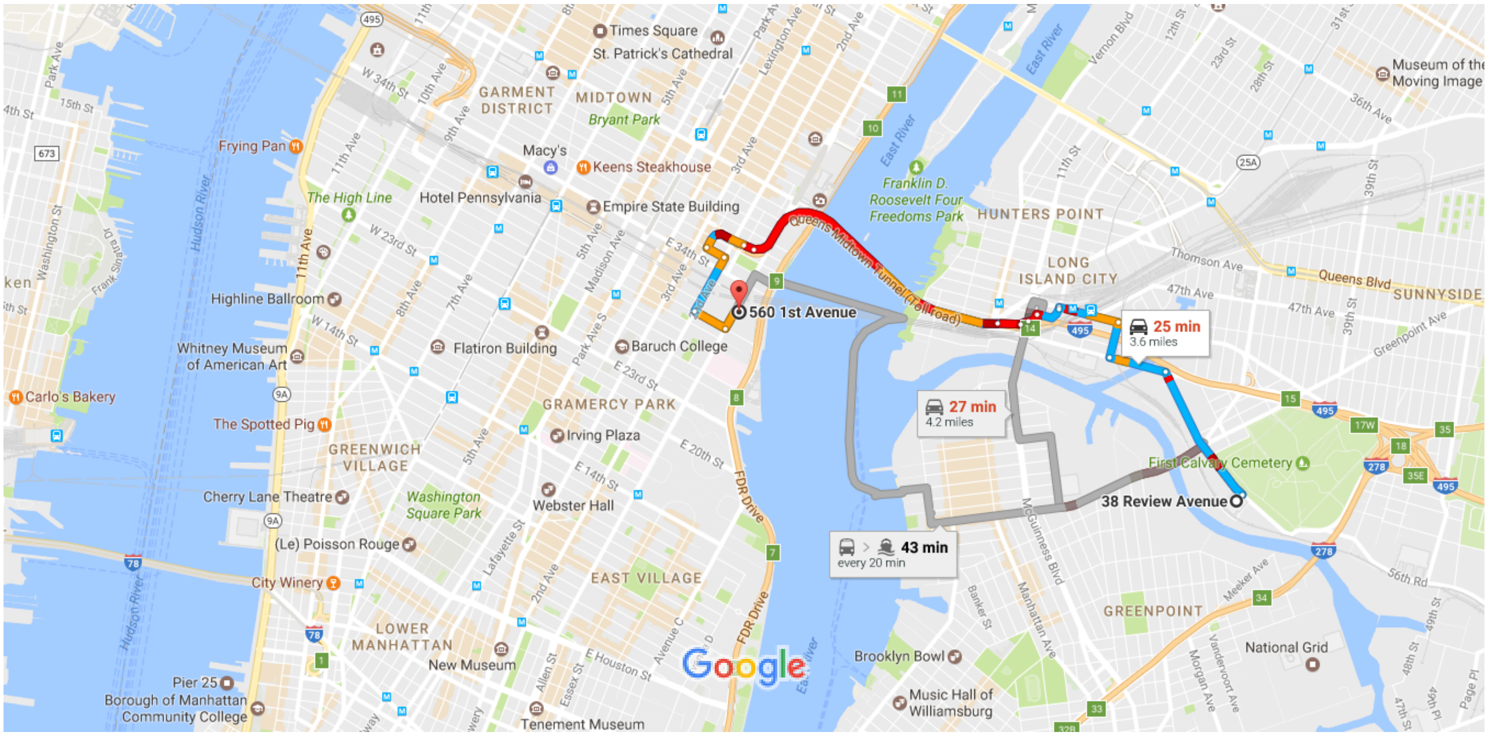
Figure 4.1 Remedy Layout for Alternative 1

ROUTE TO HOSPITAL

Google Maps

38 Review Ave, Long Island City, NY 11101 to 560 1st Avenue, New York, NY

Drive 3.6 miles, 25 min



Map data ©2017 Google 2000 ft

38 Review Ave

Long Island City, NY 11101

↑ 1. Head northwest on Review Ave toward 37th St

3 min (0.6 mi)

Continue on Borden Ave. Take 49th Ave to 50th Ave

3 min (0.6 mi)

↰ 2. Turn left onto Borden Ave

0.2 mi

↱ 3. Turn right onto 25th St

0.1 mi

↰ 4. Turn left onto 49th Ave

0.2 mi

↰ 5. Turn left onto 21st St

46 ft

Get on I-495 W

1 min (0.2 mi)

↱ 6. Turn right onto 50th Ave

0.1 mi

7. Turn left onto the I-495 W ramp
   ⚠ Toll road

   262 ft

8. Keep left and merge onto I-495 W
   ⚠ Toll road

   194 ft

Take Queens Midtown Tunnel to 1st Avenue in Manhattan

7 min (2.1 mi)

9. Merge onto I-495 W
   ⚠ Toll road

   0.1 mi

10. Continue onto Queens Midtown Tunnel
    ⚠ Toll road

    1.2 mi

11. Continue onto I-495 W/Queens Midtown Tunnel
    ⚠ Toll road

    240 ft

12. Use the left lane to take the exit toward Downtown
    ⚠ Toll road

    0.2 mi

13. Turn left onto E 35th St

    440 ft

14. Use any lane to turn right at the 1st cross street onto 2nd Ave

    0.3 mi

15. Turn left onto E 30th St

    0.1 mi

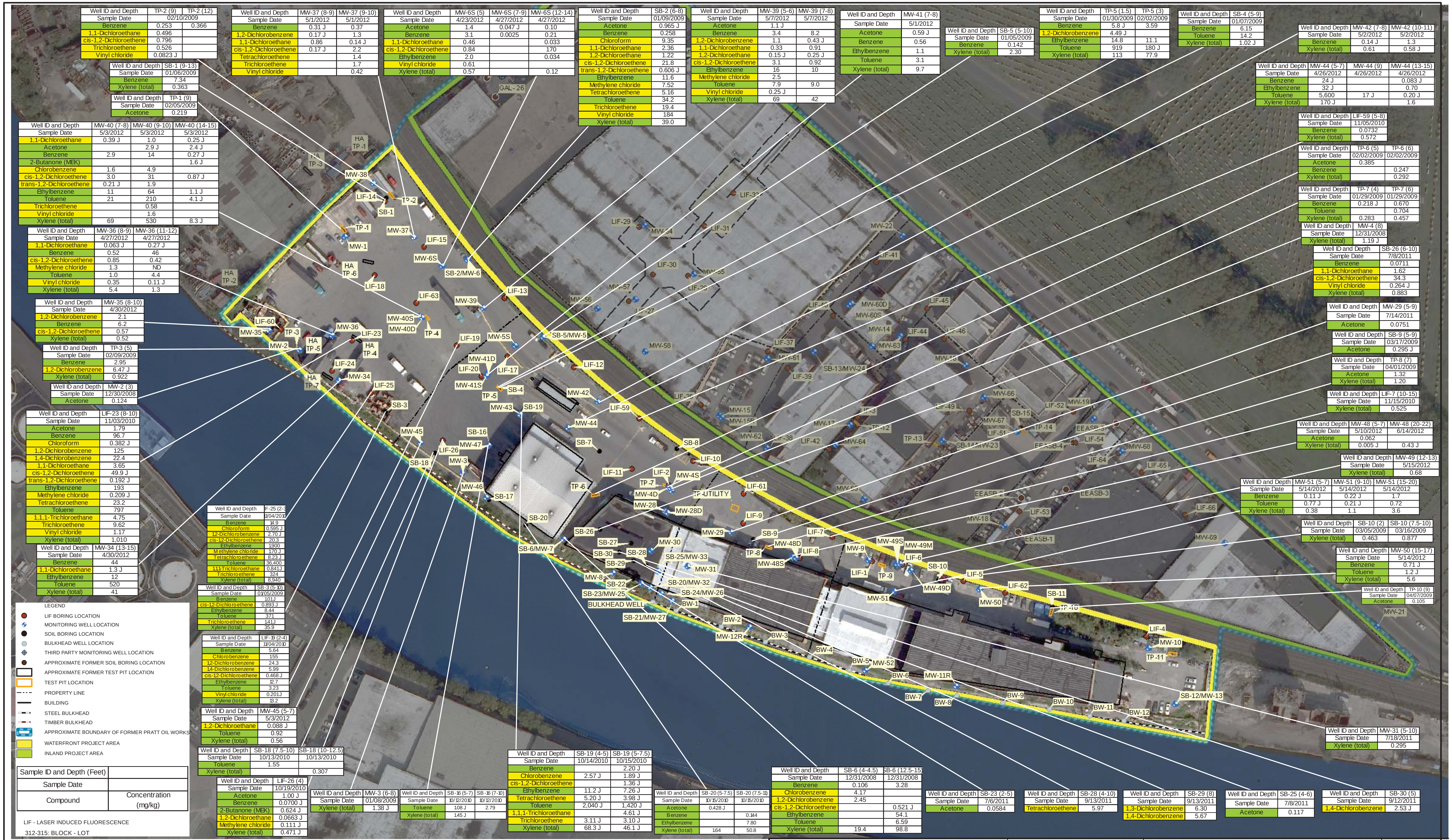
16. Use the middle lane to turn left onto 1st Avenue
    ⓘ Destination will be on the right

    453 ft

560 1st Avenue

New York, NY 10016

DISTRIBUTION OF CONTAMINATION



Well ID and Depth	TP-2 (9)	TP-2 (12)
Sample Date	02/10/2009	
Benzene	0.253	0.366
1,1-Dichloroethane	0.496	
cis-1,2-Dichloroethene	0.796	
Trichloroethene	0.526	
Vinyl chloride	0.0823 J	

Well ID and Depth	SB-1 (9-13)
Sample Date	01/06/2009
Benzene	7.34
Xylene (total)	0.363

Well ID and Depth	TP-1 (9)
Sample Date	02/05/2009
Acetone	0.219

Well ID and Depth	MW-37 (8-9)	MW-37 (9-10)
Sample Date	5/1/2012	5/1/2012
Benzene	0.31 J	0.37
1,2-Dichlorobenzene	0.17 J	1.3
1,1-Dichloroethane	0.86	0.14 J
cis-1,2-Dichloroethene	0.17 J	2.2
Tetrachloroethene		1.4
Trichloroethene		1.7
Vinyl chloride		0.42

Well ID and Depth	MW-6S (5)	MW-6S (7-9)	MW-6S (12-14)
Sample Date	4/23/2012	4/27/2012	4/27/2012
Acetone	1.4	0.047 J	0.10
Benzene	3.1	0.0025	0.21
1,1-Dichloroethane	0.46		0.033
cis-1,2-Dichloroethene	0.84		170
Ethylbenzene	2.0		0.034
Vinyl chloride	0.61		
Xylene (total)	0.57		0.12

Well ID and Depth	SB-2 (6-8)
Sample Date	01/09/2009
Acetone	0.965 J
Benzene	0.258
Chloroform	9.35
1,1-Dichloroethane	2.36
1,2-Dichloroethane	1.22
cis-1,2-Dichloroethene	21.8
trans-1,2-Dichloroethene	0.606 J
Ethylbenzene	11.6
Methylene chloride	7.52
Tetrachloroethene	5.16
Toluene	34.2
Trichloroethene	19.4
Vinyl chloride	184
Xylene (total)	39.0

Well ID and Depth	MW-39 (5-6)	MW-39 (7-8)
Sample Date	5/7/2012	5/7/2012
Acetone	1.1 J	
Benzene	3.4	8.2
1,2-Dichlorobenzene	1.1	0.43 J
1,1-Dichloroethane	0.33	0.91
1,2-Dichloroethane	0.15 J	0.25 J
cis-1,2-Dichloroethene	3.1	0.92
Ethylbenzene	16	10
Methylene chloride	2.5	
Toluene	7.9	9.0
Vinyl chloride	0.25 J	
Xylene (total)	69	42

Well ID and Depth	MW-41 (7-8)
Sample Date	5/1/2012
Acetone	0.59 J
Benzene	0.56
Ethylbenzene	1.1
Toluene	3.1
Xylene (total)	9.7

Well ID and Depth	SB-5 (5-10)
Sample Date	01/05/2009
Benzene	0.142
Xylene (total)	2.30

Well ID and Depth	TP-5 (1.5)	TP-5 (3)
Sample Date	01/30/2009	02/02/2009
Benzene	5.8 J	3.59
1,2-Dichlorobenzene	4.49 J	
Ethylbenzene	14.8	11.1
Toluene	919	180 J
Xylene (total)	113	77.9

Well ID and Depth	SB-4 (5-9)
Sample Date	01/07/2009
Benzene	6.15
Toluene	14.2
Xylene (total)	1.02 J

Well ID and Depth	MW-42 (7-8)	MW-42 (10-11)
Sample Date	5/2/2012	5/2/2012
Benzene	0.14 J	1.3
Xylene (total)	0.61	0.58 J

Well ID and Depth	MW-44 (5-7)	MW-44 (9)	MW-44 (13-15)
Sample Date	4/26/2012	4/26/2012	4/26/2012
Benzene	24 J		0.083 J
Ethylbenzene	32 J		0.70
Toluene	5,600	17 J	0.20 J
Xylene (total)	170 J		1.6

Well ID and Depth	LIF-59 (5-8)
Sample Date	11/05/2010
Benzene	0.0732
Xylene (total)	0.572

Well ID and Depth	TP-6 (5)	TP-6 (6)
Sample Date	02/02/2009	02/02/2009
Acetone	0.385	
Benzene		0.247
Xylene (total)		0.292

Well ID and Depth	TP-7 (4)	TP-7 (6)
Sample Date	01/29/2009	01/29/2009
Benzene	0.218 J	0.670
Toluene		0.704
Xylene (total)	0.283	0.457

Well ID and Depth	MW-4 (8)
Sample Date	12/31/2008
Xylene (total)	1.19 J

Well ID and Depth	SB-26 (6-10)
Sample Date	7/8/2011
Benzene	0.0711
1,1-Dichloroethane	1.62
cis-1,2-Dichloroethene	34.3
Vinyl chloride	0.264 J
Xylene (total)	0.883

Well ID and Depth	MW-29 (5-9)
Sample Date	7/14/2011
Acetone	0.0751

Well ID and Depth	SB-9 (5-9)
Sample Date	03/17/2009
Acetone	0.295 J

Well ID and Depth	TP-8 (7)
Sample Date	04/01/2009
Acetone	1.32
Xylene (total)	1.20

Well ID and Depth	LIF-7 (10-15)
Sample Date	11/15/2010
Xylene (total)	0.525

Well ID and Depth	MW-48 (5-7)	MW-48 (20-22)
Sample Date	5/10/2012	6/14/2012
Acetone	0.062	
Xylene (total)	0.005 J	0.43 J

Well ID and Depth	MW-49 (12-13)
Sample Date	5/15/2012
Xylene (total)	0.68

Well ID and Depth	MW-51 (5-7)	MW-51 (9-10)	MW-51 (15-20)
Sample Date	5/14/2012	5/14/2012	5/14/2012
Benzene	0.11 J	0.22 J	1.7
Toluene	0.77 J	0.21 J	0.72
Xylene (total)	0.38	1.1	3.6

Well ID and Depth	SB-10 (2)	SB-10 (7.5-10)
Sample Date	03/05/2009	03/16/2009
Xylene (total)	0.463	0.877

Well ID and Depth	MW-50 (15-17)
Sample Date	5/14/2012
Benzene	0.71 J
Toluene	1.2 J
Xylene (total)	5.6

Well ID and Depth	TP-10 (9)
Sample Date	04/07/2009
Acetone	0.105

Well ID and Depth	MW-31 (5-10)
Sample Date	7/18/2011
Xylene (total)	0.295

Well ID and Depth	MW-40 (7-8)	MW-40 (9-10)	MW-40 (14-15)
Sample Date	5/3/2012	5/3/2012	5/3/2012
1,1-Dichloroethane	0.39 J	1.0	0.25 J
Acetone		2.9 J	2.4 J
Benzene	2.9	14	0.27 J
2-Butanone (MEK)			1.6 J
Chlorobenzene	1.6	4.9	
cis-1,2-Dichloroethene	3.0	31	0.87 J
trans-1,2-Dichloroethene	0.21 J	1.9	
Ethylbenzene	11	64	1.1 J
Toluene	21	210	4.1 J
Trichloroethene		0.58	
Vinyl chloride		1.6	
Xylene (total)	69	530	8.3 J

Well ID and Depth	MW-36 (8-9)	MW-36 (11-12)
Sample Date	4/27/2012	4/27/2012
1,1-Dichloroethane	0.063 J	0.27 J
Benzene	0.52	46
cis-1,2-Dichloroethene	0.85	0.42
Methylene chloride	1.3	ND
Toluene	1.0	4.4
Vinyl chloride	0.35	0.11 J
Xylene (total)	5.4	1.3

Well ID and Depth	MW-35 (8-10)
Sample Date	4/30/2012
1,2-Dichlorobenzene	2.1
Benzene	6.2
cis-1,2-Dichloroethene	0.57
Xylene (total)	0.52

Well ID and Depth	TP-3 (5)
Sample Date	02/09/2009
Benzene	2.95
1,2-Dichlorobenzene	6.47 J
Xylene (total)	0.922

Well ID and Depth	MW-2 (3)
Sample Date	12/30/2008
Acetone	0.124

Well ID and Depth	LIF-23 (8-10)
Sample Date	11/03/2010
Acetone	1.79
Benzene	96.7
Chloroform	0.382 J
1,2-Dichlorobenzene	125
1,4-Dichlorobenzene	22.4
1,1-Dichloroethane	3.65
cis-1,2-Dichloroethene	49.9 J
trans-1,2-Dichloroethene	0.192 J
Ethylbenzene	193
Methylene chloride	0.209 J
Tetrachloroethene	23.2
Toluene	797
1,1,1-Trichloroethane	4.75
Trichloroethene	9.62
Vinyl chloride	1.17
Xylene (total)	1,010

Well ID and Depth	MW-34 (13-15)
Sample Date	4/30/2012
Benzene	44
1,1-Dichloroethane	1.3 J
Ethylbenzene	12
Toluene	520
Xylene (total)	41

Well ID and Depth	F-25 (2-3
Sample Date	1/04/201
Benzene	14.9
Chloroform	0.595 J
1,2-Dichlorobenzene	2.70 J
cis-1,2-Dichloroethene	20.3
Ethylbenzene	1,900
Methylene chloride	170 J
Tetrachloroethene	8.23 J
Toluene	36,400
1,1,1-Trichloroethane	0.841 J
Trichloroethene	324
Xylene (total)	8,940

Well ID and Depth	SB-3 (5-10)
Sample Date	01/05/2009
Benzene	101 J
cis-1,2-Dichloroethene	0.893 J
Ethylbenzene	8.44
Toluene	371
Trichloroethene	141 J
Xylene (total)	35.9

Well ID and Depth	LIF-19 (2-4)
Sample Date	11/04/2010
Benzene	5.64
Chlorobenzene	155
1,2-Dichlorobenzene	24.3
1,4-Dichlorobenzene	5.99
cis-1,2-Dichloroethene	0.468 J
Ethylbenzene	12.7
Toluene	3.23
Vinyl chloride	0.201 J
Xylene (total)	13.2

Well ID and Depth	MW-45 (5-7)
Sample Date	5/3/2012
1,2-Dichloroethane	0.088 J
Toluene	0.92
Xylene (total)	0.56

Well ID and Depth	SB-18 (7.5-10)	SB-18 (10-12.5)
Sample Date	10/13/2010	10/13/2010
Toluene	1.55	
Xylene (total)		0.307

Well ID and Depth	LIF-26 (4)
Sample Date	10/19/2010
Acetone	1.00 J
Benzene	0.0700 J
2-Butanone (MEK)	0.624 J
1,2-Dichloroethane	0.0663 J
Methylene chloride	0.111 J
Xylene (total)	0.471 J

Well ID and Depth	MW-3 (6-8)
Sample Date	01/08/2009
Xylene (total)	1.38 J

Well ID and Depth	SB-16 (5-7)	SB-16 (7-10)
Sample Date	10/12/2010	10/12/2010
Toluene	108 J	2.79
Xylene (total)	145 J	

Well ID and Depth	SB-19 (4-5)	SB-19 (5-7.5)
Sample Date	10/14/2010	10/15/2010
Benzene		2.20 J
Chlorobenzene	2.57 J	1.89 J
cis-1,2-Dichloroethene		1.36 J
Ethylbenzene	11.2 J	7.26 J
Tetrachloroethene	5.20 J	3.98 J
Toluene	2,040 J	1,420 J
1,1,1-Trichloroethane		4.61 J
Trichloroethene	3.11 J	3.10 J
Xylene (total)	68.3 J	46.1 J

Well ID and Depth	SB-20 (5-7.5)	SB-20 (7.5-11)
Sample Date	10/15/2010	10/15/2010
Acetone	0.428 J	
Benzene		0.144
Ethylbenzene		7.80
Xylene (total)	164	50.8

Well ID and Depth	SB-6 (4-4.5)	SB-6 (12.5-15)
Sample Date	12/31/2008	12/31/2008
Benzene	0.106	3.28
Chlorobenzene	4.17	
1,2-Dichlorobenzene	2.45	
cis-1,2-Dichloroethene		0.521 J
Ethylbenzene		54.1
Toluene		6.59
Xylene (total)	19.4	98.8

Well ID and Depth	SB-23 (2-5)
Sample Date	7/6/2011
Acetone	0.0584

Well ID and Depth	SB-28 (4-10)
Sample Date	9/13/2011
Tetrachloroethene	5.97

Well ID and Depth	SB-29 (8)
Sample Date	9/13/2011
1,3-Dichlorobenzene	6.30
1,4-Dichlorobenzene	5.67

Well ID and Depth	SB-25 (4-6)
Sample Date	7/8/2011
Acetone	0.117

Well ID and Depth	SB-30 (5)
Sample Date	9/12/2011
1,4-Dichlorobenzene	2.53 J

LEGEND

- ● LIF BORING LOCATION
- ⊕ MONITORING WELL LOCATION
- ● SOIL BORING LOCATION
- ⊗ BULKHEAD WELL LOCATION
- ⊕ THIRD PARTY MONITORING WELL LOCATION
- ● APPROXIMATE FORMER SOIL BORING LOCATION
- ▭ APPROXIMATE FORMER TEST PIT LOCATION
- ▭ TEST PIT LOCATION
- - - - PROPERTY LINE
- ── BUILDING
- STEEL BULKHEAD
- TIMBER BULKHEAD
- APPROXIMATE BOUNDARY OF FORMER PRATT OIL WORKS
- 🟨 WATERFRONT PROJECT AREA
- 🟩 INLAND PROJECT AREA

Sample ID and Depth (Feet)	
Sample Date	
Compound	Concentration (mg/kg)

LIF - LASER INDUCED FLUORESCENCE

312-315: BLOCK - LOT

SOURCE: MICROSOFT AERIAL IMAGERY 2006

N

0 40 80
Feet

1 inch = 80 feet

NOTES:
1. J - INDICATES AN ESTIMATED VALUE.
2. FIGURE ILLUSTRATES CONCENTRATIONS DETECTED ABOVE SOIL CLEAN UP OBJECTIVES (SCO-UNRESTRICTED). SEE TABLE FOR OTHER COMPOUNDS DETECTED.
3. mg/kg - MILLIGRAMS PER KILOGRAM.
4. YELLOW SHADING INDICATES CHLORINATED VOC COMPOUNDS.
5. PINK SHADING INDICATES NON CHLORINATED VOC COMPOUNDS DETECTED IN >50% OF SAMPLES.
6. GREEN SHADING INDICATES NON CHLORINATED VOC COMPOUNDSDETECTED IN <50% OF SAMPLES.
7. BLANK INDICATES COMPOUND REPORTED BELOW DETECTION LIMITS OR GUIDANCE VALUES.

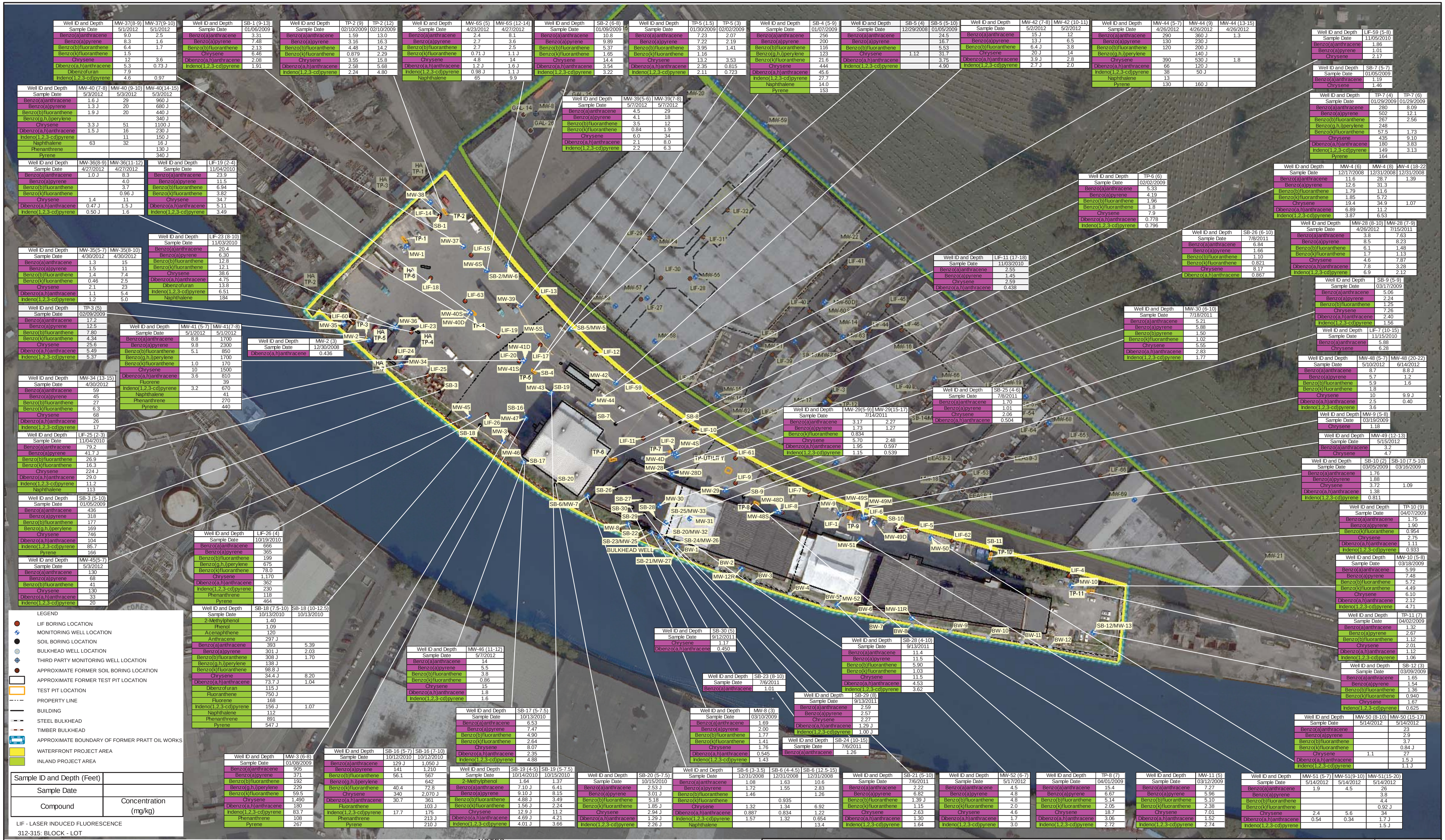
KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	124102
DRAWN:	12/13/2012
DRAWN BY:	J.R.
CHECKED BY:	J.W.
FILE NAME:	

SOIL SAMPLE LOCATIONS AND
VOC DISTRIBUTION MAP
(WATERFRONT PROJECT AREA)

FORMER PRATT OIL WORKS
THE INLAND PROJECT AREA (TRACT I)
THE WATERFRONT PROJECT AREA (TRACT II)
LONG ISLAND CITY, NEW YORK

FIGURE
15A



Well ID and Depth	MW-37(8-9)	MW-37(9-10)
Sample Date	5/1/2012	5/1/2012
Benzo(a)anthracene	9.0	2.5
Benzo(a)pyrene	8.3	1.6
Benzo(b)fluoranthene	6.4	1.7
Benzo(k)fluoranthene	1.5	
Chrysene	12	3.6
Dibenzo(a,h)anthracene	5.3	0.73 J
Dibenzofuran	7.9	
Indeno(1,2,3-cd)pyrene	4.6	0.97

Well ID and Depth	SB-1 (9-13)
Sample Date	01/06/2009
Benzo(a)anthracene	3.31
Benzo(a)pyrene	7.48
Benzo(b)fluoranthene	2.13
Chrysene	6.46
Dibenzo(a,h)anthracene	2.08
Indeno(1,2,3-cd)pyrene	1.91

Well ID and Depth	TP-2 (9)	TP-2 (12)
Sample Date	02/10/2009	02/10/2009
Benzo(a)anthracene	1.59	13.0
Benzo(a)pyrene	3.16	16.3
Benzo(b)fluoranthene	4.48	14.2
Benzo(k)fluoranthene	0.879	2.29
Chrysene	3.55	15.8
Dibenzo(a,h)anthracene	2.58	5.68
Indeno(1,2,3-cd)pyrene	2.24	4.80

Well ID and Depth	MW-6S (5)	MW-6S (12-14)
Sample Date	4/23/2012	4/27/2012
Benzo(a)anthracene	2.4	8.1
Benzo(a)pyrene	2.7	3.6
Benzo(b)fluoranthene	2.7	2.5
Benzo(k)fluoranthene	0.71 J	1.1 J
Chrysene	4.8	14
Dibenzo(a,h)anthracene	1.2 J	1.6 J
Indeno(1,2,3-cd)pyrene	0.98 J	1.1 J
Naphthalene	65	9.9

Well ID and Depth	SB-2 (6-8)
Sample Date	01/09/2009
Benzo(a)anthracene	10.8
Benzo(a)pyrene	9.89
Benzo(b)fluoranthene	5.37
Benzo(k)fluoranthene	1.65
Chrysene	14.4
Dibenzo(a,h)anthracene	3.54
Indeno(1,2,3-cd)pyrene	3.22

Well ID and Depth	TP-5 (1.5)	TP-5 (3)
Sample Date	01/30/2009	02/02/2009
Benzo(a)anthracene	7.23	2.07
Benzo(a)pyrene	7.22	2.19
Benzo(b)fluoranthene	3.95	1.41
Benzo(k)fluoranthene	1.16	
Chrysene	13.2	3.53
Dibenzo(a,h)anthracene	2.35	0.815
Indeno(1,2,3-cd)pyrene	2.11	0.723

Well ID and Depth	SB-4 (5-9)
Sample Date	01/07/2009
Benzo(a)anthracene	256
Benzo(a)pyrene	200
Benzo(b)fluoranthene	116
Benzo(g,h,i)perylene	123
Benzo(k)fluoranthene	21.6
Chrysene	444
Dibenzo(a,h)anthracene	45.6
Indeno(1,2,3-cd)pyrene	27.7
Naphthalene	14.0
Pyrene	153

Well ID and Depth	SB-5 (4)	SB-5 (5-10)
Sample Date	12/29/2008	01/05/2009
Benzo(a)anthracene		24.5
Benzo(a)pyrene		16.7
Benzo(b)fluoranthene		5.53
Chrysene	1.12	31.7
Dibenzo(a,h)anthracene		3.75
Indeno(1,2,3-cd)pyrene		4.90

Well ID and Depth	MW-42 (7-8)	MW-42 (10-11)
Sample Date	5/2/2012	5/2/2012
Benzo(a)anthracene	15 J	12
Benzo(a)pyrene	13 J	6.5
Benzo(b)fluoranthene	6.4 J	3.8
Chrysene	20 J	14
Dibenzo(a,h)anthracene	3.9 J	2.8
Indeno(1,2,3-cd)pyrene	2.7 J	2.0

Well ID and Depth	MW-44 (5-7)	MW-44 (9)	MW-44 (13-15)
Sample Date	4/26/2012	4/26/2012	4/26/2012
Benzo(a)anthracene	290	360 J	1.3
Benzo(a)pyrene	130	230 J	
Benzo(b)fluoranthene	120	200 J	
Benzo(g,h,i)perylene		140 J	
Chrysene	390	530 J	1.8
Dibenzo(a,h)anthracene	66	120 J	
Indeno(1,2,3-cd)pyrene	38	50 J	
Naphthalene	13		
Pyrene	130	160 J	

Well ID and Depth	LIF-59 (5-8)
Sample Date	11/05/2010
Benzo(a)anthracene	1.86
Benzo(a)pyrene	1.01
Chrysene	2.17

Well ID and Depth	SB-7 (5-7)
Sample Date	01/05/2009
Benzo(a)anthracene	1.19
Chrysene	1.46

Well ID and Depth	MW-40 (7-8)	MW-40 (9-10)	MW-40(14-15)
Sample Date	5/3/2012	5/3/2012	5/3/2012
Benzo(a)anthracene	1.6 J	29	960 J
Benzo(a)pyrene	1.3 J	20	680 J
Benzo(b)fluoranthene	1.9 J	20	440 J
Benzo(g,h,i)perylene			340 J
Chrysene	3.3 J	51	1100 J
Dibenzo(a,h)anthracene	1.5 J	16	230 J
Indeno(1,2,3-cd)pyrene		11	150 J
Naphthalene	63	32	16 J
Phenanthrene			130 J
Pyrene			340 J

Well ID and Depth	MW-39(5-6)	MW-39(7-8)
Sample Date	5/7/2012	5/7/2012
Benzo(a)anthracene	4.5	29
Benzo(a)pyrene	4.1	18
Benzo(b)fluoranthene	3.5	12
Benzo(k)fluoranthene	0.84	1.9
Chrysene	6.0	34
Dibenzo(a,h)anthracene	2.1	8.0
Indeno(1,2,3-cd)pyrene	2.2	6.3

Well ID and Depth	TP-7 (4)	TP-7 (6)
Sample Date	01/29/2009	01/29/2009
Benzo(a)anthracene	280	8.09
Benzo(a)pyrene	502	12.1
Benzo(b)fluoranthene	267	2.56
Benzo(g,h,i)perylene	248	
Benzo(k)fluoranthene	57.5	1.73
Chrysene	435	9.10
Dibenzo(a,h)anthracene	180	3.83
Indeno(1,2,3-cd)pyrene	149	3.13
Pyrene	164	

Well ID and Depth	MW-36(8-9)	MW-36(11-12)
Sample Date	4/27/2012	4/27/2012
Benzo(a)anthracene	1.0 J	8.3
Benzo(a)pyrene		4.0
Benzo(b)fluoranthene		3.7
Benzo(k)fluoranthene		0.96 J
Chrysene	1.4	11
Dibenzo(a,h)anthracene	0.47 J	1.5 J
Indeno(1,2,3-cd)pyrene	0.50 J	1.6

Well ID and Depth	LIF-19 (2-4)
Sample Date	11/04/2010
Benzo(a)anthracene	23.9
Benzo(a)pyrene	11.5
Benzo(b)fluoranthene	6.94
Benzo(k)fluoranthene	3.82
Chrysene	34.7
Dibenzo(a,h)anthracene	5.11
Indeno(1,2,3-cd)pyrene	3.49

Well ID and Depth	TP-6 (6)
Sample Date	02/02/2009
Benzo(a)anthracene	5.33
Benzo(a)pyrene	4.19
Benzo(b)fluoranthene	1.96
Benzo(k)fluoranthene	1.8
Chrysene	7.9
Dibenzo(a,h)anthracene	0.778
Indeno(1,2,3-cd)pyrene	0.796

Well ID and Depth	MW-4 (6)	MW-4 (8)	MW-4 (18-22)
Sample Date	12/17/2008	12/31/2008	12/31/2008
Benzo(a)anthracene	11.6	28.7	1.39
Benzo(a)pyrene	12.6	31.3	
Benzo(b)fluoranthene	1.79	11.6	
Benzo(k)fluoranthene	1.85	5.72	
Chrysene	19.4	34.9	1.07
Dibenzo(a,h)anthracene	6.89	11.2	
Indeno(1,2,3-cd)pyrene	3.87	6.53	

Well ID and Depth	MW-28 (8-10)	MW-28 (7-9)
Sample Date	4/26/2012	7/15/2011
Benzo(a)anthracene	3.8	7.63
Benzo(a)pyrene	8.5	8.23
Benzo(b)fluoranthene	6.1	1.48
Benzo(k)fluoranthene	1.7	1.13
Chrysene	4.6	7.87
Dibenzo(a,h)anthracene	7.8	3.28
Indeno(1,2,3-cd)pyrene	6.9	2.12

Well ID and Depth	SB-26 (6-10)
Sample Date	7/8/2011
Benzo(a)anthracene	6.84
Benzo(a)pyrene	1.66
Benzo(b)fluoranthene	1.10
Benzo(k)fluoranthene	0.821
Chrysene	8.17
Dibenzo(a,h)anthracene	0.867

Well ID and Depth	MW-35(5-7)	MW-35(8-10)
Sample Date	4/30/2012	4/30/2012
Benzo(a)anthracene	1.3	15
Benzo(a)pyrene	1.5	11
Benzo(b)fluoranthene	1.4	7.4
Benzo(k)fluoranthene	0.46	2.5
Chrysene	2.1	23
Dibenzo(a,h)anthracene	1.1	5.4
Indeno(1,2,3-cd)pyrene	1.2	5.0

Well ID and Depth	LIF-23 (8-10)
Sample Date	11/03/2010
Benzo(a)anthracene	20.4
Benzo(a)pyrene	6.30
Benzo(b)fluoranthene	12.8
Benzo(k)fluoranthene	12.1
Chrysene	38.6
Dibenzo(a,h)anthracene	4.75
Dibenzofuran	13.8
Indeno(1,2,3-cd)pyrene	6.51
Naphthalene	184

Well ID and Depth	LIF-11 (17-18)
Sample Date	11/03/2010
Benzo(a)anthracene	2.55
Benzo(a)pyrene	1.45
Chrysene	2.59
Dibenzo(a,h)anthracene	0.438

Well ID and Depth	SB-9 (5-9)
Sample Date	03/17/2009
Benzo(a)anthracene	5.06
Benzo(a)pyrene	2.24
Benzo(b)fluoranthene	1.25
Chrysene	7.26
Dibenzo(a,h)anthracene	2.40
Indeno(1,2,3-cd)pyrene	1.56

Well ID and Depth	TP-3 (5)
Sample Date	02/09/2009
Benzo(a)anthracene	17.2
Benzo(a)pyrene	12.5
Benzo(b)fluoranthene	7.80
Benzo(k)fluoranthene	4.34
Chrysene	25.6
Dibenzo(a,h)anthracene	5.49
Indeno(1,2,3-cd)pyrene	5.37

Well ID and Depth	MW-41 (5-7)	MW-41(7-8)
Sample Date	5/1/2012	5/1/2012
Benzo(a)anthracene	8.8	1700
Benzo(a)pyrene	9.8	2300
Benzo(b)fluoranthene	5.1	850
Benzo(g,h,i)perylene		1700
Benzo(k)fluoranthene	1.0	170
Chrysene	10	1500
Dibenzo(a,h)anthracene	3.6	810
Fluorene		39
Indeno(1,2,3-cd)pyrene	3.2	670
Naphthalene		41
Phenanthrene		270
Pyrene		440

Well ID and Depth	MW-2 (3)
Sample Date	12/30/2008
Dibenzo(a,h)anthracene	0.436

Well ID and Depth	MW-30 (6-10)
Sample Date	7/18/2011
Benzo(a)anthracene	5.21
Benzo(a)pyrene	5.88
Benzo(b)pyrene	1.50
Benzo(k)fluoranthene	1.02
Chrysene	5.55
Dibenzo(a,h)anthracene	2.83
Indeno(1,2,3-cd)pyrene	1.77

Well ID and Depth	LIF-7 (10-15)
Sample Date	11/15/2010
Benzo(a)anthracene	5.88
Chrysene	6.28

Well ID and Depth	MW-48 (5-7)	MW-48 (20-22)
Sample Date	5/10/2012	6/14/2012
Benzo(a)anthracene	8.7	8.8 J
Benzo(a)pyrene	5.7	1.2
Benzo(b)fluoranthene	5.9	1.6
Benzo(k)fluoranthene	1.8	
Chrysene	10	9.9 J
Dibenzo(a,h)anthracene	2.5	0.40
Indeno(1,2,3-cd)pyrene	3.6	

Well ID and Depth	MW-34 (13-15)
Sample Date	4/30/2012
Benzo(a)anthracene	59
Benzo(a)pyrene	45
Benzo(b)fluoranthene	27
Benzo(k)fluoranthene	6.3
Chrysene	68
Dibenzo(a,h)anthracene	26
Indeno(1,2,3-cd)pyrene	17

Well ID and Depth	SB-25 (4-6)
Sample Date	7/8/2011
Benzo(a)anthracene	1.70
Benzo(a)pyrene	1.01
Chrysene	2.06
Dibenzo(a,h)anthracene	0.504

Well ID and Depth	MW-29(5-9)	MW-29(15-17)
Sample Date	7/14/2011	
Benzo(a)anthracene	3.17	2.27
Benzo(a)pyrene	1.73	1.27
Benzo(k)fluoranthene	0.834	
Chrysene	5.70	2.48
Dibenzo(a,h)anthracene	1.95	0.597
Indeno(1,2,3-cd)pyrene	1.15	0.539

Well ID and Depth	MW-9 (5-8)
Sample Date	03/19/2009
Chrysene	1.18

Well ID and Depth	LIF-25 (2-3)
Sample Date	11/04/2010
Benzo(a)anthracene	79.2
Benzo(a)pyrene	41.7 J
Benzo(b)fluoranthene	26.9
Benzo(k)fluoranthene	16.3
Chrysene	224 J
Dibenzo(a,h)anthracene	29.0
Indeno(1,2,3-cd)pyrene	11.2
Naphthalene	113

Well ID and Depth	MW-49 (12-13)
Sample Date	5/15/2012
Benzo(a)anthracene	3.2
Chrysene	4.7

Well ID and Depth	SB-10 (2)	SB-10 (7.5-10)
Sample Date	03/05/2009	03/16/2009
Benzo(a)anthracene	1.76	
Benzo(a)pyrene	1.88	
Chrysene	3.72	1.09
Dibenzo(a,h)anthracene	1.38	
Indeno(1,2,3-cd)pyrene	0.811	

Well ID and Depth	SB-3 (5-10)
Sample Date	01/05/2009
Benzo(a)anthracene	436
Benzo(a)pyrene	318
Benzo(b)fluoranthene	177
Benzo(g,h,i)perylene	169
Chrysene	746
Dibenzo(a,h)anthracene	104
Indeno(1,2,3-cd)pyrene	85.7
Pyrene	166

Well ID and Depth	TP-10 (9)
Sample Date	04/07/2009
Benzo(a)anthracene	1.75
Benzo(a)pyrene	1.90
Benzo(k)fluoranthene	0.954
Chrysene	2.75
Dibenzo(a,h)anthracene	1.11
Indeno(1,2,3-cd)pyrene	0.933

Well ID and Depth	LIF-26 (4)
Sample Date	10/19/2010
Benzo(a)anthracene	666
Benzo(a)pyrene	365
Benzo(b)fluoranthene	199
Benzo(g,h,i)perylene	675
Benzo(k)fluoranthene	78.0
Chrysene	1,170
Dibenzo(a,h)anthracene	362
Indeno(1,2,3-cd)pyrene	230
Phenanthrene	118
Pyrene	464

Well ID and Depth	MW-45(5-7)
Sample Date	5/3/2012
Benzo(a)anthracene	130
Benzo(a)pyrene	68
Benzo(b)fluoranthene	41
Chrysene	130
Dibenzo(a,h)anthracene	33
Indeno(1,2,3-cd)pyrene	20

Well ID and Depth	MW-10 (5-8)
Sample Date	03/18/2009
Benzo(a)anthracene	5.99
Benzo(a)pyrene	7.48
Benzo(b)fluoranthene	5.72
Benzo(k)fluoranthene	4.49
Chrysene	6.10
Dibenzo(a,h)anthracene	2.12
Indeno(1,2,3-cd)pyrene	4.71

Well ID and Depth	SB-18 (7.5-10)	SB-18 (10-12.5)
Sample Date	10/13/2010	10/13/2010
2-Methylphenol	1.40	
Phenol	1.09	
Acenaphthene	120	
Anthracene	297 J	
Benzo(a)anthracene	393	5.39
Benzo(a)pyrene	301 J	2.03
Benzo(b)fluoranthene	308 J	1.70
Benzo(g,h,i)perylene	138 J	
Benzo(k)fluoranthene	98.8 J	
Chrysene	34.4 J	8.20
Dibenzo(a,h)anthracene	73.7 J	1.04
Dibenzofuran	115 J	
Fluoranthene	750 J	
Fluorene	168	
Indeno(1,2,3-cd)pyrene	156 J	1.07
Naphthalene	112	
Phenanthrene	891	
Pyrene	547 J	

Well ID and Depth	SB-30 (5)
Sample Date	9/12/2011
Chrysene	1.17
Dibenzo(a,h)anthracene	0.450

Well ID and Depth	SB-28 (4-10)
Sample Date	9/13/2011
Benzo(a)anthracene	11.4
Benzo(a)pyrene	11.5
Benzo(b)fluoranthene	5.90
Benzo(k)fluoranthene	1.03
Chrysene	11.5
Dibenzo(a,h)anthracene	4.53
Indeno(1,2,3-cd)pyrene	3.62

Well ID and Depth	TP-11 (7)
Sample Date	04/02/2009
Benzo(a)anthracene	1.32
Benzo(a)pyrene	2.67
Benzo(b)fluoranthene	1.12
Chrysene	2.01
Dibenzo(a,h)anthracene	1.12
Indeno(1,2,3-cd)pyrene	1.06

Well ID and Depth	MW-46 (11-12)
Sample Date	5/7/2012
Benzo(a)anthracene	14
Benzo(a)pyrene	5.5
Benzo(b)fluoranthene	3.8
Benzo(k)fluoranthene	0.86
Chrysene	15
Dibenzo(a,h)anthracene	1.8
Indeno(1,2,3-cd)pyrene	1.6

Well ID and Depth	SB-23 (8-10)
Sample Date	7/6/2011
Benzo(a)anthracene	1.01

Well ID and Depth	SB-12 (3)
Sample Date	03/09/2009
Benzo(a)anthracene	1.65
Benzo(a)pyrene	1.54
Benzo(b)fluoranthene	1.36
Benzo(k)fluoranthene	0.940
Chrysene	1.67
Indeno(1,2,3-cd)pyrene	0.625

Well ID and Depth	SB-29 (8)
Sample Date	9/13/2011
Benzo(a)anthracene	2.59
Benzo(a)pyrene	2.57
Chrysene	2.27
Dibenzo(a,h)anthracene	1.29 J
Indeno(1,2,3-cd)pyrene	1.00 J

Well ID and Depth	SB-17 (5-7.5)
Sample Date	10/13/2010
Benzo(a)anthracene	6.53
Benzo(a)pyrene	7.47
Benzo(b)fluoranthene	4.90
Benzo(k)fluoranthene	2.64
Chrysene	8.07
Dibenzo(a,h)anthracene	2.35
Indeno(1,2,3-cd)pyrene	4.88

Well ID and Depth	MW-8 (3)
Sample Date	03/10/2009
Benzo(a)anthracene	1.69
Benzo(a)pyrene	2.00
Benzo(b)fluoranthene	1.77
Benzo(k)fluoranthene	1.41
Chrysene	1.76
Dibenzo(a,h)anthracene	0.545
Indeno(1,2,3-cd)pyrene	1.43

Well ID and Depth	SB-24 (10-15)
Sample Date	7/6/2011
Benzo(a)anthracene	1.26

Well ID and Depth	MW-50 (8-10)	MW-50 (15-17)
Sample Date	5/14/2012	5/14/2012
Benzo(a)anthracene		23
Benzo(a)pyrene		2.9
Benzo(b)fluoranthene		3.7
Benzo(k)fluoranthene		0.84 J
Chrysene	1.1	27
Dibenzo(a,h)anthracene		1.5 J
Indeno(1,2,3-cd)pyrene		1.1 J

Well ID and Depth	MW-3 (6-8)
Sample Date	01/08/2009
Benzo(a)anthracene	905
Benzo(a)pyrene	371
Benzo(b)fluoranthene	192
Benzo(g,h,i)perylene	229
Benzo(k)fluoranthene	59.5
Chrysene	1,490
Dibenzo(a,h)anthracene	180
Indeno(1,2,3-cd)pyrene	83.7
Phenanthrene	108
Pyrene	267

Well ID and Depth	SB-16 (5-7)	SB-16 (7-10)
Sample Date	10/12/2010	10/12/2010
Benzo(a)anthracene	129 J	1,050 J
Benzo(a)pyrene	141	1,210
Benzo(b)fluoranthene	56.1	567
Benzo(g,h,i)perylene		642
Benzo(k)fluoranthene	40.4	72.8
Chrysene	340	2,070 J
Dibenzo(a,h)anthracene	30.7	361
Fluoranthene		103 J
Indeno(1,2,3-cd)pyrene	17.7	175
Phenanthrene		213 J
Pyrene		210 J

Well ID and Depth	SB-19 (4-5)	SB-19 (5-7.5)
Sample Date	10/14/2010	10/15/2010
2-Methylphenol	1.64	1.37
Benzo(a)anthracene	7.10 J	6.41
Benzo(a)pyrene	9.10 J	8.15
Benzo(b)fluoranthene	4.88 J	3.49
Benzo(k)fluoranthene	1.56 J	2.24
Chrysene	12.9 J	11.2
Dibenzo(a,h)anthracene	4.69 J	4.21
Indeno(1,2,3-cd)pyrene	4.01 J	3.66

Well ID and Depth	SB-20 (5-7.5)
Sample Date	10/15/2010
Benzo(a)anthracene	2.53 J
Benzo(a)pyrene	3.01 J
Benzo(b)fluoranthene	5.18
Benzo(k)fluoranthene	1.85 J
Chrysene	2.94 J
Dibenzo(a,h)anthracene	1.29 J
Indeno(1,2,3-cd)pyrene	2.26 J

Well ID and Depth	SB-6 (3-3.5)	SB-6 (4-4.5)	SB-6 (12.5-15)
Sample Date	12/31/2008	12/31/2008	12/31/2008
Benzo(a)anthracene	1.08	1.63	10.6
Benzo(a)pyrene	1.72	1.55	2.83
Benzo(b)fluoranthene	1.46		1.26
Benzo(k)fluoranthene		0.935	
Chrysene	1.32	1.34	6.92
Dibenzo(a,h)anthracene	0.887	0.834	1.22
Indeno(1,2,3-cd)pyrene	1.57	1.32	0.654
Naphthalene			13.4

Well ID and Depth	SB-21 (5-10)
Sample Date	7/6/2011
Benzo(a)anthracene	2.22
Benzo(a)pyrene	6.82
Benzo(b)fluoranthene	1.39 J
Benzo(k)fluoranthene	1.15
Chrysene	2.63
Dibenzo(a,h)anthracene	1.30
Indeno(1,2,3-cd)pyrene	1.64

Well ID and Depth	MW-52 (6-7)
Sample Date	5/17/2012
Benzo(a)anthracene	4.5
Benzo(a)pyrene	4.8
Benzo(b)fluoranthene	4.8
Benzo(k)fluoranthene	2.0
Chrysene	4.6
Dibenzo(a,h)anthracene	1.7
Indeno(1,2,3-cd)pyrene	3.0

Well ID and Depth	TP-8 (7)
Sample Date	04/01/2009
Benzo(a)anthracene	15.4
Benzo(a)pyrene	6.67
Benzo(b)fluoranthene	5.14
Benzo(k)fluoranthene	2.05
Chrysene	18.7
Dibenzo(a,h)anthracene	3.06
Indeno(1,2,3-cd)pyrene	2.72

Well ID and Depth	MW-11 (5)
Sample Date	03/12/2009
Benzo(a)anthracene	7.27
Benzo(a)pyrene	5.96
Benzo(b)fluoranthene	5.10
Benzo(k)fluoranthene	2.38
Chrysene	7.01
Dibenzo(a,h)anthracene	1.52
Indeno(1,2,3-cd)pyrene	2.74

Well ID and Depth	MW-51 (5-7)	MW-51(9-10)	MW-51(15-20)
Sample Date	5/14/2012	5/14/2012	5/14/2012
Benzo(a)anthracene	1.9	4.5	26
Benzo(a)pyrene			3.8
Benzo(b)fluoranthene			4.4
Benzo(k)fluoranthene			0.92 J
Chrysene	2.4	5.6	34
Dibenzo(a,h)anthracene	0.54	0.34	1.7 J
Indeno(1,2,3-cd)pyrene			1.5 J

LEGEND

- ● LIF BORING LOCATION
- ⌖ MONITORING WELL LOCATION
- ● SOIL BORING LOCATION
- ⊗ BULKHEAD WELL LOCATION
- ⊕ THIRD PARTY MONITORING WELL LOCATION
- ● APPROXIMATE FORMER SOIL BORING LOCATION
- ☐ APPROXIMATE FORMER TEST PIT LOCATION
- ☐ TEST PIT LOCATION
- — · · — PROPERTY LINE
- —— BUILDING
- STEEL BULKHEAD
- TIMBER BULKHEAD
- APPROXIMATE BOUNDARY OF FORMER PRATT OIL WORKS
- 🟨 WATERFRONT PROJECT AREA
- 🟩 INLAND PROJECT AREA

Sample ID and Depth (Feet)	
Sample Date	
Compound	Concentration (mg/kg)

LIF - LASER INDUCED FLUORESCENCE

312-315: BLOCK - LOT

SOURCE: MICROSOFT AERIAL IMAGERY 2006

N

0 40 80 Feet

1 inch = 80 feet

NOTES:
1. J - INDICATES AN ESTIMATED VALUE.
2. FIGURE ILLUSTRATES CONCENTRATIONS DETECTED ABOVE SOIL CLEAN UP OBJECTIVES(SCO-UNRESTRICTED). SEE TABLE FOR OTHER COMPOUNDS DETECTED.
3. mg/kg - MILLIGRAMS PER KILOGRAM.
4. PINK SHADING INDICATES SVOC COMPOUNDS DETECTED IN >50% OF SAMPLES.
5. GREEN SHADING INDICATES SVOC COMPOUNDS DETECTED IN <50% OF SAMPLES.
6. BLANK INDICATES COMPOUND REPORTED BELOW DETECTION LIMITS OR GUIDANCE VALUES.

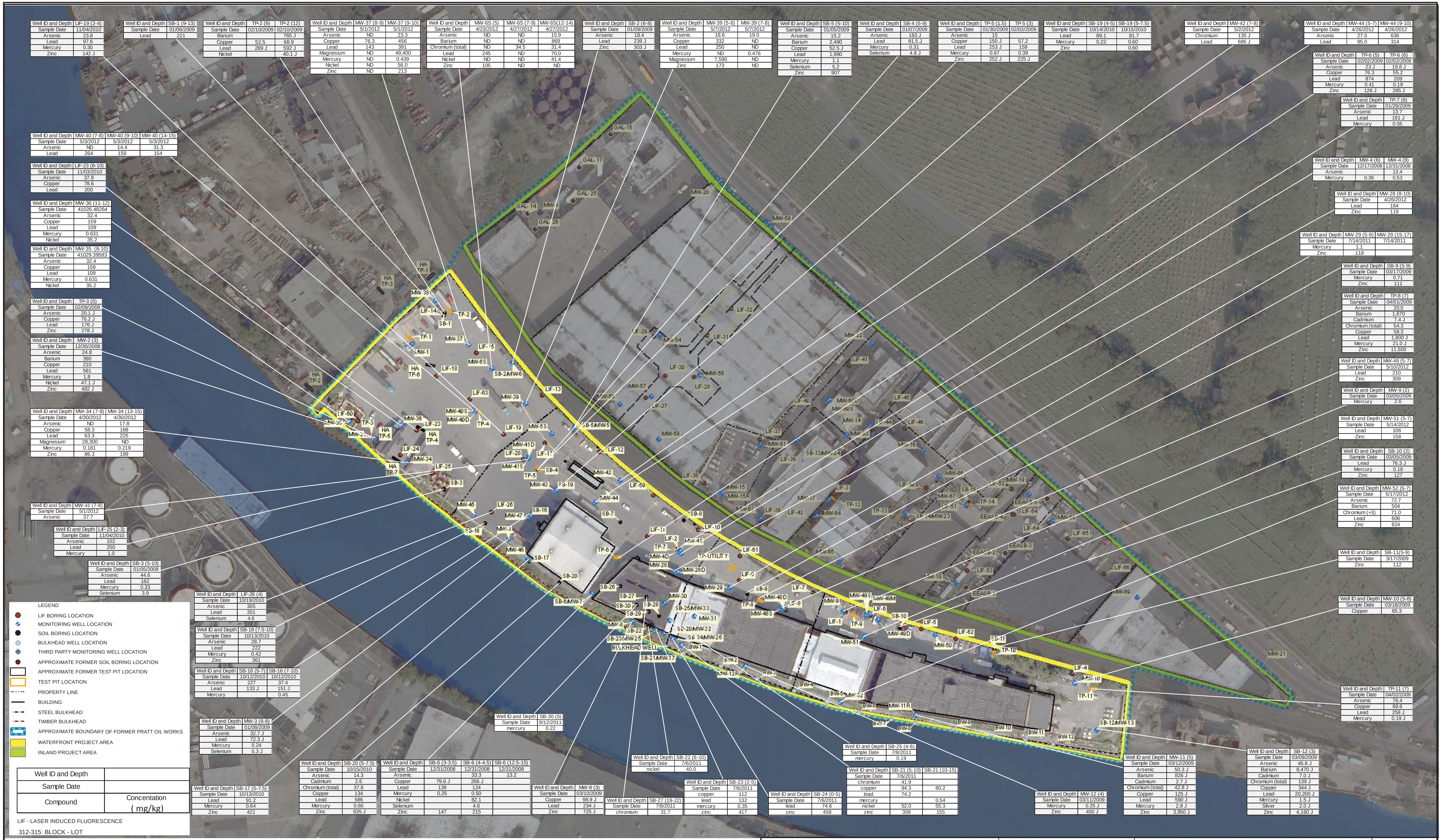
KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	124102
DRAWN:	12/13/2012
DRAWN BY:	J.R.
CHECKED BY:	J.W.
FILE NAME:	

SOIL SAMPLE LOCATIONS AND SVOC DISTRIBUTION MAP (WATERFRONT PROJECT AREA)

FORMER PRATT OIL WORKS
THE INLAND PROJECT AREA (TRACT I)
THE WATERFRONT PROJECT AREA (TRACT II)
LONG ISLAND CITY, NEW YORK

FIGURE
16A



Well ID and Depth	LIF-19 (2-4)
Sample Date	11/04/2010
Arsenic	23.8
Lead	97.6
Mercury	0.30
Zinc	142 J

Well ID and Depth	SB-1 (9-13)
Sample Date	01/06/2009
Lead	221

Well ID and Depth	TP-2 (9)	TP-2 (12)
Sample Date	02/10/2009	02/10/2009
Barium		765 J
Copper	52.5	68.9
Lead	289 J	592 J
Nickel		40.1 J

Well ID and Depth	MW-37 (8-9)	MW-37 (9-10)
Sample Date	5/1/2012	5/1/2012
Arsenic	ND	23.3
Copper	76.3	456
Lead	143	391
Magnesium	ND	49,400
Mercury	ND	0.439
Nickel	ND	56.0
Zinc	ND	213

Well ID and Depth	MW-6S (5)	MW-6S (7-9)	MW-6S(12-14)
Sample Date	4/23/2012	4/27/2012	4/27/2012
Arsenic	ND	ND	15.9
Barium	ND	ND	869
Chromium (total)	ND	34.5	31.4
Lead	245	ND	70.0
Nickel	ND	ND	41.4
Zinc	105	ND	ND

Well ID and Depth	SB-2 (6-8)
Sample Date	01/09/2009
Arsenic	18.4
Lead	239 J
Zinc	303 J

Well ID and Depth	MW-39 (5-6)	MW-39 (7-8)
Sample Date	5/7/2012	5/7/2012
Arsenic	18.6	19.0
Copper	332	ND
Lead	250	ND
Mercury	ND	0.476
Magnesium	7,590	ND
Zinc	173	ND

Well ID and Depth	SB-5 (5-10)
Sample Date	01/05/2009
Arsenic	15.2
Barium	2,490
Copper	52.5 J
Lead	1,990
Mercury	1.1
Selenium	5.2
Zinc	907

Well ID and Depth	SB-4 (5-9)
Sample Date	01/07/2009
Arsenic	183 J
Lead	81.5 J
Mercury	0.31
Selenium	4.8 J

Well ID and Depth	TP-5 (1.5)	TP-5 (3)
Sample Date	01/30/2009	02/02/2009
Arsenic	15	
Copper	150 J	57.2
Lead	253 J	159
Mercury	0.67	0.39
Zinc	252 J	225 J

Well ID and Depth	SB-19 (4-5)	SB-19 (5-7.5)
Sample Date	10/14/2010	10/15/2010
Lead	89.1	81.7
Mercury	0.22	0.60
Zinc		0.60

Well ID and Depth	MW-42 (7-8)
Sample Date	5/2/2012
Chromium	135 J
Lead	685 J

Well ID and Depth	MW-44 (5-7)	MW-44 (9-10)
Sample Date	4/26/2012	4/26/2012
Arsenic	27.5	636
Lead	95.0	314

Well ID and Depth	TP-6 (5)	TP-6 (6)
Sample Date	02/02/2009	02/02/2009
Arsenic	23 J	19.8 J
Copper	76.3	55.2
Lead	874	209
Mercury	0.41	0.19
Zinc	126 J	285 J

Well ID and Depth	TP-7 (6)
Sample Date	01/29/2009
Arsenic	13.7
Lead	191 J
Mercury	0.55

Well ID and Depth	MW-4 (6)	MW-4 (8)
Sample Date	12/17/2008	12/31/2008
Arsenic		13.4
Mercury	0.36	0.53

Well ID and Depth	MW-28 (8-10)
Sample Date	4/26/2012
Lead	164
Zinc	119

Well ID and Depth	MW-29 (5-9)	MW-29 (15-17)
Sample Date	7/14/2011	7/14/2011
Mercury	1.1	
Zinc	118	

Well ID and Depth	SB-9 (5-9)
Sample Date	03/17/2009
Mercury	0.71
Zinc	111

Well ID and Depth	TP-8 (7)
Sample Date	04/01/2009
Arsenic	20.0
Barium	1,670
Cadmium	7.4 J
Chromium (total)	54.3
Copper	58.3
Lead	1,800 J
Mercury	21.0 J
Zinc	11,500

Well ID and Depth	MW-48 (5-7)
Sample Date	5/10/2012
Lead	210
Zinc	309

Well ID and Depth	MW-9 (2)
Sample Date	03/05/2009
Mercury	2.6

Well ID and Depth	MW-51 (5-7)
Sample Date	5/14/2012
Lead	106
Zinc	158

Well ID and Depth	SB-10 (2)
Sample Date	03/05/2009
Lead	76.3 J
Mercury	0.18
Zinc	127

Well ID and Depth	MW-52 (6-7)
Sample Date	5/17/2012
Arsenic	72.7
Barium	504
Chromium (+3)	71.0
Lead	606
Zinc	824

Well ID and Depth	SB-11(5-9)
Sample Date	3/17/2009
Zinc	112

Well ID and Depth	MW-10 (5-8)
Sample Date	03/18/2009
Copper	65.3

Well ID and Depth	TP-11 (7)
Sample Date	04/02/2009
Arsenic	76.4
Copper	69.6
Lead	258 J
Mercury	0.19 J

Well ID and Depth	SB-12 (3)
Sample Date	03/09/2009
Arsenic	45.8 J
Barium	8,470 J
Cadmium	7.0 J
Chromium (total)	139 J
Copper	344 J
Lead	20,200 J
Mercury	1.5 J
Silver	2.0 J
Zinc	4,160 J

Well ID and Depth	MW-11 (5)
Sample Date	03/12/2009
Arsenic	50.3 J
Barium	826 J
Cadmium	2.7 J
Chromium (total)	42.8 J
Copper	125 J
Lead	590 J
Mercury	2.8 J
Zinc	3,950 J

Well ID and Depth	MW-12 (4)
Sample Date	03/11/2009
Mercury	0.25 J
Zinc	450 J

Well ID and Depth	SB-25 (4-6)
Sample Date	7/8/2011
mercury	0.19

Well ID and Depth	SB-21 (5-10)	SB-21 (10-15)
Sample Date	7/6/2011	
chromium	41.9	
copper	94.3	60.2
lead	74.2	
mercury		0.54
nickel	52.0	55.3
zinc	359	155

Well ID and Depth	SB-24 (0-5)
Sample Date	7/6/2011
lead	74.6
zinc	458

Well ID and Depth	SB-23 (2-5)
Sample Date	7/6/2011
copper	112
lead	132
mercury	0.35
zinc	417

Well ID and Depth	SB-22 (6-10)
Sample Date	7/6/2011
nickel	40.0

Well ID and Depth	SB-27 (19-22)
Sample Date	7/8/2011
chromium	31.7

Well ID and Depth	MW-8 (3)
Sample Date	03/10/2009
Copper	98.9 J
Lead	234 J
Zinc	725 J

Well ID and Depth	SB-30 (5)
Sample Date	9/12/2011
mercury	0.22

Well ID and Depth	SB-6 (3-3.5)	SB-6 (4-4.5)	SB-6 (12.5-15)
Sample Date	12/31/2008	12/31/2008	12/31/2008
Arsenic		33.3	13.2
Copper	79.6 J	266 J	
Lead	139	124	
Mercury	0.25	0.50	
Nickel		82.1	
Selenium		4.6	
Zinc	147	215	

Well ID and Depth	SB-20 (5-7.5)
Sample Date	10/15/2010
Arsenic	14.3
Cadmium	2.6
Chromium (total)	37.8
Copper	134
Lead	586
Mercury	0.60
Zinc	635 J

Well ID and Depth	SB-17 (5-7.5)
Sample Date	10/13/2010
Lead	91.2
Mercury	0.64
Zinc	421

Well ID and Depth	MW-3 (6-8)
Sample Date	01/08/2009
Arsenic	32.7 J
Lead	72.3 J
Mercury	0.24
Selenium	5.3 J

Well ID and Depth	SB-16 (5-7)	SB-16 (7-10)
Sample Date	10/12/2010	10/12/2010
Arsenic	227	37.4
Lead	133 J	151 J
Mercury		0.45

Well ID and Depth	SB-18 (7.5-10)
Sample Date	10/13/2010
Arsenic	28.7
Lead	222
Mercury	0.42
Zinc	361

Well ID and Depth	LIF-26 (4)
Sample Date	10/19/2010
Arsenic	305
Lead	201
Selenium	4.6

Well ID and Depth	SB-3 (5-10)
Sample Date	01/05/2009
Arsenic	44.6
Lead	182
Mercury	0.33
Selenium	3.9

Well ID and Depth	LIF-25 (2-3)
Sample Date	11/04/2010
Arsenic	102
Lead	250
Mercury	1.0

Well ID and Depth	MW-41 (7-8)
Sample Date	5/1/2012
Arsenic	37.7

Well ID and Depth	MW-34 (7-8)	MW-34 (13-15)
Sample Date	4/30/2012	4/30/2012
Arsenic	ND	17.8
Copper	58.3	168
Lead	63.3	225
Magnesium	28,300	ND
Mercury	0.181	0.219
Zinc	86.3	199

Well ID and Depth	MW-2 (3)
Sample Date	12/30/2008
Arsenic	24.8
Barium	390
Copper	210
Lead	581
Mercury	1.8
Nickel	47.1 J
Zinc	482 J

Well ID and Depth	TP-3 (5)
Sample Date	02/09/2009
Arsenic	20.1 J
Copper	76.2 J
Lead	176 J
Zinc	278 J

Well ID and Depth	MW-35 (8-10)
Sample Date	41029.39583
Arsenic	32.4
Copper	159
Lead	109
Mercury	0.631
Nickel	35.2

Well ID and Depth	MW-36 (11-12)
Sample Date	41026.48264
Arsenic	32.4
Copper	159
Lead	109
Mercury	0.631
Nickel	35.2

Well ID and Depth	LIF-23 (8-10)
Sample Date	11/03/2010
Arsenic	37.8
Copper	78.6
Lead	200

Well ID and Depth	MW-40 (7-8)	MW-40 (9-10)	MW-40 (14-15)
Sample Date	5/3/2012	5/3/2012	5/3/2012
Arsenic	ND	14.4	31.3
Lead	264	159	154

LEGEND

●	LIF BORING LOCATION
⊕	MONITORING WELL LOCATION
●	SOIL BORING LOCATION
⊗	BULKHEAD WELL LOCATION
⊕	THIRD PARTY MONITORING WELL LOCATION
●	APPROXIMATE FORMER SOIL BORING LOCATION
☐	APPROXIMATE FORMER TEST PIT LOCATION
☐	TEST PIT LOCATION
- - · -	PROPERTY LINE
—	BUILDING
-·-	STEEL BULKHEAD
-·-	TIMBER BULKHEAD
▭	APPROXIMATE BOUNDARY OF FORMER PRATT OIL WORKS
🟨	WATERFRONT PROJECT AREA
🟩	INLAND PROJECT AREA

Well ID and Depth	
Sample Date	
Compound	Concentation (mg/kg)

LIF - LASER INDUCED FLUORESCENCE

312-315: BLOCK - LOT

SOURCE: MICROSOFT AERIAL IMAGERY 2006

N

0 40 80 Feet

1 inch = 80 feet

NOTES:
1. J - INDICATES AN ESTIMATED VALUE.
2. FIGURE ILLUSTRATES CONCENTRATIONS DETECTED ABOVE SOIL CLEAN UP OBJECTIVES (SCO-UNRESTRICTED). SEE TABLE FOR OTHER COMPOUNDS DETECTED.
3. mg/kg - MILLIGRAMS PER KILOGRAM
4. BLANK INDICATES COMPOUND REPORTED BELOW DETECTION LIMITS OR GUIDANCE VALUES.

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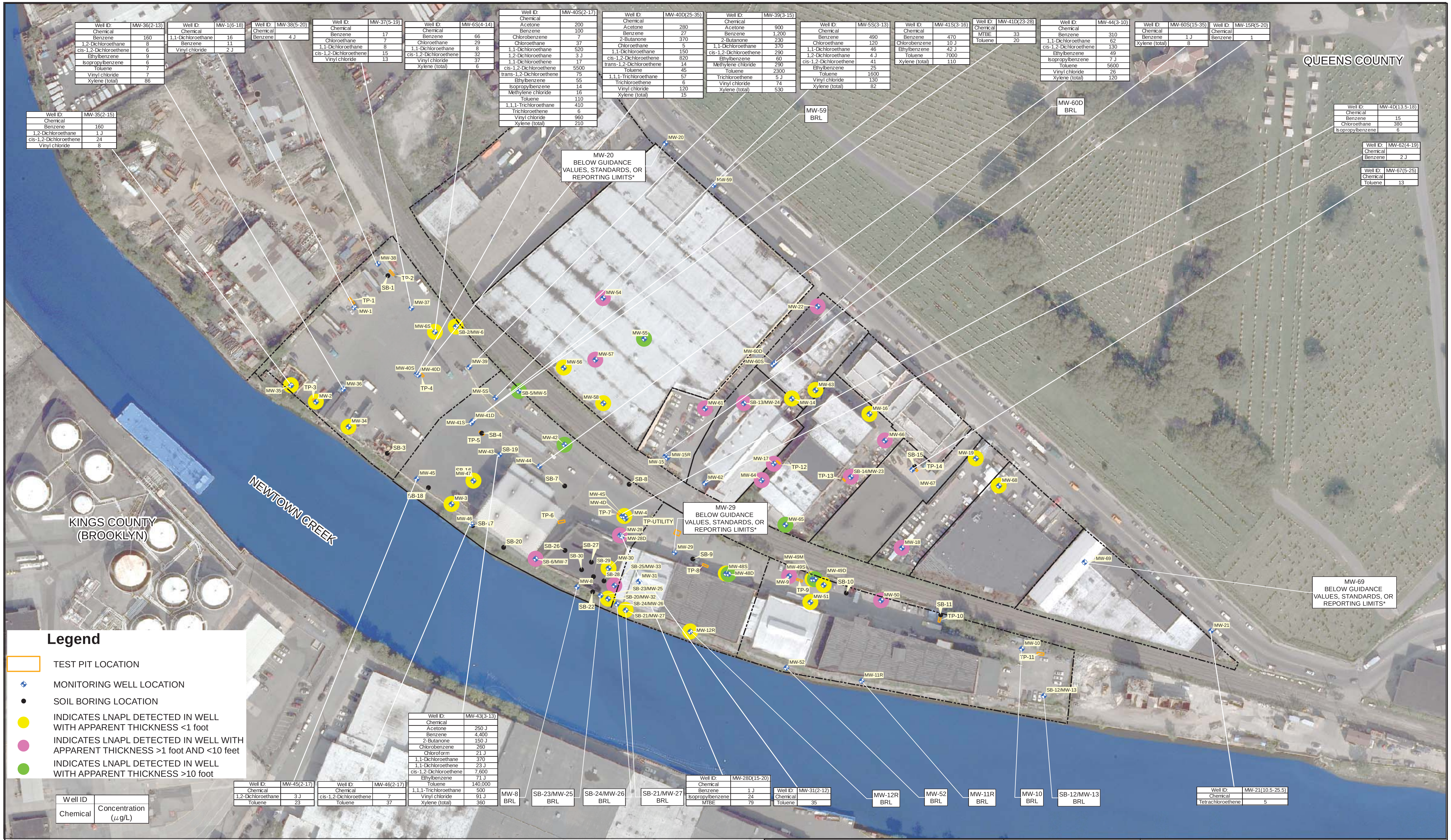
PROJECT NO.	124102
DRAWN:	12/13/2012
DRAWN BY:	J.R.
CHECKED BY:	J.W.
FILE NAME:	

SOIL SAMPLE LOCATIONS AND METALS DISTRIBUTION MAP (WATERFRONT PROJECT AREA)

FORMER PRATT OIL WORKS
THE INLAND PROJECT AREA (TRACT I)
THE WATERFRONT PROJECT AREA (TRACT II)
LONG ISLAND CITY, NEW YORK

FIGURE
17A



MW-20
BELOW GUIDANCE
VALUES, STANDARDS, OR
REPORTING LIMITS*

MW-29
BELOW GUIDANCE
VALUES, STANDARDS, OR
REPORTING LIMITS*

MW-69
BELOW GUIDANCE
VALUES, STANDARDS, OR
REPORTING LIMITS*

MW-59
BRL

MW-60D
BRL

MW-8
BRL

SB-23/MW-25
BRL

SB-24/MW-26
BRL

SB-21/MW-27
BRL

MW-12R
BRL

MW-52
BRL

MW-11R
BRL

MW-10
BRL

SB-12/MW-13
BRL

Legend

- ▭ TEST PIT LOCATION
- ⊕ MONITORING WELL LOCATION
- • SOIL BORING LOCATION
- 🟡 INDICATES LNAPL DETECTED IN WELL WITH APPARENT THICKNESS <1 foot
- 🟣 INDICATES LNAPL DETECTED IN WELL WITH APPARENT THICKNESS >1 foot AND <10 feet
- 🟢 INDICATES LNAPL DETECTED IN WELL WITH APPARENT THICKNESS >10 foot

Well ID	
Chemical	Concentration (μg/L)

Well ID:	MW-36(2-13)
Chemical	
Benzene	160
1,2-Dichloroethane	8
cis-1,2-Dichloroethene	6
Ethylbenzene	9
Isopropylbenzene	6
Toluene	7
Vinyl chloride	7
Xylene (total)	86

Well ID:	MW-1(6-18)
Chemical	
1,1-Dichloroethane	16
Benzene	11
Vinyl chloride	2 J

Well ID:	MW-38(5-20)
Chemical	
Benzene	4 J

Well ID:	MW-37(5-19)
Chemical	
Benzene	17
Chloroethane	7
1,1-Dichloroethane	8
cis-1,2-Dichloroethene	15
Vinyl chloride	13

Well ID:	MW-6S(4-14)
Chemical	
Benzene	66
Chloroethane	29
1,1-Dichloroethane	8
cis-1,2-Dichloroethene	32
Vinyl chloride	37
Xylene (total)	6

Well ID:	MW-40S(2-17)
Chemical	
Acetone	200
Benzene	100
Chlorobenzene	7
Chloroethane	37
1,1-Dichloroethane	520
1,2-Dichloroethane	3 J
1,1-Dichloroethene	17
cis-1,2-Dichloroethene	5500
trans-1,2-Dichloroethene	75
Ethylbenzene	55
Isopropylbenzene	14
Methylene chloride	16
Toluene	110
1,1,1-Trichloroethane	410
Trichloroethene	6
Vinyl chloride	960
Xylene (total)	210

Well ID:	MW-40D(25-35)
Chemical	
Acetone	280
Benzene	27
2-Butanone	370
Chloroethane	5
1,1-Dichloroethane	150
cis-1,2-Dichloroethene	820
trans-1,2-Dichloroethene	14
Toluene	45
1,1,1-Trichloroethane	57
Trichloroethene	6
Vinyl chloride	120
Xylene (total)	15

Well ID:	MW-39(3-15)
Chemical	
Acetone	900
Benzene	1,200
2-Butanone	230
1,1-Dichloroethane	370
cis-1,2-Dichloroethene	290
Ethylbenzene	60
Methylene chloride	290
Toluene	2300
Trichloroethene	5 J
Vinyl chloride	74
Xylene (total)	530

Well ID:	MW-5S(3-13)
Chemical	
Benzene	490
Chloroethane	120
1,1-Dichloroethane	46
1,2-Dichloroethane	4 J
cis-1,2-Dichloroethene	41
Ethylbenzene	25
Toluene	1600
Vinyl chloride	130
Xylene (total)	82

Well ID:	MW-41S(3-16)
Chemical	
Benzene	470
Chlorobenzene	10 J
Ethylbenzene	42 J
Toluene	7000
Xylene (total)	110

Well ID:	MW-41D(23-28)
Chemical	
MTBE	33
Toluene	20

Well ID:	MW-44(3-10)
Chemical	
Benzene	310
1,1-Dichloroethane	62
cis-1,2-Dichloroethene	130
Ethylbenzene	49
Isopropylbenzene	7 J
Toluene	5600
Vinyl chloride	26
Xylene (total)	120

Well ID:	MW-60S(15-35)
Chemical	
Benzene	1 J
Xylene (total)	8

Well ID:	MW-15R(5-20)
Chemical	
Benzene	1

Well ID:	MW-35(2-15)
Chemical	
Benzene	160
1,2-Dichloroethane	1 J
cis-1,2-Dichloroethene	24
Vinyl chloride	8

Well ID:	MW-4D(13.5-18)
Chemical	
Benzene	15
Chloroethane	380
Isopropylbenzene	6

Well ID:	MW-62(4-19)
Chemical	
Benzene	2 J

Well ID:	MW-67(5-25)
Chemical	
Toluene	13

Well ID:	MW-43(3-13)
Chemical	
Acetone	250 J
Benzene	4,400
2-Butanone	150 J
Chlorobenzene	260
Chloroform	21 J
1,1-Dichloroethane	370
1,1-Dichloroethene	23 J
cis-1,2-Dichloroethene	7,600
Ethylbenzene	71 J
Toluene	140,000
1,1,1-Trichloroethane	500
Vinyl chloride	91 J
Xylene (total)	360

Well ID:	MW-45(2-17)
Chemical	
1,2-Dichloroethane	3 J
Toluene	23

Well ID:	MW-46(2-17)
Chemical	
cis-1,2-Dichloroethene	7
Toluene	37

Well ID:	MW-28D(15-20)
Chemical	
Benzene	1 J
Isopropylbenzene	24
MTBE	79

Well ID:	MW-31(2-12)
Chemical	
Toluene	35

Well ID:	MW-21(10.5-25.5)
Chemical	
Tetrachloroethene	5

SOURCE: MICROSOFT AERIAL IMAGERY 2006

NOTES:
1. J - INDICATES AN ESTIMATED VALUE.
2. FIGURE ILLUSTRATES COMPOUNDS DETECTED ABOVE GROUNDWATER STANDARDS OR GUIDANCE VALUES. SEE TABLES FOR OTHER COMPOUNDS DETECTED.
3. SAMPLES COLLECTED FROM 7/2/12 TO 7/12/12 WITH THE EXCEPTION OF MW-69 (COLLECTED 10/4/12).
4. BRL - BELOW LABORATORY REPORTING LIMITS.
5. μg/L - MICROGRAMS PER LITER.
6. * - REPORTING LIMITS ABOVE STANDARDS OR GUIDANCE VALUES.
7. MONITORING WELLS NOT SAMPLED DUE TO THE PRESENCE OF LNAPL ARE INDICATED BY COLORED HALOS.
8. LNAPL- LIGHT NON AQUEOUS PHASE LIQUID.
9. MW-19 WAS INNACCESSIBLE AND THEREFORE NOT SAMPLED.

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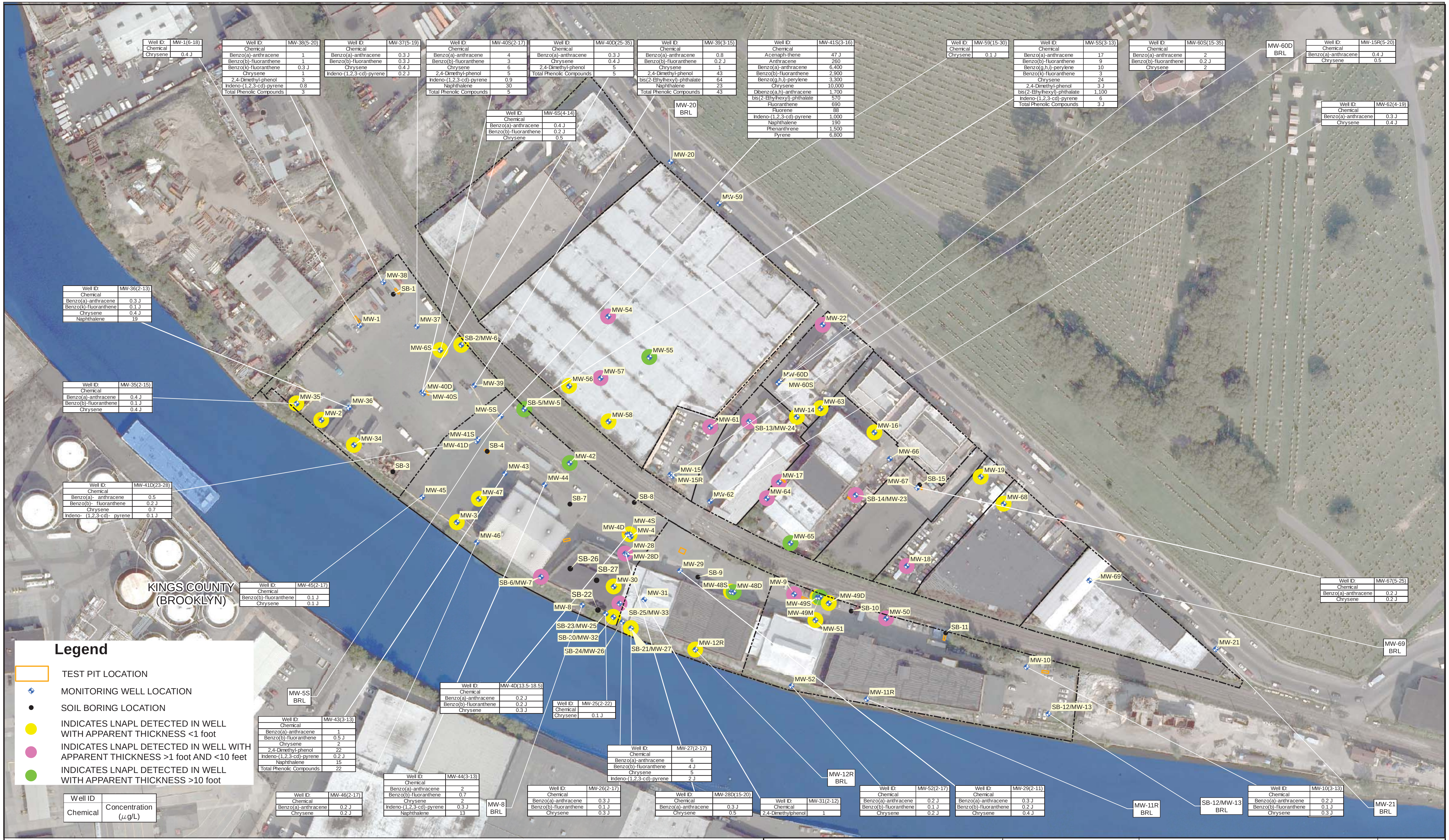
PROJECT NO.	124102
DRAWN:	12/13/2012
DRAWN BY:	J.R.
CHECKED BY:	J.W.
FILE NAME:	

DISSOLVED VOCs DISTRIBUTION MAP- JULY 2012

FORMER PRATT OIL WORKS
THE INLAND PROJECT AREA (TRACT I)
THE WATERFRONT PROJECT AREA (TRACT II)
LONG ISLAND CITY, NEW YORK

FIGURE
19A



Well ID:	MW-1(6-18)
Chemical	
Chrysene	0.4 J

Well ID:	MW-38(5-20)
Chemical	
Benzo(a)-anthracene	1
Benzo(b)-fluoranthene	1
Benzo(k)-fluoranthene	0.3 J
Chrysene	1
2,4-Dimethyl-phenol	3
Indeno-(1,2,3-cd)-pyrene	0.8
Total Phenolic Compounds	3

Well ID:	MW-37(5-19)
Chemical	
Benzo(a)-anthracene	0.3 J
Benzo(b)-fluoranthene	0.3 J
Chrysene	0.4 J
Indeno-(1,2,3-cd)-pyrene	0.2 J

Well ID:	MW-40S(2-17)
Chemical	
Benzo(a)-anthracene	4
Benzo(b)-fluoranthene	3
Chrysene	6
2,4-Dimethyl-phenol	5
Indeno-(1,2,3-cd)-pyrene	0.9
Naphthalene	30
Total Phenolic Compounds	5

Well ID:	MW-40D(25-35)
Chemical	
Benzo(a)-anthracene	0.3 J
Chrysene	0.4 J
2,4-Dimethyl-phenol	5
Total Phenolic Compounds	5

Well ID:	MW-39(3-15)
Chemical	
Benzo(a)-anthracene	0.8
Benzo(b)-fluoranthene	0.2 J
Chrysene	1
2,4-Dimethyl-phenol	43
bis(2-Ethylhexyl)-phthalate	64
Naphthalene	23
Total Phenolic Compounds	43

Well ID:	MW-41S(3-16)
Chemical	
Acenaph-thene	47 J
Anthracene	260
Benzo(a)-anthracene	6,400
Benzo(b)-fluoranthene	2,900
Benzo(g,h,i)-perylene	3,300
Chrysene	10,000
Dibenzo(a,h)-anthracene	1,700
bis(2-Ethylhexyl)-phthalate	570
Fluoranthene	690
Fluorene	88
Indeno-(1,2,3-cd)-pyrene	1,000
Naphthalene	190
Phenanthrene	1,500
Pyrene	6,800

Well ID:	MW-6S(4-14)
Chemical	
Benzo(a)-anthracene	0.4 J
Benzo(b)-fluoranthene	0.2 J
Chrysene	0.5

MW-20
BRL

Well ID:	MW-59(15-30)
Chemical	
Chrysene	0.1 J

Well ID:	MW-5S(3-13)
Chemical	
Benzo(a)-anthracene	17
Benzo(b)-fluoranthene	9
Benzo(g,h,i)-perylene	10
Benzo(k)-fluoranthene	3
Chrysene	24
2,4-Dimethyl-phenol	3 J
bis(2-Ethylhexyl)-phthalate	1,100
Indeno-(1,2,3-cd)-pyrene	6
Total Phenolic Compounds	3 J

Well ID:	MW-60S(15-35)
Chemical	
Benzo(a)-anthracene	2
Benzo(b)-fluoranthene	0.2 J
Chrysene	2

MW-60D
BRL

Well ID:	MW-15R(5-20)
Chemical	
Benzo(a)-anthracene	0.4 J
Chrysene	0.5

Well ID:	MW-62(4-19)
Chemical	
Benzo(a)-anthracene	0.3 J
Chrysene	0.4 J

Well ID:	MW-36(2-13)
Chemical	
Benzo(a)-anthracene	0.3 J
Benzo(k)-fluoranthene	0.1 J
Chrysene	0.4 J
Naphthalene	19

Well ID:	MW-35(2-15)
Chemical	
Benzo(a)-anthracene	0.4 J
Benzo(b)-fluoranthene	0.1 J
Chrysene	0.4 J

Well ID:	MW-41D(23-28)
Chemical	
Benzo(a)- anthracene	0.5
Benzo(b)- fluoranthene	0.2 J
Chrysene	0.7
Indeno- (1,2,3-cd)- pyrene	0.1 J

Well ID:	MW-45(2-17)
Chemical	
Benzo(b)-fluoranthene	0.1 J
Chrysene	0.1 J

Well ID:	MW-67(5-25)
Chemical	
Benzo(a)-anthracene	0.2 J
Chrysene	0.2 J

MW-69
BRL

Legend

- ▭ TEST PIT LOCATION
- ⊕ MONITORING WELL LOCATION
- ● SOIL BORING LOCATION
- 🟡 INDICATES LNAPL DETECTED IN WELL WITH APPARENT THICKNESS <1 foot
- 🟣 INDICATES LNAPL DETECTED IN WELL WITH APPARENT THICKNESS >1 foot AND <10 feet
- 🟢 INDICATES LNAPL DETECTED IN WELL WITH APPARENT THICKNESS >10 foot

Well ID	
Chemical	Concentration (µg/L)

MW-5S
BRL

Well ID:	MW-43(3-13)
Chemical	
Benzo(a)-anthracene	1
Benzo(b)-fluoranthene	0.5 J
Chrysene	2
2,4-Dimethyl-phenol	22
Indeno-(1,2,3-cd)-pyrene	0.2 J
Naphthalene	15
Total Phenolic Compounds	22

Well ID:	MW-4D(13.5-18.5)
Chemical	
Benzo(a)-anthracene	0.2 J
Benzo(b)-fluoranthene	0.2 J
Chrysene	0.3 J

Well ID:	MW-25(2-22)
Chemical	
Chrysene	0.1 J

Well ID:	MW-46(2-17)
Chemical	
Benzo(a)-anthracene	0.2 J
Chrysene	0.2 J

Well ID:	MW-44(3-13)
Chemical	
Benzo(a)-anthracene	2
Benzo(b)-fluoranthene	0.7
Chrysene	2
Indeno-(1,2,3-cd)-pyrene	0.3 J
Naphthalene	13

MW-8
BRL

Well ID:	MW-26(2-17)
Chemical	
Benzo(a)-anthracene	0.3 J
Benzo(b)-fluoranthene	0.1 J
Chrysene	0.3 J

Well ID:	MW-27(2-17)
Chemical	
Benzo(a)-anthracene	6
Benzo(b)-fluoranthene	4 J
Chrysene	5
Indeno-(1,2,3-cd)-pyrene	2 J

Well ID:	MW-28D(15-20)
Chemical	
Benzo(a)-anthracene	0.3 J
Chrysene	0.5

Well ID:	MW-31(2-12)
Chemical	
2,4-Dimethylphenol	1

MW-12R
BRL

Well ID:	MW-52(2-17)
Chemical	
Benzo(a)-anthracene	0.2 J
Benzo(b)-fluoranthene	0.1 J
Chrysene	0.2 J

Well ID:	MW-29(2-11)
Chemical	
Benzo(a)-anthracene	0.3 J
Benzo(b)-fluoranthene	0.2 J
Chrysene	0.4 J

MW-11R
BRL

SB-12/MW-13
BRL

Well ID:	MW-10(3-13)
Chemical	
Benzo(a)-anthracene	0.2 J
Benzo(b)-fluoranthene	0.1 J
Chrysene	0.3 J

MW-21
BRL

SOURCE: MICROSOFT AERIAL IMAGERY 2006

NOTES:
1. J - INDICATES AN ESTIMATED VALUE.
2. FIGURE ILLUSTRATES COMPOUNDS DETECTED ABOVE GROUNDWATER STANDARDS OR GUIDANCE VALUES. SEE TABLES FOR OTHER COMPOUNDS DETECTED.
3. SAMPLES COLLECTED FROM 7/2/12 TO 7/12/12 WITH THE EXCEPTION OF MW-69 (COLLECTED 10/4/12).
4. BRL - BELOW LABORATORY REPORTING LIMITS.
5. µg/L - MICROGRAMS PER LITER.
6. * - REPORTING LIMITS ABOVE STANDARDS OR GUIDANCE VALUES.
7. MONITORING WELLS NOT SAMPLED DUE TO THE PRESENCE OF LNAPL ARE INDICATED BY COLORED HALOS.
8. LNAPL- LIGHT NON AQUEOUS PHASE LIQUID.
9. MW-19 WAS INNACCESSIBLE AND THEREFORE NOT SAMPLED.

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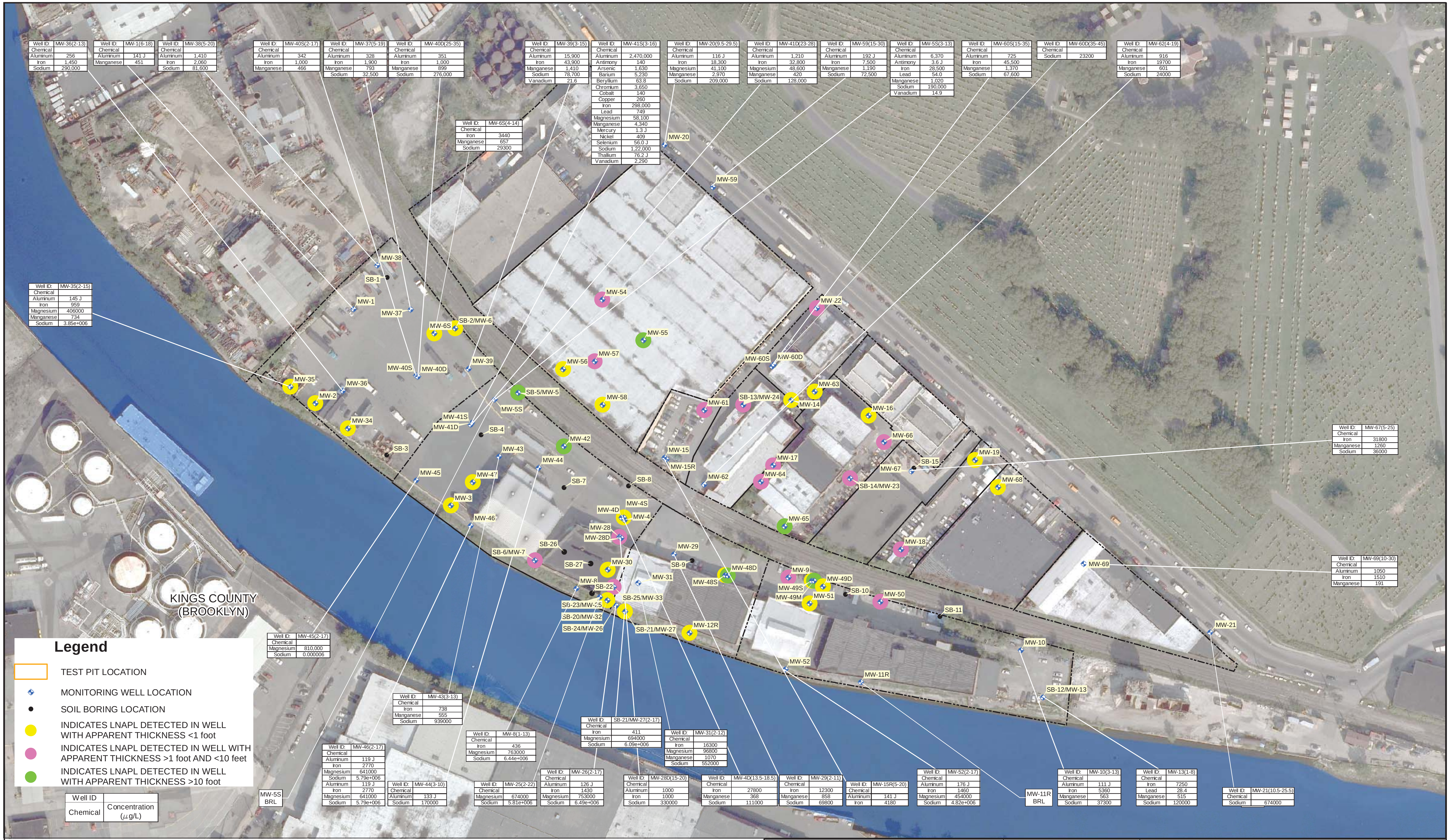
PROJECT NO.	124102
DRAWN:	12/13/2012
DRAWN BY:	J.R.
CHECKED BY:	J.W.
FILE NAME:	

DISSOLVED SVOCs DISTRIBUTION MAP

JULY 2012

FORMER PRATT OIL WORKS
THE INLAND PROJECT AREA (TRACT I)
THE WATERFRONT PROJECT AREA (TRACT II)
LONG ISLAND CITY, NEW YORK

FIGURE
20



Well ID:	MW-36(2-13)
Chemical	
Aluminum	256
Iron	1,450
Sodium	290,000

Well ID:	MW-1(6-18)
Chemical	
Aluminum	141 J
Manganese	451

Well ID:	MW-38(5-20)
Chemical	
Aluminum	1,410
Iron	2,060
Sodium	81,600

Well ID:	MW-40S(2-17)
Chemical	
Aluminum	342
Iron	1,000
Manganese	466

Well ID:	MW-37(5-19)
Chemical	
Aluminum	328
Iron	1,900
Manganese	793
Sodium	32,500

Well ID:	MW-40D(25-35)
Chemical	
Aluminum	351
Iron	1,000
Manganese	899
Sodium	276,000

Well ID:	MW-39(3-15)
Chemical	
Aluminum	15,900
Iron	43,900
Manganese	1,410
Sodium	78,700
Vanadium	21.6

Well ID:	MW-41S(3-16)
Chemical	
Aluminum	2,470,000
Antimony	140
Arsenic	1,630
Barium	5,230
Beryllium	63.8
Chromium	3,650
Cobalt	140
Copper	260
Iron	298,000
Lead	749
Magnesium	58,100
Manganese	4,340
Mercury	1.3 J
Nickel	409
Selenium	56.0 J
Sodium	1,22,000
Thallium	76.2 J
Vanadium	2,290

Well ID:	MW-6S(4-14)
Chemical	
Iron	3440
Manganese	657
Sodium	29300

Well ID:	MW-20(9.5-29.5)
Chemical	
Aluminum	116 J
Iron	18,300
Magnesium	41,100
Manganese	2,970
Sodium	209,000

Well ID:	MW-41D(23-28)
Chemical	
Aluminum	1,210
Iron	32,800
Magnesium	48,600
Manganese	420
Sodium	128,000

Well ID:	MW-59(15-30)
Chemical	
Aluminum	192 J
Iron	7,500
Manganese	1,190
Sodium	72,500

Well ID:	MW-5S(3-13)
Chemical	
Aluminum	6,370
Antimony	3.6 J
Iron	28,500
Lead	54.0
Manganese	1,020
Sodium	190,000
Vanadium	14.9

Well ID:	MW-60S(15-35)
Chemical	
Aluminum	725
Iron	45,500
Manganese	1,370
Sodium	67,600

Well ID:	MW-60D(35-45)
Chemical	
Sodium	23200

Well ID:	MW-62(4-19)
Chemical	
Aluminum	916
Iron	19700
Manganese	601
Sodium	24000

Well ID:	MW-35(2-15)
Chemical	
Aluminum	145 J
Iron	959
Magnesium	406000
Manganese	734
Sodium	3.85e+006

Well ID:	MW-67(5-25)
Chemical	
Iron	31800
Manganese	1260
Sodium	36000

Well ID:	MW-69(10-30)
Chemical	
Aluminum	1050
Iron	1510
Manganese	191

Well ID:	MW-45(2-17)
Chemical	
Magnesium	810,000
Sodium	0.000006

Well ID:	MW-43(3-13)
Chemical	
Iron	738
Manganese	555
Sodium	939000

Well ID:	MW-8(1-13)
Chemical	
Iron	436
Magnesium	763000
Sodium	6.44e+006

Well ID:	SB-21/MW-27(2-17)
Chemical	
Iron	411
Magnesium	694000
Sodium	6.09e+006

Well ID:	MW-31(2-12)
Chemical	
Iron	16300
Magnesium	96800
Manganese	1070
Sodium	552000

Well ID:	MW-46(2-17)
Chemical	
Aluminum	119 J
Iron	2770
Magnesium	641000
Sodium	5.79e+006
Aluminum	119 J
Iron	2770
Magnesium	641000
Sodium	5.79e+006

Well ID:	MW-44(3-10)
Chemical	
Aluminum	133 J
Sodium	170000

Well ID:	MW-25(2-22)
Chemical	
Magnesium	674000
Sodium	5.81e+006

Well ID:	MW-26(2-17)
Chemical	
Aluminum	126 J
Iron	1430
Magnesium	753000
Sodium	6.49e+006

Well ID:	MW-28D(15-20)
Chemical	
Aluminum	1000
Iron	1000
Sodium	330000

Well ID:	MW-4D(13.5-18.5)
Chemical	
Iron	27800
Manganese	368
Sodium	111000

Well ID:	MW-29(2-11)
Chemical	
Iron	12300
Manganese	858
Sodium	69800

Well ID:	MW-15R(5-20)
Chemical	
Aluminum	141 J
Iron	4180

Well ID:	MW-52(2-17)
Chemical	
Aluminum	176 J
Iron	1460
Magnesium	454000
Sodium	4.82e+006

MW-5S
BRL

MW-11R
BRL

Well ID:	MW-10(3-13)
Chemical	
Aluminum	111 J
Iron	5360
Manganese	563
Sodium	37300

Well ID:	MW-13(1-8)
Chemical	
Iron	7250
Lead	28.4
Manganese	515
Sodium	120000

Well ID:	MW-21(10.5-25.5)
Chemical	
Sodium	674000

Legend

▭	TEST PIT LOCATION
⊕	MONITORING WELL LOCATION
●	SOIL BORING LOCATION
🟡	INDICATES LNAPL DETECTED IN WELL WITH APPARENT THICKNESS <1 foot
🟣	INDICATES LNAPL DETECTED IN WELL WITH APPARENT THICKNESS >1 foot AND <10 feet
🟢	INDICATES LNAPL DETECTED IN WELL WITH APPARENT THICKNESS >10 foot

Well ID	
Chemical	Concentration (μg/L)

SOURCE: MICROSOFT AERIAL IMAGERY 2006

N

0 40 80
Feet

NOTES:
1. J - INDICATES AN ESTIMATED VALUE.
2. FIGURE ILLUSTRATES COMPOUNDS DETECTED ABOVE GROUNDWATER STANDARDS OR GUIDANCE VALUES. SEE TABLES FOR OTHER COMPOUNDS DETECTED.
3. SAMPLES COLLECTED FROM 7/2/12 TO 7/12/12 WITH THE EXCEPTION OF MW-69 (COLLECTED 10/4/12).
4. BRL - BELOW LABORATORY REPORTING LIMITS.
5. μg/L - MICROGRAMS PER LITER.
6. * - REPORTING LIMITS ABOVE STANDARDS OR GUIDANCE VALUES.
7. MONITORING WELLS NOT SAMPLED DUE TO THE PRESENCE OF LNAPL ARE INDICATED BY COLORED HALOS.
8. LNAPL- LIGHT NON AQUEOUS PHASE LIQUID.
9. MW-19 WAS INNACCESSIBLE AND THEREFORE NOT SAMPLED.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	124102
DRAWN:	12/13/2012
DRAWN BY:	J.R.
CHECKED BY:	J.W.
FILE NAME:	

METALS DETECTED IN
GROUNDWATER SAMPLES
DISTRIBUTION MAP - JULY 2012

FORMER PRATT OIL WORKS
THE INLAND PROJECT AREA (TRACT I)
THE WATERFRONT PROJECT AREA (TRACT II)
LONG ISLAND CITY, NEW YORK

FIGURE
21

MATERIAL SAFETY DATA SHEETS

Material Safety Data Sheet

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

Chevron Ursa® Hydraulic Oil 10W

Product Use: Hydraulic Oil
Product Number(s): CPS273270
Company Identification
Chevron Products Company
a division of Chevron U.S.A. Inc.
6001 Bollinger Canyon Rd.
San Ramon, CA 94583
United States of America
www.chevronlubricants.com

Transportation Emergency Response
CHEMTREC: (800) 424-9300 or (703) 527-3887
Health Emergency
Chevron Emergency Information Center: Located in the USA. International collect calls accepted.
(800) 231-0623 or (510) 231-0623
Product Information
email : lubemsds@chevron.com
Product Information: (800) LUBE TEK
MSDS Requests: (800) 414-6737

SECTION 2 COMPOSITION/ INFORMATION ON INGREDIENTS

COMPONENTS	CAS NUMBER	AMOUNT
Highly refined mineral oil (C15 - C50)	Mixture	75 - 95 %weight
Zinc alkyl dithiophosphate	68649-42-3	1 - 5 %weight

SECTION 3 HAZARDS IDENTIFICATION

IMMEDIATE HEALTH EFFECTS
Eye: Not expected to cause prolonged or significant eye irritation.
Skin: Contact with the skin is not expected to cause prolonged or significant irritation. Contact with the skin is not expected to cause an allergic skin response. Not expected to be harmful to internal organs if absorbed through the skin. High-Pressure Equipment Information: Accidental high-velocity injection under the skin of materials of this type may result in serious injury. Seek medical attention at once should an accident like this occur. The initial wound at the injection site may not appear to be serious at first; but, if left untreated, could result in disfigurement or amputation of the affected part.

Ingestion: Not expected to be harmful if swallowed.
Inhalation: Not expected to be harmful if inhaled. Contains a petroleum-based mineral oil. May cause respiratory irritation or other pulmonary effects following prolonged or repeated inhalation of oil mist at airborne levels above the recommended mineral oil mist exposure limit. Symptoms of respiratory irritation may include coughing and difficulty breathing.

SECTION 4 FIRST AID MEASURES

Eye: No specific first aid measures are required. As a precaution, remove contact lenses, if worn, and flush eyes with water.
Skin: No specific first aid measures are required. As a precaution, remove clothing and shoes if contaminated. To remove the material from skin, use soap and water. Discard contaminated clothing and shoes or thoroughly clean before reuse.
Ingestion: No specific first aid measures are required. Do not induce vomiting. As a precaution, get medical advice.
Inhalation: No specific first aid measures are required. If exposed to excessive levels of material in the air, move the exposed person to fresh air. Get medical attention if coughing or respiratory discomfort occurs.
Note to Physicians: In an accident involving high-pressure equipment, this product may be injected under the skin. Such an accident may result in a small, sometimes bloodless, puncture wound. However, because of its driving force, material injected into a fingertip can be deposited into the palm of the hand. Within 24 hours, there is usually a great deal of swelling, discoloration, and intense throbbing pain. Immediate treatment at a surgical emergency center is recommended.

SECTION 5 FIRE FIGHTING MEASURES

Leaks/ruptures in high pressure system using materials of this type can create a fire hazard when in the vicinity of ignition sources (eg. open flame, pilot lights, sparks, or electric arcs).

FIRE CLASSIFICATION:
OSHA Classification (29 CFR 1910.1200): Not classified by OSHA as flammable or combustible.

NFPA RATINGS: Health: 0 Flammability: 1 Reactivity: 0

FLAMMABLE PROPERTIES:
Flashpoint: (Cleveland Open Cup) 205 °C (401 °F) (Min)
Autoignition: No Data Available
Flammability (Explosive) Limits (% by volume in air): Lower: Not Applicable Upper: Not Applicable

EXTINGUISHING MEDIA: Use water fog, foam, dry chemical or carbon dioxide (CO2) to extinguish flames.

PROTECTION OF FIRE FIGHTERS:
Fire Fighting Instructions: This material will burn although it is not easily ignited. For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment, including self-contained breathing apparatus.
Combustion Products: Highly dependent on combustion conditions. A complex mixture of airborne solids, liquids, and gases including carbon monoxide, carbon dioxide, and unidentified organic compounds will be evolved when this material undergoes combustion. Combustion may form oxides of: Calcium, Sulfur, Phosphorus, Boron, Molybdenum, Nitrogen, Zinc .

SECTION 6 ACCIDENTAL RELEASE MEASURES

Protective Measures: Eliminate all sources of ignition in vicinity of spilled material.
Spill Management: Stop the source of the release if you can do it without risk. Contain release to prevent further contamination of soil, surface water or groundwater. Clean up spill as soon as possible, observing precautions in Exposure Controls/Personal Protection. Use appropriate techniques such as applying non-combustible absorbent materials or pumping. Where feasible and appropriate, remove contaminated soil. Place contaminated materials in disposable containers and dispose of in a manner consistent with applicable regulations.
Reporting: Report spills to local authorities and/or the U.S. Coast Guard's National Response Center at (800) 424-8802 as appropriate or required.

SECTION 7 HANDLING AND STORAGE

Precautionary Measures: DO NOT USE IN HIGH PRESSURE SYSTEMS in the vicinity of flames, sparks and hot surfaces. Use only in well ventilated areas. Keep container closed.
Keep out of the reach of children.
General Handling Information: Avoid contaminating soil or releasing this material into sewage and drainage systems and bodies of water.
Static Hazard: Electrostatic charge may accumulate and create a hazardous condition when handling this material. To minimize this hazard, bonding and grounding may be necessary but may not, by themselves, be sufficient. Review all operations which have the potential of generating and accumulating an electrostatic charge and/or a flammable atmosphere (including tank and container filling, splash filling, tank cleaning, sampling, gauging, switch loading, filtering, mixing, agitation, and vacuum truck operations) and use appropriate mitigating procedures. For more information, refer to OSHA Standard 29 CFR 1910.106, 'Flammable and Combustible Liquids', National Fire Protection Association (NFPA 77, 'Recommended Practice on Static Electricity', and/or the American Petroleum Institute (API) Recommended Practice 2003, 'Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents'.
Container Warnings: Container is not designed to contain pressure. Do not use pressure to empty container or it may rupture with explosive force. Empty containers retain product residue (solid, liquid, and/or vapor) and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition. They may explode and cause injury or death. Empty containers should be completely drained, properly closed, and promptly returned to a drum reconditioner or disposed of properly.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

GENERAL CONSIDERATIONS:

Special note: Do not use in breathing air apparatus or medical equipment. Consider the potential hazards of this material (see Section 3), applicable exposure limits, job activities, and other substances in the work place when designing engineering controls and selecting personal protective equipment. If engineering controls or work practices are not adequate to prevent exposure to harmful levels of this material, the personal protective equipment listed below is recommended. The user should read and understand all instructions and limitations supplied with the equipment since protection is usually provided for a limited time or under certain circumstances.

ENGINEERING CONTROLS:

Use in a well-ventilated area.

PERSONAL PROTECTIVE EQUIPMENT

Eye/Face Protection: No special eye protection is normally required. Where splashing is possible, wear safety glasses with side shields as a good safety practice.
Skin Protection: No special protective clothing is normally required. Where splashing is possible, select protective clothing depending on operations conducted, physical requirements and other substances in the workplace. Suggested materials for protective gloves include: Viton, Nitrile Rubber, Silver Shield, 4H (PE/EVAL).

Respiratory Protection: No respiratory protection is normally required.
If user operations generate an oil mist, determine if airborne concentrations are below the occupational exposure limit for mineral oil mist. If not, wear an approved respirator that provides adequate protection from the measured concentrations of this material. For air-purifying respirators use a particulate cartridge.
Use a positive pressure air-supplying respirator in circumstances where air-purifying respirators may not provide adequate protection.
Occupational Exposure Limits:

Component	Agency	TWA	STEL	Ceiling	Notation
Highly refined mineral oil (C15 - C50)	ACGIH	5 mg/m3	10 mg/m3	--	--
Highly refined mineral oil (C15 - C50)	OSHA Z-1	5 mg/m3	--	--	--

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Attention: the data below are typical values and do not constitute a specification.

Color: Amber
Physical State: Liquid
Odor: Petroleum odor
pH: Not Applicable
Vapor Pressure: <0.01 mmHg @ 37.8 °C (100 °F)
Vapor Density (Air = 1): >1
Boiling Point: >315°C (599°F)
Solubility: Soluble in hydrocarbons; insoluble in water
Freezing Point: Not Applicable
Melting Point: Not Applicable
Specific Gravity: 0.87 - 0.89 @ 15.6°C (60.1°F) / 15.6°C (60.1°F)
Viscosity: 6.1 mm2/s @ 100°C (212°F) Minimum

SECTION 10 STABILITY AND REACTIVITY

Chemical Stability: This material is considered stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.
Incompatibility With Other Materials: May react with strong acids or strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.
Hazardous Decomposition Products: Hydrogen Sulfide (Temperatures >149 °F (65 °C))
Hazardous Polymerization: Hazardous polymerization will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

IMMEDIATE HEALTH EFFECTS

Eye Irritation: The eye irritation hazard is based on evaluation of data for similar materials or product components.
Skin Irritation: The skin irritation hazard is based on evaluation of data for similar materials or product components.
Skin Sensitization: The skin sensitization hazard is based on evaluation of data for similar materials or product components.
Acute Dermal Toxicity: The acute dermal toxicity hazard is based on evaluation of data for similar materials or product components.
Acute Oral Toxicity: The acute oral toxicity hazard is based on evaluation of data for similar

materials or product components.
Acute Inhalation Toxicity: The acute inhalation toxicity hazard is based on evaluation of data for similar materials or product components.

ADDITIONAL TOXICOLOGY INFORMATION:
This product contains petroleum base oils which may be refined by various processes including severe solvent extraction, severe hydrocracking, or severe hydrotreating. None of the oils requires a cancer warning under the OSHA Hazard Communication Standard (29 CFR 1910.1200). These oils have not been listed in the National Toxicology Program (NTP) Annual Report nor have they been classified by the International Agency for Research on Cancer (IARC) as; carcinogenic to humans (Group 1), probably carcinogenic to humans (Group 2A), or possibly carcinogenic to humans (Group 2B). These oils have not been classified by the American Conference of Governmental Industrial Hygienists (ACGIH) as: confirmed human carcinogen (A1), suspected human carcinogen (A2), or confirmed animal carcinogen with unknown relevance to humans (A3).

SECTION 12 ECOLOGICAL INFORMATION

ECOTOXICITY
This material is not expected to be harmful to aquatic organisms. The ecotoxicity hazard is based on an evaluation of data for the components or a similar material.

ENVIRONMENTAL FATE
Ready Biodegradability: This material is not expected to be readily biodegradable. The biodegradability of this material is based on an evaluation of data for the components or a similar material.

SECTION 13 DISPOSAL CONSIDERATIONS

Use material for its intended purpose or recycle if possible. Oil collection services are available for used oil recycling or disposal. Place contaminated materials in containers and dispose of in a manner consistent with applicable regulations. Contact your sales representative or local environmental or health authorities for approved disposal or recycling methods.

SECTION 14 TRANSPORT INFORMATION

The description shown may not apply to all shipping situations. Consult 49CFR, or appropriate Dangerous Goods Regulations, for additional description requirements (e.g., technical name) and mode-specific or quantity-specific shipping requirements.

DOT Shipping Description: PETROLEUM LUBRICATING OIL, NOT REGULATED AS A HAZARDOUS MATERIAL FOR TRANSPORTATION UNDER 49 CFR
Additional Information:NOT HAZARDOUS BY U.S. DOT. ADR/RID HAZARD CLASS NOT APPLICABLE.

IMO/IMDG Shipping Description: PETROLEUM LUBRICATING OIL; NOT REGULATED AS DANGEROUS GOODS FOR TRANSPORT UNDER THE IMDG CODE

ICAO/IATA Shipping Description: PETROLEUM LUBRICATING OIL; NOT REGULATED AS DANGEROUS GOODS FOR TRANSPORT UNDER ICAO TI OR IATA DGR

SECTION 15 REGULATORY INFORMATION

EPCRA 311/312 CATEGORIES: 1. Immediate (Acute) Health Effects: NO
2. Delayed (Chronic) Health Effects: NO
3. Fire Hazard: NO
4. Sudden Release of Pressure Hazard: NO
5. Reactivity Hazard: NO

REGULATORY LISTS SEARCHED:

01-1=IARC Group 1
01-2A=IARC Group 2A
01-2B=IARC Group 2B
02=NTP Carcinogen
03=EPCRA 313
04=CA Proposition 65
05=MA RTK
06=NJ RTK
07=PA RTK

The following components of this material are found on the regulatory lists indicated.

Zinc alkyl dithiophosphate	03, 06

CHEMICAL INVENTORIES:
All components comply with the following chemical inventory requirements: DSL (Canada), IECSC (China), PICCS (Philippines), TSCA (United States).

One or more components is listed on ELINCS (European Union). Secondary notification by the importer may be required.

One or more components does not comply with the following chemical inventory requirements: AICS (Australia), ENCS (Japan), KECI (Korea).

NEW JERSEY RTK CLASSIFICATION:
Under the New Jersey Right-to-Know Act L. 1983 Chapter 315 N.J.S.A. 34:5A-1 et. seq., the product is to be identified as follows: PETROLEUM OIL (Hydraulic oil)

WHMIS CLASSIFICATION:
This product is not considered a controlled product according to the criteria of the Canadian Controlled Products Regulations.

SECTION 16 OTHER INFORMATION

NFPA RATINGS: Health: 0 Flammability: 1 Reactivity: 0

HMIS RATINGS: Health: 1 Flammability: 1 Reactivity: 0
(0-Least, 1-Slight, 2-Moderate, 3-High, 4-Extreme, PPE:- Personal Protection Equipment Index recommendation, *- Chronic Effect Indicator). These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association (NFPA) or the National Paint and Coating Association (for HMIS ratings).

LABEL RECOMMENDATION:
Label Category : INDUSTRIAL OIL 1 - IND1

REVISION STATEMENT: This is a new Material Safety Data Sheet.
Revision Date: May 29, 2008

ABBREVIATIONS THAT MAY HAVE BEEN USED IN THIS DOCUMENT:

TLV - Threshold Limit Value	TWA - Time Weighted Average
STEL - Short-term Exposure Limit	PEL - Permissible Exposure Limit
	CAS - Chemical Abstract Service Number
ACGIH - American Conference of Government Industrial Hygienists	IMO/IMDG - International Maritime Dangerous Goods Code
API - American Petroleum Institute	MSDS - Material Safety Data Sheet
CVX - Chevron	NFPA - National Fire Protection Association (USA)
DOT - Department of Transportation (USA)	NTP - National Toxicology Program (USA)
IARC - International Agency for Research on Cancer	OSHA - Occupational Safety and Health Administration

Prepared according to the OSHA Hazard Communication Standard (29 CFR 1910.1200) and the ANSI MSDS Standard (Z400.1) by the Chevron Energy Technology Company, 100 Chevron Way, Richmond, California 94802.

The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since this information may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

ALCONOX MSDS

Section 1 : MANUFACTURER INFORMATION

Product name: Alconox

Supplier: Same as manufacturer.

Manufacturer: Alconox, Inc.
30 Glenn St.
Suite 309
White Plains, NY 10603.

Manufacturer emergency phone number: 800-255-3924.
813-248-0585 (outside of the United States).

Manufacturer: Alconox, Inc.
30 Glenn St.
Suite 309
White Plains, NY 10603.

Supplier MSDS date: 2005/03/09

D.O.T. Classification: Not regulated.

Section 2 : HAZARDOUS INGREDIENTS

C.A.S.	CONCENTRATION %	Ingredient Name	T.L.V.	LD/50	LC/50
25155-30-0	10-30	SODIUM DODECYLBENZENESULFONATE	NOT AVAILABLE	438 MG/KG RAT ORAL 1330 MG/KG MOUSE ORAL	NOT AVAILABLE
497-19-8	7-13	SODIUM CARBONATE	NOT AVAILABLE	4090 MG/KG RAT ORAL 6600 MG/KG MOUSE ORAL	2300 MG/M3/2H RAT INHALATION 1200 MG/M3/2H MOUSE INHALATION
7722-88-5	10-30	TETRASODIUM PYROPHOSPHATE	5 MG/M3	4000 MG/KG RAT ORAL 2980 MG/KG MOUSE ORAL	NOT AVAILABLE
7758-29-4	10-30	SODIUM PHOSPHATE	NOT AVAILABLE	3120 MG/KG RAT ORAL 3100 MG/KG MOUSE ORAL >4640 MG/KG RABBIT DERMAL	NOT AVAILABLE

Section 2A : ADDITIONAL INGREDIENT INFORMATION

Note: (supplier).
CAS# 497-19-8: LD50 4020 mg/kg - rat oral.
CAS# 7758-29-4: LD50 3100 mg/kg - rat oral.

Section 3 : PHYSICAL / CHEMICAL CHARACTERISTICS

Physical state: Solid

Appearance & odor: Almost odourless.
White granular powder.

Odor threshold (ppm): Not available.

Vapour pressure (mmHg): Not applicable.

Vapour density (air=1): Not applicable.

By weight: Not available.

Evaporation rate (butyl acetate = 1): Not applicable.

Boiling point (°C): Not applicable.

Freezing point (°C): Not applicable.

pH: (1% aqueous solution).
9.5

Specific gravity @ 20 °C: (water = 1).
0.85 - 1.10

Solubility in water (%): 100 - > 10% w/w

Coefficient of water\oil dist.: Not available.

VOC: None

Section 4 : FIRE AND EXPLOSION HAZARD DATA

Flammability: Not flammable.

Conditions of flammability: Surrounding fire.

Extinguishing media: Carbon dioxide, dry chemical, foam.
Water
Water fog.

Special procedures: Self-contained breathing apparatus required.
Firefighters should wear the usual protective gear.

Auto-ignition temperature: Not available.

Flash point (°C), method: None

Lower flammability limit (% vol): Not applicable.

Upper flammability limit (% vol): Not applicable.

Not available.

Sensitivity to mechanical impact: Not applicable.

Hazardous combustion products: Oxides of carbon (COx).
Hydrocarbons.

Rate of burning: Not available.

Explosive power: None

Section 5 : REACTIVITY DATA

Chemical stability: Stable under normal conditions.

Conditions of instability: None known.

Hazardous polymerization: Will not occur.

Incompatible substances: Strong acids.
Strong oxidizers.

Hazardous decomposition products: See hazardous combustion products.

Section 6 : HEALTH HAZARD DATA

Route of entry: Skin contact, eye contact, inhalation and ingestion.

Effects of Acute Exposure

Eye contact: May cause irritation.

Skin contact: Prolonged contact may cause irritation.

Inhalation: Airborne particles may cause irritation.

Ingestion: May cause vomiting and diarrhea.
May cause abdominal pain.
May cause gastric distress.

Effects of chronic exposure: Contains an ingredient which may be corrosive.

LD50 of product, species & route: > 5000 mg/kg rat oral.

LC50 of product, species & route: Not available for mixture, see the ingredients section.

Exposure limit of material: Not available for mixture, see the ingredients section.

Sensitization to product: Not available.

Carcinogenic effects: Not listed as a carcinogen.

Reproductive effects: Not available.

Teratogenicity: Not available.

Mutagenicity: Not available.

Synergistic materials: Not available.

Medical conditions aggravated by exposure: Not available.

First Aid

Skin contact: Remove contaminated clothing.
Wash thoroughly with soap and water.
Seek medical attention if irritation persists.

Eye contact: Check for and remove contact lenses.
Flush eyes with clear, running water for 15 minutes while holding eyelids open: if irritation persists, consult a physician.

Inhalation: Remove victim to fresh air.
Seek medical attention if symptoms persist.

Ingestion: Dilute with two glasses of water.
Never give anything by mouth to an unconscious person.
Do not induce vomiting, seek immediate medical attention.

Section 7 : PRECAUTIONS FOR SAFE HANDLING AND USE

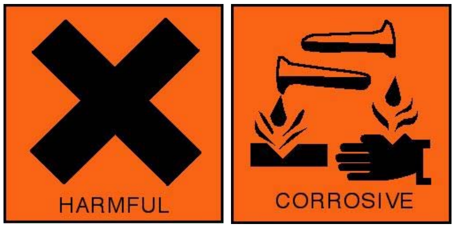
Leak/Spill:	Contain the spill. Recover uncontaminated material for re-use. Wear appropriate protective equipment. Contaminated material should be swept or shoveled into appropriate waste container for disposal.
Waste disposal:	In accordance with municipal, provincial and federal regulations.
Handling procedures and equipment:	Protect against physical damage. Avoid breathing dust. Wash thoroughly after handling. Keep out of reach of children. Avoid contact with skin, eyes and clothing. Launder contaminated clothing prior to reuse.
Storage requirements:	Keep containers closed when not in use. Store away from strong acids or oxidizers. Store in a cool, dry and well ventilated area.

Section 8 : CONTROL MEASURES

Precautionary Measures

Gloves/Type:	Neoprene or rubber gloves.
Respiratory/Type:	If exposure limit is exceeded, wear a NIOSH approved respirator.
Eye/Type:	Safety glasses with side-shields.
Footwear/Type:	Safety shoes per local regulations.
Clothing/Type:	As required to prevent skin contact.
Other/Type:	Eye wash facility should be in close proximity. Emergency shower should be in close proximity.
Ventilation requirements:	Local exhaust at points of emission.

Safety (MSDS) data for hydrochloric acid (1 molar)



General

Synonyms: muriatic acid, chlorohydric acid, dilute hydrochloric acid, diulte HCL
Molecular formula: HCl
CAS No: 7647-01-0
EC No: 231-595-7

Physical data

Appearance: clear colourless liquid with pungent odour.
Melting point:
Boiling point:
Specific gravity:
Vapour pressure:
Flash point: none
Explosion limits: none
Autoignition temperature: none

Stability

Stable. Incompatible with most common metals, amines, metal oxides, acetic anhydride, propiolactone, vinyl acetate, mercuric sulphate, calcium phosphide, formaldehyde, alkalies, carbonates, strong bases, sulphuric acid, chlorosulphonic acid.

Toxicology

Corrosive. Inhalation of vapour is harmful. Ingestion may be fatal. Liquid can cause severe damage to skin and eyes. TLV 5 ppm.

Toxicity data (for the concentrated acid)

(The meaning of any abbreviations which appear in this section is given here.)

ORL-RBT LD50 900 mg kg^{-1}
IPR-MUS LD50 40 mg kg^{-1}
IHL-RAT LC50 3124 ppm/1h.
IHL-HMN LCLO 1300 ppm 30min

Risk phrases

(The meaning of any risk phrases which appear in this section is given here.)
R20 R21 R22 R36 R37 R38.

Personal protection

Safety glasses. Effective ventilation.

Safety phrases

(The meaning of any safety phrases which appear in this section is given here.)
S26 S45.

[Return to Physical & Theoretical Chemistry Lab. Safety home page.]

Safety (MSDS) data for polyisobutylene

General

Synonyms: 2-methyl-1-propene homopolymer, isobutylene polymer, polymerized 2-methylpropene, isobutylene resin
Molecular formula: $[C_4H_8]_n$
CAS No: 9003-27-4
EINECS No:

Physical data

Appearance:
Melting point: [Physical properties depend upon the number of monomer units in the polymer]
Boiling point:
Vapour density:
Vapour pressure:
Density (g cm^{-3}): Typically around 0.92 for commercially available liquid polymer
Flash point:
Explosion limits:
Autoignition temperature:
Water solubility:

Stability

Combustible. Incompatible with strong oxidising agents.

Toxicology

n/a

Transport information

Personal protection

In the massive (lump) form, no protection is generally required. Avoid breathing dust if the material is provided as a powder.

[Return to Physical & Theoretical Chemistry Lab. Safety home page.]

This information was last updated on October 5, 2003. We have tried to make it as accurate and useful as possible, but can take no responsibility for its use, misuse, or accuracy. We have not verified this information, and cannot guarantee that it is up-to-date.

LIQUINOX MSDS

Section 1 : PRODUCT AND COMPANY IDENTIFICATION

Chemical family:	Detergent.
Manufacturer:	Alconox, Inc. 30 Glenn St. Suite 309 White Plains, NY 10603.
Manufacturer emergency phone number:	800-255-3924. 813-248-0585 (outside of the United States).
Supplier:	Same as manufacturer.
Product name:	Liquinox

Section 2 : INGREDIENT INFORMATION

C.A.S.	CONCENTRATION %	Ingredient Name	T.L.V.	LD/50	LC/50
25155-30-0	10-30	SODIUM DODECYLBENZENESULFONATE	NOT AVAILABLE	438 MG/KG RAT ORAL 1330 MG/KG MOUSE ORAL	NOT AVAILABLE

Section 3 : HAZARD IDENTIFICATION

Route of entry:	Skin contact, eye contact, inhalation and ingestion.
Effects of acute exposure	
Eye contact:	May cause irritation.
Skin contact:	Prolonged and repeated contact may cause irritation.
Inhalation:	May cause headache and nausea.
Ingestion:	May cause vomiting and diarrhea. May cause gastric distress.
Effects of chronic exposure:	See effects of acute exposure.

Section 4 : FIRST AID MEASURES

Skin contact:	Remove contaminated clothing. Wash thoroughly with soap and water. Seek medical attention if irritation persists.

Eye contact: Check for and remove contact lenses.
Flush eyes with clear, running water for 15 minutes while holding eyelids open: if irritation persists, consult a physician.

Inhalation: Remove victim to fresh air.
If irritation persists, seek medical attention.

Ingestion: Do not induce vomiting, seek medical attention.
Dilute with two glasses of water.
Never give anything by mouth to an unconscious person.

Section 5 : FIRE FIGHTING MEASURES

Flammability: Not flammable.

Conditions of flammability: Surrounding fire.

Extinguishing media: Carbon dioxide, dry chemical, foam.
Water
Water fog.

Special procedures: Self-contained breathing apparatus required.
Firefighters should wear the usual protective gear.
Use water spray to cool fire exposed containers.

Auto-ignition temperature: Not available.

Flash point (°C), method: None

Lower flammability limit (% vol): Not applicable.

Upper flammability limit (% vol): Not applicable.

Explosion Data

Sensitivity to static discharge: Not available.

Sensitivity to mechanical impact: Not available.

Hazardous combustion products: Oxides of carbon (COx).
Hydrocarbons.

Rate of burning: Not available.

Explosive power: Containers may rupture if exposed to heat or fire.

Section 6 : ACCIDENTAL RELEASE MEASURES

Leak/Spill: Contain the spill.
Prevent entry into drains, sewers, and other waterways.
Wear appropriate protective equipment.
Small amounts may be flushed to sewer with water.
Soak up with an absorbent material.
Place in appropriate container for disposal.
Notify the appropriate authorities as required.

Section 7 : HANDLING AND STORAGE

Handling procedures and equipment: Protect against physical damage.
Avoid breathing vapors/mists.

Wear personal protective equipment appropriate to task.
Wash thoroughly after handling.
Keep out of reach of children.
Avoid contact with skin, eyes and clothing.
Avoid extreme temperatures.
Launder contaminated clothing prior to reuse.

Storage requirements: Store away from incompatible materials.
Keep containers closed when not in use.

Section 8 : EXPOSURE CONTROLS / PERSONAL PROTECTION

Precautionary Measures

Gloves/Type: Wear appropriate gloves.

Respiratory/Type: None required under normal use.

Eye/Type: Safety glasses recommended.

Footwear/Type: Safety shoes per local regulations.

Clothing/Type: As required to prevent skin contact.

Other/Type: Eye wash facility should be in close proximity.
Emergency shower should be in close proximity.

Ventilation requirements: Local exhaust at points of emission.

Exposure limit of material: Not available.

Section 9 : PHYSICAL AND CHEMICAL PROPERTIES

Physical state: Liquid.

Appearance & odor: Odourless.
Pale yellow.

Odor threshold (ppm): Not available.

Vapour pressure (mmHg): @ 20°C (68°F).
17

Vapour density (air=1): >1

Volatiles (%)

By volume: Not available.

Evaporation rate (butyl acetate = 1): < 1.

Boiling point (°C): 100 (212F)

Freezing point (°C): Not available.

pH: 8.5

Specific gravity @ 20 °C: (water = 1).
1.083

Solubility in water (%):	Complete.
Coefficient of water\oil dist.:	Not available.
VOC:	None
Chemical family:	Detergent.

Section 10 : STABILITY AND REACTIVITY

Chemical stability:	Product is stable under normal handling and storage conditions.
Conditions of instability:	Extreme temperatures.
Hazardous polymerization:	Will not occur.
Incompatible substances:	Strong acids. Strong oxidizing agents.
Hazardous decomposition products:	See hazardous combustion products.

Section 11 : TOXICOLOGICAL INFORMATION

LD50 of product, species & route:	> 5000 mg/kg rat oral.
LC50 of product, species & route:	Not available.
Sensitization to product:	Not available.
Carcinogenic effects:	Not listed as a carcinogen.
Reproductive effects:	Not available.
Teratogenicity:	Not available.
Mutagenicity:	Not available.
Synergistic materials:	Not available.

Section 12 : ECOLOGICAL INFORMATION

Environmental toxicity:	No data at this time.
Environmental fate:	No data at this time.

Section 13 : DISPOSAL CONSIDERATIONS

Waste disposal:	In accordance with local and federal regulations.

Section 14 : TRANSPORT INFORMATION

D.O.T. CLASSIFICATION:	Not regulated.
Special shipping information:	Not regulated.

Section 15 : REGULATORY INFORMATION

Canadian Regulatory Information

WHMIS classification: Not controlled.

DSL status: Not available.

USA Regulatory Information

SARA hazard catagories sections 311/312:
Immediate (Acute) Health Hazard: No.
Delayed (Chronic) Health Hazard: No.
Fire Hazard: No.
Sudden Release of Pressure: No.
Reactive: No.

SARA Section 313: None

TSCA inventory: All components of this product are listed on the TSCA inventory.

NFPA

Health Hazard: 1

Flammability: 0

Physical hazard: 0

Section 16 : OTHER INFORMATION

Supplier MSDS date: 2005/02/24

Data prepared by:
Global Safety Management
3340 Peachtree Road, #1800
Atlanta, GA 30326

Phone: 877-683-7460
Fax: (877) 683-7462

Web: www.globalsafetynet.com
Email: info@globalsafetynet.com.

General note: This material safety data sheet was prepared from information obtained from various sources, including product suppliers and the Canadian Center for Occupational Health and Safety.

MSDS

Definition of terms

Material Safety Data Sheet for #2 Diesel

1. Chemical Product

MSDS Number: U7770

MSDS Date: 01-31-99

Product Name: #2 Diesel Fuel

24 Hour Emergency Phone: (210) 979-8346
Transportation Emergencies: Call Chemtrec at 1-800-424-9300
MSDS Assistance: (210) 592-4593

Distributors Name and Address:
T.W. Brown Oil Co., Inc.
1857 Knoll Drive
Ventura, California 93003

Chemical Name:#2 Diesel Fuel **Cas Number:** 68476-34-6

Synonyms/Common Names: This Material Safety Data Sheet applies to the following product descriptions for Hazard Communication purposes only. Technical specifications vary greatly depending on the product, and are not reflected in this document. Consult specification sheets for technical information.

California Air Resources Board (Carb) Diesel Fuel- On-road, Off-Road, Tax Exempt blends
Premium Diesel Fuel- Low-Sulfur, High-sulfur, On-Road, Off-Road, Tax Exempt blends
#2 Distillate- Low-Sulfur, High-sulfur, On-Road, Off-Road, Tax Exempt blends
#2 Diesel Fuel- Low-Sulfur, High-sulfur, On-Road, Off-Road, Tax Exempt blends
#2 Fuel Oil- Low-Sulfur, High-sulfur, On-Road, Off-Road, Tax Exempt blends

2. Composition, Information On Ingredients

Product Use: This product is intended for use as a fuel in engines and heaters designed for diesel fuels, and for use in engineered processes. Use in other applicatiions may result in higher exposures and require additional controls, such as local exhaust ventilation and personal protective equipment.

Description: #2 Diesel is a complex mixture of hydrocarbons from a variety of chemical processes blended to meet standardized product specifications. Composition varies greatly and includes C9 to C20 hydrocarbons with a boiling range of about 325-675 degrees F. The following is a non-exhaustive list of common components, typical percentage ranges in product, and occupational exposure limits for each.

Component or Material Name	%	CAS Number	ACGIH Limits TLV -- STEL -- Units	OSHA Exposure Limits PEL -- STEL -- C/P -- Units
Cat cracked distillate, light	0-100	64741-59-9	100 -- NA -- mg/m3	N/A -- N/A -- N/A -- N/A
Hydrotreated distillate, middle	0-100	64742-46-7	100 -- NA -- mg/m3	N/A -- N/A -- N/A -- N/A
Hydrotreated distillate, light	0-100	64742-47-8	100 -- NA -- mg/m3	N/A -- N/A -- N/A -- N/A
Gas oil, light	0-100	64741-44-2	100 -- NA -- mg/m3	N/A -- N/A -- N/A -- N/A

3. Hazards Identification

Health Hazard Data:

1. The major effect of exposure to this product is giddiness, headache, central nervous system depression; possible irritation of eyes, nose, and lungs; and dermal irritation. Signs of kidney and liver damage may be delayed. Pulmonary irritation secondary to exhalation fo solvent.

2. NIOSH recommends that whole diesel engine exhaust be regarded as a potential occupational carcinogen. Follow OSHA and NSHA rules where diesel engine exhaust fumes may be generated.

3. A life time skin painting study by the American Petroleum Institute has shown that similar naphtha products with a boiling range of 350-700 degrees F usually produce skin tumors and/ or skin cancers in laboratory mice. Only a weak to moderate response occurred. The effect to humans has not been determined.

4. Positive results at 2.0 ml/kg and 6.0 ml/kg noted in mutagenesis studies via in-vivo bone marrow cytogenetics assay in rats.

5. Kerosene is classified as a severe skin irritant. Mutation data has been reported for kerosene products. Hydrotreated kerosene is listed as being probably carcinogenic to humans with limited evidence in humans and sufficient evidence in experimental animals.

Hazards of Combustion Products: Carbon monoxide and carbon dioxide can be found in the combustion products of this product and other forms of hydrocarbon combustion. Carbon monoxide in moderate concentrations can cause symptoms of headache, nausea, vomiting, increased cardiac output, and confusion. Exposure to higher concentrations of carbon monoxide can cause loss of consciousness, heart damage, brain damage, and/or death. Exposure to high concentrations of carbon dioxide can cause simple asphyxiation by displacing available oxygen. Combustion of this and other similar materials should only be carried out in well ventilated areas.

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MSDS

Material Safety Data Sheet for Gasoline

Definition of terms

1. Chemical Product

MSDS Number: U4080

MSDS Date: 01-1-99

Product Name: Gasoline

24 Hour Emergency Phone: (210) 979-8346
Transportation Emergencies: Call Chemtrec at 1-800-424-9300
MSDS Assistance: (210) 592-4593

Distributors Name and Address:
T.W. Brown Oil Co., Inc.
1857 Knoll Drive
Ventura, California 93003

Chemical Name: Gasoline **Cas Number:** 8006-61-9

Synonyms/Common Names: This Material Safety Data Sheet applies to the following product descriptions for Hazard Communication purposes only. Technical specifications vary greatly depending on the product, and are not reflected in this document. Consult specification sheets for technical information.

Unleaded Ggasoline Blendstocks/Subgrades- all types, grades, octanes, and vapor pressures.
California Air Resources Board (Carb) Gasoline- all grades, octanes, vapor pressures, and oxygenate blends.
Reformulated Gasoline (RFG)-all grades, octanes, vapor pressures, and oxygenate blends.
California Reformulated Gasoline (CARFG)-all grades, octanes, vapor pressures, and oxygenate blends.
Conventional Gasoline-all grades, octanes, vapor pressures, and oxygenate blends.

2. Composition, Information On Ingredients

Product Use: This product is intended for use as a fuel in engines or for use in engineered processes. Use in other applicatiions may result in higher exposures and require additional controls, such as local exhaust ventilation and personal protective equipment.

Description: Reformulated gasoline is a complex mixture of hydrocarbons from a variety of chemical processes blended to meet standardized product specifications. Composition varies greatly and includes C? to C? hydrocarbons with a boiling range of about 80-473 degrees F. The following is a non-exhaustive list of common components, typical percentage ranges in product, and occupational exposure limits for each. Functional and performance additives may also be present at concentrations below reporting thresholds.

Component or Material Name	%	CAS Number	ACGIH Limits TLV -- STEL -- Units	OSHA Exposure Limits PEL -- STEL -- C/P -- Units
Gasoline	90-100	Mixture	300--500--ppm	NA--NA--NA -- ----
Butane	<9	106-97-8	800--NA--ppm	NA--NA--NA -- ----
Pentane	<6	109-66-0	600--750--ppm	1000--NA--NA--ppm
n-Hexane	<4	110-54-3	50--NA--ppm	500--NA--NA--ppm
Hexan(other isomers)	<8	NA	500--1,000--ppm	NA--NA--NA-- ----
Benzene	1.2 - 4.9	7-4-2	0.5--2.5--ppm	1--5--NA--ppm
N-heptane	<2	14-82-5	400--500--ppm	500--NA--NA--ppm
Ethylbenzene	<2	100-41-4	100--125--ppm	100--NA--NA--ppm
Xylene (o,m,p, - isomers)	<11	1330-20-7	100--150--ppm	100--NA--NA--ppm
Cyclohexane	<2	110-82-7	300--NA--ppm	300--NA--NA--ppm
Trimethylbenzene	<4	25551-13-7	25--NA--ppm	NA-NA-NA- ----
Methyl-t-butyl ether (MTBE)	0-15	1634-04-4	40--NA--ppm	NA-NA-NA- ----
Toluene	<12	108-88-3	50-NA-ppm	200-300/500-NA-ppm
Ethyl-t-butyl ether (ETBE)	0-7	637-92-3	N/A-NA-ppm	NA-NA-NA- ----
t-amyl-methyl-ether	0-5	994-05-8	N/A-NA-ppm	NA-NA-NA- ----
Ethanol	0-11	64-17-5	1,000-NA-ppm	1,000-NA-NA-ppm

C=Ceiling concentration not to be exceeded at any tume. P= Peak concentration for a single 10 minute exposure per day.

3. Hazards Identification

Health Hazard Data:

1. The major effect of exposure to this product is central nervous system depression and polyneuropathy.

2. Studies have shown that repeated exposure of laboratory animals to high concentrations of whole gasoline vapors at 67,262 and 2056 ppm has caused kidney damage and cancer of the kidney in rats and liver cancer in mice.

3. LARC has listed gasoline as possibly carcinogenic (2B) to humans with limited evidence in humans in the absence of sufficient evidence in experimental animals. NIOSH lists gasoline as a carcinogen with no further classification.

4. N-heptane and cyclohexane cause narcosis and irritation of eyes and mucous membranes. Cyclohexane has been reported to cause liver and kidney changes in rabbits. N-heptane has been reported to cause polyneuritis following prolonged exposure.

5. ACGIH lists benzene a human carcinogen with and assigned TLV of 0.5 ppm 8 hour TWA and a STEL of 2.5 ppm; IARC, NTP $ OSHA show sufficient evidence for classifying Benzene as a human carcinogen, see 29 CGR 1910.1028 for current PEL of 1 ppm and specific actions to take. Studies have shown that benzene can induce leukemia at concentrations as low as 1 ppm. Significant elevations of chromosomal aberrations have been corroborated among workers exposed to levels at mean concentrations less than 10 ppm. Based on risk assessment studies by Rinsky, an individual inhaling 1 ppm of benzene for 40 years, the odds of benzene-induced leukemic death were 1.7 times higher than those of unexposed workers.

6. MTBE is a mild irritant to the eye with an LC50 of 85 mg/m3 on 4 hr. exposure and an LD50 ~4 ml/Kg (RATS). An increase in anesthesia with increasing concentration (250,500 & 1000 ppm) was observed during a 90 day Test exposure. ACGIH has listed MTBE as an animal carcinogen (A3) based on tests in experimental animals at relatively high dose levels, by routes of administration, at sites, of histologic types, or by mechanisms not considered relevant to worker exposure. Available evidence suggests that MTBE is not likely to cause cancer in humans except under uncommon or unlikely routes of levels of exposure.

7. Trimethylbenzene (pseudocumene (1,2,4,) & mesitylene (1,2,5,)) has a PEL and TLV of 25 ppm 8 hr. TWA; the isomers may cause nervousness, tension, and anxiety and asthmatic bronchitis.

8. n-Hexane has been shown to cause polyneuropathy (peripheral nerve damage) after repeated and prolonged exposure, other hexanes show narcotic effects at 1000 ppm and are not metabolized like n-hexane.

9. Toluene can cause impairment of coordination and momentary loss of memory (200-500 ppm); Palpations, extreme weakness and pronounced loss of coordination (500-1500). The 100 ppm 8 hr. TWA and the 150 ppm STEL provides adequate protection.

10. The toxicological effects of ETBE and TAME have not been thoroughly investigated. ETBE and TAME are expected to be an inhalation hazard and a severe eye and moderate skin irritant.

Hazards of Combustion Products: Carbon monoxide and carbon dioxide can be found in the combustion products of this product and other forms of hydrocarbon combustion. Carbon monoxide in moderate concentrations can cause symptoms of headache, nausea, vomiting, increased cardiac output, and confusion. Exposure to higher concentrations of carbon monoxide can cause loss of consciousness, heart damage, brain damage, and/or death. Exposure to high concentrations of carbon dioxide can cause simple asphyxiation by displacing available oxygen. Combustion of this and other similar materials should only be carried out in well ventilated areas.

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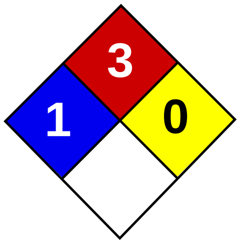

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Methyl alcohol MSDS

Section 1: Chemical Product and Company Identification

Product Name: Methyl alcohol

Catalog Codes: SLM3064, SLM3952

CAS#: 67-56-1

RTECS: PC1400000

TSCA: TSCA 8(b) inventory: Methyl alcohol

CI#: Not applicable.

Synonym: Wood alcohol, Methanol; Methylol; Wood Spirit; Carbinol

Chemical Name: Methanol

Chemical Formula: CH3OH

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Methyl alcohol	67-56-1	100

Toxicological Data on Ingredients: Methyl alcohol: ORAL (LD50): Acute: 5628 mg/kg [Rat]. DERMAL (LD50): Acute: 15800 mg/kg [Rabbit]. VAPOR (LC50): Acute: 64000 ppm 4 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator). Severe over-exposure can result in death.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Classified POSSIBLE for human. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to eyes. The substance may be toxic to blood, kidneys, liver, brain, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS), optic nerve. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 464°C (867.2°F)

Flash Points: CLOSED CUP: 12°C (53.6°F). OPEN CUP: 16°C (60.8°F).

Flammable Limits: LOWER: 6% UPPER: 36.5%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Explosive in presence of open flames and sparks, of heat.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Explosive in the form of vapor when exposed to heat or flame. Vapor may travel considerable distance to source of ignition and flash back. When heated to decomposition, it emits acrid smoke and irritating fumes. CAUTION: MAY BURN WITH NEAR INVISIBLE FLAME

Special Remarks on Explosion Hazards:
Forms an explosive mixture with air due to its low flash point. Explosive when mixed with Choroform + sodium methoxide and diethyl zinc. It boils violently and explodes.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.

Large Spill:
Flammable liquid. Poisonous liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, metals, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 200 from OSHA (PEL) [United States] TWA: 200 STEL: 250 (ppm) from ACGIH (TLV) [United States] [1999] STEL: 250 from NIOSH [United States] TWA: 200 STEL: 250 (ppm) from NIOSH SKIN TWA: 200 STEL: 250 (ppm) [Canada] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Alcohol like. Pungent when crude.

Taste: Not available.

Molecular Weight: 32.04 g/mole

Color: Colorless.

pH (1% soln/water): Not available.

Boiling Point: 64.5°C (148.1°F)

Melting Point: -97.8°C (-144°F)

Critical Temperature: 240°C (464°F)

Specific Gravity: 0.7915 (Water = 1)

Vapor Pressure: 12.3 kPa (@ 20°C)

Vapor Density: 1.11 (Air = 1)

Volatility: Not available.

Odor Threshold: 100 ppm

Water/Oil Dist. Coeff.: The product is more soluble in water; log(oil/water) = -0.8

Ionicity (in Water): Non-ionic.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ingnition sources, incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, metals, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Can react vigorously with oxidizers. Violent reaction with alkyl aluminum salts, acetyl bromide, chloroform + sodium methoxide, chromic anhydride, cyanuirc chlorite, lead perchlorate, phosphorous trioxide, nitric acid. Exothermic reaction with sodium hydroxide + chloroform. Incompatible with beryllium dihydride, metals (potassium and magnesium), oxidants (barium perchlorate, bromine, sodium hypochlorite, chlorine, hydrogen peroxide), potassium tert-butoxide, carbon tetrachloride, alkali metals, metals (aluminum, potassium magnesium, zinc), and dichlormethane. Rapid autocatalytic dissolution of aluminum, magnesium or zinc in 9:1 methanol + carbon tetrachloride - sufficiently vigorous to be rated as potentially hazardous. May attack some plastics, rubber, and coatings.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 5628 mg/kg [Rat]. Acute dermal toxicity (LD50): 15800 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 64000 4 hours [Rat].

Chronic Effects on Humans:
MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Classified POSSIBLE for human. Causes damage to the following organs: eyes. May cause damage to the following organs: blood, kidneys, liver, brain, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS), optic nerve.

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:

Passes through the placental barrier. May affect genetic material. May cause birth defects and adverse reproductive effects(paternal and maternal effects and fetotoxicity) based on animal studies.

Special Remarks on other Toxic Effects on Humans:

Section 12: Ecological Information

Ecotoxicity: Ecotoxicity in water (LC50): 29400 mg/l 96 hours [Fathead Minnow].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation:
Methanol in water is rapidly biodegraded and volatilized. Aquatic hydrolysis, oxidation, photolysis, adsorption to sediment, and bioconcentration are not significant fate processes. The half-life of methanol in surfact water ranges from 24 hrs. to 168 hrs. Based on its vapor pressure, methanol exists almost entirely in the vapor phase in the ambient atmosphere. It is degraded by reaction with photochemically produced hydroxyl radicals and has an estimated half-life of 17.8 days. Methanol is physically removed from air by rain due to its solubility. Methanol can react with NO2 in pollulted to form methyl nitrate. The half-life of methanol in air ranges from 71 hrs. (3 days) to 713 hrs. (29.7 days) based on photooxidation half-life in air.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Methyl alcohol UNNA: 1230 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Methyl alcohol Illinois toxic substances disclosure to employee act: Methyl alcohol Illinois chemical safety act: Methyl alcohol New York release reporting list: Methyl alcohol Rhode Island RTK hazardous substances: Methyl alcohol Pennsylvania RTK: Methyl alcohol Minnesota: Methyl alcohol Massachusetts RTK: Methyl alcohol Massachusetts spill list: Methyl alcohol New Jersey: Methyl alcohol New Jersey spill list: Methyl alcohol Louisiana spill reporting: Methyl alcohol California Directors List of Hazardous Substances (8CCR 339): Methyl alcohol Tennesse Hazardous Right to Know : Methyl alcohol TSCA 8(b) inventory: Methyl alcohol SARA 313 toxic chemical notification and release reporting: Methyl alcohol CERCLA: Hazardous substances.: Methyl alcohol: 5000 lbs. (2268 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC). Class D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R11- Highly flammable. R23/24/25- Toxic by inhalation, in contact with skin and if swallowed. R39- Danger of very serious irreversible effects. R39/23/24/25- Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed. S7- Keep container tightly closed. S16- Keep away from sources of ignition - No smoking. S36/37- Wear suitable protective clothing and gloves. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References:
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -Material safety data sheet emitted by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec. -Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. LOLI, HSDB, RTECS, HAZARDTEXT, REPROTOX databases

Other Special Considerations: Not available.

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